C0070005 Incoming #5017

Canyon Fuel Company, LLC
A Subsidiary of Bowie Resource Holdings, LLC

Skyline Mine
Gregg A. Galecki, Environmental Engineer
HC35, Box 380
Helper, Utah 84526
(435) 448-2636
Fax (435) 448-2632

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May 8, 2017

Mr. Daron R. Haddock
Coal Program Manager
Division of Oil, Gas, and Mining
1594 West North Temple
Salt Lake City, Utah 84114-5801

RE: Flat Canyon Lease, Federal Lease UTU-77114, Clean Copies, Canyon Fuel Company, LLC, Skyline Mine, Task ID # 5017, C/007/0005

Dear Daron:

Attached to this letter are C1 and C2 forms outlining information submitted in response to Task ID # 5017 to include mining in the Flat Canyon Federal Lease UTU-77114. Provided are two (2) clean sets of the information that has been conditionally approved by the Division based on receiving clean copies and OSM approval.

If you have any questions regarding this information, please give me a call at (435) 448-2636.

Sincerely:

Gregg A. Galecki
Canyon Fuel Company, LLC.
Environmental Engineer – Skyline Mines

APPLICATION FOR COAL PERMIT PROCESSING

Permit Change ☒ New Permit ☐ Renewal ☐ Exploration ☐ Bond Release ☐ Transfer ☐

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine **Permit Number:** C/007/005
Title: Flat Canyon Lease
Description, Include reason for application and timing required to implement:
Modification to conduct mining in new Federal Lease UTU-771114, Task ID# 5017 CLEAN COPIES

Instructions: If you answer yes to any of the first eight (gray) questions, this application may require Public Notice publication.

☐ Yes ☒ No 1. Change in the size of the Permit Area? Acres: ___Disturbed Area: _____ ☐ increase ☐ decrease.
☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO# _____
☐ Yes ☒ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☐ Yes ☒ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☒ Yes ☐ No 6. Does the application require or include public notice publication?
☒ Yes ☐ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☐ Yes ☒ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV # _____
☐ Yes ☒ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain:
☐ Yes ☒ No 11. Does the application affect the surface landowner or change the post mining land use?
☒ Yes ☐ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☒ Yes ☐ No 13. Does the application require or include collection and reporting of any baseline information?
☐ Yes ☒ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☐ Yes ☒ No 15. Does the application require or include soil removal, storage or placement?
☐ Yes ☒ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☐ Yes ☒ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☒ Yes ☐ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☒ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
☒ Yes ☐ No 20. Does the application require or include subsidence control or monitoring?
☐ Yes ☒ No 21. Have reclamation costs for bonding been provided?
☒ Yes ☐ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☒ Yes ☐ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

Information submitted electronically in Adobe Acrobat .pdf format. (This number includes a copy for the Price Field Office.)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

Corey Heaps
Print Name

Corey Heaps, GM, 5-8-17
Sign Name, Position, Date

Subscribed and sworn to before me this 8 day of April, 2017

Melissa S Willden
Notary Public

My commission Expires: 4-19, 2019
Attest: State of Utah } ss:
County of Carbon

MELISSA S WILLDEN
Notary Public State of Utah
My Commission Expires
March 19 2019
Commission #682454

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining
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APPLICATION FOR COAL PERMIT PROCESSING
Detailed Schedule Of Changes to the Mining And Reclamation Plan

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine **Permit Number:** C/007/005
Title: Flat Canyon Lease Task ID # 5107 Page 1 of 2 CLEAN COPIES

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Chapter 1 Table 1.114 (page 1-23), pages 1-19, 1-20,1-30, 1-31, 1-32(a), 1-39, Plates 1.6-1_Rev6, 1.6-2_rev.8, and 1.6-3_rev.11
☒ Add	☐ Replace	☐ Remove	Chapter 1, pages 1-20(a), 1-20(b), and 1-32a
☒ Add	☐ Replace	☐ Remove	Chapter 1, Appendix 118-A: USFS letter, Emery Water Conservancy District letter, Price River Watershed Improvement District Letter, Legal Notice, Coal Lease UTU-77114, Tracy Lease, Cunningham lease, Pacificorp lease, UDOT, Tracy and Cunningham notification letters
☒ Add	☐ Replace	☐ Remove	Chapter 2, Section 2.1 Environmental Resources, page 2-4e
☐ Add	☒ Replace	☐ Remove	Chapter 2, Section 2.2 Geology and Geotechnical, pages 2-10, 2-11, 2-12, 2-13 (2-12, 2-13, 2-15 confidential), 2-19 (Table2.2.8-2), 2-20
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.3 Groundwater Hydrology, pages 2-29, 2-29a, 2-29b, 2-29c, 2-29d, 2-30(j1), 2-30(l), 2-33, 2-34, 2-35, 2-35c
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.3 Groundwater Hydrology, pages 2-36, 2-36a, 2-36b (Table 2.3.7-1), 2-38 (Table 2.3.7-3), 2-39 (Table 2.3.7-4)
☒ Add	☐ Replace	☐ Remove	Chapter 2 Section 2.3, pages 2.30(j1a), 2-30(j1b), 2-30(j1c), 2-33a, 2-35d
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.4 Surface Water Hydrology, pages 2-40, 2-41, 2-42, 2-42a, 2-42b, 2-43b, 2-44a, 2-44b, 2-45, 2-46, 2-46b and (ADD Figure 4-1)
☒ Add	☐ Replace	☐ Remove	Chapter 2 Plates 2.3.4-1D Cross Section Structure Profile Flat Canyon LBA
☒ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.5 Hydrologic Impacts of Mining Activities, pages 2-48, 2-49,2-50, 2-51, 2-51c, ADD 2-51a-1, 2-51a-2, 2-51a-3, 2-51a-4, and 2-51c1
☐ Add	☒ Replace	☐ Remove	Chapter 2, Section 2.6 Climate – General Information, Page 2-55
☒ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.7 Vegetation, page 2-63a, (ADD 2-63a1, 2-63b (Fig 2.7.9-1), 2-63c (Fig. 2.7.9-2))
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.8 Aquatic Wildlife Resources, pages 2-67,2-70, 2-71 2-71a, 2-71b, 2-72a (Fig2.8-1a)
☒ Add	☐ Replace	☐ Remove	Chapter 2 Section 2.9 Terrestrial Wildlife page 2-104(m)
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.10 Raptors, page 2-111c
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.12 pages 2-122, 2-124, 2-125
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.14 page 2-161
☐ Add	☒ Replace	☐ Remove	Chapter 2 , Plates 2.2.7-1_rev3, 2.3.6-1_rev17, 2.3.5.1-1_rev7, 2.2.7-4_rev4, 2.12.1-1_rev6, 2.3.6-2_Rev8, 2.3.4-2_Rev8
☒ Add	☐ Replace	☐ Remove	Chapter 2, Plates 2.3.6-1A_Rev0, 2.3.6-3_Rev0, 2.5.2-2_Rev0
☒ Add	☐ Replace	☐ Remove	PHC Addendum Volume 2 - Appendix N Groundwater and Surface-Water Systems in the Flat Canyon Tract and Adjacent area…Petersen Hydrologic, Inc. 13Aug2014
☒ Add	☐ Replace	☐ Remove	PHC Addendum Volume 2 - Appendix O Groundwater Conditions in The Star Point Sandstone In the Vicinity of the Skyline Mine,2014, Petersen Hydrologic, Inc.

Two (2) paper copies are submitted for final approval. Plates requiring professional certification have been certified.

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APPLICATION FOR COAL PERMIT PROCESSING
Detailed Schedule Of Changes to the Mining And Reclamation Plan

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine **Permit Number:** C/007/005
Title: Flat Canyon Lease Task ID # 5017 Page 2 of 2 CLEAN COPIES

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☒ Add	☒ Replace	☐ Remove	Chapter 3 Section 3.1 pages 3-6, 3-12, 3-13, 3-14 (ADD 3-6a)
☐ Add	☒ Replace	☐ Remove	Chapter 3 Section 3.3 page 3-81
☐ Add	☒ Replace	☐ Remove	Chapter 3, Plates 3.1.8-3_rev2017, Plate 3.3-4_rev. 1
☐ Add	☒ Replace	☐ Remove	Chapter 4 Section 4.17 page 4-94, 4-95, 4-95b, 4-95c
☐ Add	☒ Replace	☐ Remove	Chapter 4 Plate 4.17-3A
☒ Add	☐ Replace	☐ Remove	Appendix A-1, Volume 2, Results of the 2015 Geomorphic Evaluation of Eccles Creek, Earthfax, October 2015
☒ Add	☐ Replace	☐ Remove	Appendix A-1, Volume 2, Lease UTU-77114 Baseline Water Quality data of Proposed additional water monitoring sites
☒ Add	☐ Replace	☐ Remove	Appendix A-2, Volume 2: 1) Toad Survey - Alpine Ecological, August 2014; 2) Prime Farmland Determination - NRCS, August 2014, 3) USF&WLS Species by County Review, Alpine Ecological, October 2015; 4) Vegetative Analysis of Seven Proposed Drill Sites and Seven References Sites, Alpine Ecological, August 2015; 5) Subsidence Area Vegetative Monitoring Protocol, Alpine Ecological, October 2015 (StreamVegMonitorMemo) 6) BLM subsidence mitigation Plan, May 2016, Canyon Fuel Company, LLC
☒ Add	☐ Replace	☐ Remove	Appendix A-3, Southwest Reserve Roof, Coal, and Floor analysis (holes 99-33-1, 95-21-1, 95-28-1, 98-3-2C), 15-21-2, 15-21-2 lithologic description
☒ Add	☐ Replace	☐ Remove	Appendix A-3, Southwest Reserves NEPA Analysis Area, 2011, Western Land Services Inc. 08.10.2011
☒ Add	☐ Replace	☐ Remove	Appendix A-3, Southwest Reserves NEPA Analysis Area, 2012, Western Land Services Inc. 08.06.12
☒ Add	☐ Replace	☐ Remove	Appendix A-4, Volume 2 - Flat Canyon Coal Lease Tract Final EIS, January 2002
☒ Add	☐ Replace	☐ Remove	Appendix A-4, Volume 2 – 2002 Flat Record of Decision, USFS SIR Feb 2013, USFS-BLM correspondence Feb 2013, Flat Canyon FONSI, April 2017
☒ Add	☐ Replace	☐ Remove	Appendix A-4 CONFIDENTIAL File 1) SHPO concurrence letter; 2) Hopi Tribe concurrence letter; 3) EPG email; 4) NRHP site 42Sp445 map
☐ Add	☐ Replace	☐ Remove	
☒ Add	☐ Replace	☐ Remove	PHC Addendum Vol. 2 – Appendix P; 2016 Addendum to Star Point Sandstone report; Petersen Hydrologic, LLC, August 2016
☒ Add	☐ Replace	☐ Remove	PHC Addendum Vol. 2 – Appendix Q; Groundwater Model Update Overview, August 2016
☒ Add	☐ Replace	☐ Remove	PHC Addendum Vol. 2 – Appendix R; UpdateSkylineGWReport, SRK Consulting, July 2016
☒ Add	☐ Replace	☐ Remove	PHC Addendum Vol. 2 – Appendix S; In Mine Water Volume Calculations

Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.

Two (2) paper copies of the information are submitted for final approval. Plates requiring professional certification have been certified.

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112.500 Legal or Equitable Owner of the Surface and Mineral Properties to be Mined [unchanged]

Skyline Mines is operated on a leasehold interest owned by Canyon Fuel Company, LLC. The land on which the mining is to occur, except for a small tract in Carbon County, is a part of the Manti-La Sal National Forest four miles southwest of Scofield, Utah in Eccles Canyon. The permit area also includes areas for use as access roads and rail loading facilities located in Township 13 South, Range 7 East over portions of Sections 17 and 18. Right-of-way and surface easements are also included for construction of a coal conveyance system from the mine portal area down Eccles Canyon to the coal storage and loadout facility at the mouth of the canyon. In addition to the above, the permit area includes an area of leased surface rights for use as access roads and a waste site from the George Telonis Estate, (Fontini Telonis et al, P.O. Box A.D., Price, Utah 84501) located in Township 13 South, Range 7 East, SLM, Section 4: SW 1/4, NW 1/4, consisting of approximately 27.83 acres.

Various organizations hold interests, as overriding royalty interests, in and to the coal within the permit area boundaries. The identified holders of overriding interests are:

Kanawha and Hocking Coal and Coke Company
P.0. Box 507
Clear Creek, Utah 84501

Routt County Development, Ltd.
c/o Energy Fuels Corporation
Three Park Central
Suite 900
1515 Arapahoe
Denver, Colorado 80202

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No area within the lands to be affected by surface operations and facilities or within the area of coal to be mined is under a real estate contract.

112.600 Owners of Record of Property Contiguous to Proposed Permit Area

The following list, contains the names and addresses of all owners of surface lands contiguous to the lease boundary and are illustrated on Drawing 1.6-1 (excluding the waste rock disposal area):

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Utah Power & Light Company
1407 West North Temple
Salt Lake City, Utah 84110

Helen Marakis
160 East 1st South
Price, Utah 84501

United States of America
Department of Agriculture
U.S. Forest Service
599 West Price River Drive
Price, Utah 84501

Virginia W. Mower
56 West 200 South
Fairview, Utah 84629

Kanawha & Hocking Coal & Coke Co.
P.O. Box 507
Clear Creek, Utah 84501

Euray Allred
P.O. Box 35
Fountain Green, Utah 84632

Church of Jesus Christ of Latter Day Saints
50 E North Temple
Salt Lake City, UT 84150

.Shirley Cox Trust
700 S 700E
Centerville, UT 84014

G. Wayne Mower et.al.
514 Americas Way #1151
Box Elder, SD 57719

Sandra Lyn Shelley et.al.
1496 N 200 W
Sunset, UT 84015

Cox Inc
504 E 3230 N
Provo, UT 84604

Neal Rosenbaum et.al.
746 E. 200 N.
Spanish Fork, UT 84660

Nick and Koula Marakis
150 East 1st South
Price, Utah 84501

Bessie Oman (Milton)
61 South Main
Salt Lake City, Utah 84115

Greek Orthodox Church (Helinic)
P.O. Box 688
Price, Utah 84501

Union Pacific Railroad
1416 Dodge Street
Omaha, Nebraska 68179-0001

David G. and Rene L. Cunningham
995 East Hillside Drive
Provo, Utah 84604

George E. Liodakis
2655 E. Chalet Circle
Sandy, Utah 84093

Richard S. Christensen Trust
265 E 3450 N
Provo, UT 84604

Terry R. Cox et.al.
c/o Timothy G. Deward
9513 Chavez Dr.
South Jordan, UT 84095

Leslie Scott Watson et.al.
145 W/ Rosewood Cir
Centerfield, UT 84014

Jeffery W. Jensen et.al.
Verl W. Jensen
163 W 600 N
Clearfield UT 840115

Kenneth R. Bench
PO Box 385
Fairview, UT 84629

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Collard Family Trust
Linda Mariotti
6022 Emerald Ridge Cove
Salt Lake City, UT 84121

DKL, LLC
3585 N. University Ave. Ste 275
Provo, UT 84604

Roy F. Hatch (Four Seasons)
370 N. Main
Manti, UT 84642

The following list contains the names and addresses of the owners of mineral acreage contiguous to the mine permit boundary and are illustrated on Drawing 1.6-2 (excluding the waste rock disposal area and rail loadout):

Carbon County, Utah
Court House
Price, Utah 84501

Peper Estate
975 West 600 South
Orem, Utah 84058

C&B Coal
975 West 600 South
Orem, Utah 84058

Utah Power and Light Company
1407 West North Temple
Salt Lake City, Utah 84110

James and Linda Tracy
3148 North Timpview Drive
Provo, Utah 84604

Church of Jesus Christ of Latter Day Saints
50 E North Temple
Salt Lake City, UT 84150

.Shirley Cox Trust
700 S 700E
Centerville, UT 84014

G. Wayne Mower et.al.
514 Americas Way #1151
Box Elder, SD 57719

Sandra Lyn Shelley et.al.
1496 N 200 W
Sunset, UT 84015

United States of America
Department of the Interior
Bureau of Land Management
2370 South 2300 West
Salt Lake City, Utah 84119

Canyon Fuel Company, LLC
225 N. 5th Street, Ste 900
Grand Junction, Colorado 81501

Energy Fuels
Three Park Central, Suite 900
1515 Arapahoe
Denver, Colorado 80202

David G. and Rene L. Cunningham
995 East Hillside Drive
Provo, Utah 84604

Richard S. Christensen Trust
265 E 3450 N
Provo, UT 84604

Terry R. Cox et.al.
c/o Timothy G. Deward
9513 Chavez Dr.
South Jordan, UT 84095

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Centerfield, UT 84014

Jeffery W. Jensen et.al.
Verl W. Jensen
163 W 600 N
Clearfield UT 840115

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Cox Inc
504 E 3230 N
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Linda Mariotti
6022 Emerald Ridge Cove
Salt Lake City, UT 84121

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3585 N. University Ave. Ste 275
Provo, UT 84604

.

Revised: 12-30-16

Kenneth R. Bench
PO Box 385
Fairview, UT 84629

Roy F. Hatch (Four Seasons)
370 N. Main
Manti, UT 84642

1-20(b)

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Table 1.114
Lease Acreage, Coal and Surface Ownership

Lease No. or Entity	Active Lease Acres	Date of Issuance	Coal Ownership	Surface Ownership / Action
U-147570	2,092.70	1-May-65	BLM	USFS
	-560.00	20-Dec-06		Relinquished
U-0142235	520	1-Oct-64	BLM	USFS
U-073120	557.22	1-Feb-64	BLM	USFS
U-044076	2,367.82	1-Sep-65	BLM	USFS
	121.50	19-Apr-01	BLM	USFS
U-020305	1,439.40	1-Mar-62	BLM	USFS
	-610.00	30-Jun-93		Assigned to U-70018
	-550.00	7-Sep-06		Relinquished
UTU-70018	610.00	30-Jun-93	BLM	USFS
	-610.00	15-Sep-06	BLM	Relinquished
UTU-67939	3,291	1-Sep-96	BLM	USFS, D.Euray Allred & Madelyn E. Allred Trust
	770.52	2-Apr-12	BLM	USFS, D.Euray Allred & Madelyn E. Allred Trust
UTU-77114	2692.16	7/1/2015	BLM	USFS
C&B Energy	120	30-Jul-02	C&B Energy	Koula Marakis, Trust: George E. & Helen Liodakis & Liodakis Ranch
Carbon County	65	1-May-74	Carbon County	Canyon Fuel Company, LLC., Milton D. Oman, LTD,
	746.25	1-Aug-02	Carbon County	Koula Marakis, Trust: George E. & Helen Liodakis & Liodakis Ranch
Canyon Fuel Company, LLC	240	20-Dec-10	Canyon Fuel Company, LLC	D. Euray Allred & Madelyn E. Allred Trust
Canyon Fuel Company, LLC	346.68	22-May-98	Cunningham / Tracy	David G, & Rene L. Cunningham
Active Federal Coal Acreage	12,132.32			
Active Non-Federal Coal Acreage	1517.93			
Total Active Lease	13,650.25			

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Leasehold interests involve all or part of the leases which have been subleased and/or assigned to Canyon Fuel Company, LLC.

Acres listed in leasehold interest are identified both on Plate 1.6-2 and Plate 1.6-3; Landownership is identified on Plate 1.6-1.

114 Right-of-Entry Information

The Skyline Mines will be operated on the leasehold interests owned by Canyon Fuel Company, LLC. The lands on which mining is to occurs includes part of the Manti-LaSal National Forest, and both county and private leases (see Drawings 1.6-1 and 1.6-3 of the unmodified permit). Post mining land use of National Forest lands are outlined in the approved Manti-La Sal Forest Land Use Management Plan. The waste rock disposal area and Winter Quarters Ventilation Facility are on private land as also shown on Drawing 1.6-1. The leasehold interests involve all or a part of the following coal leases, which have been subleased and/or assigned to Canyon Fuel Company, LLC (additional information provided on Table 114.1):

Federal Lease		Issued to	Date of Issuance
Utah - 020305		Emmett K. Olson	03/01/62
Utah - 044076		Armeda N. McKinnon	09/01/65
Utah - 0142235		Malcolm N. McKinnon	10/01/64
Utah - 0147570		Malcolm N. McKinnon	05/01/65
Utah - 073120		Independent Coal and Coke Company	02/01/64
Utah - 67939	Tract 1	Coastal States Energy Co.	09/01/96
	Tract 2	Canyon Fuel Company, LLC	04/02/12

County Lease	Issued to	Date of Issuance
Carbon County Coal Lease	Kanawha and Hocking Coal and Coke Company	5/1/74
Carbon County Coal Lease	Canyon Fuel Company, LLC	05/15/02

Private Lease	Issued to	Date of Issuance
UP&L Tract	Canyon Fuel Company, LLC	2/1/99
C&B Energy	Canyon Fuel Company, LLC	8/1/02
Peabody Natural Resources Company (formerly known as Hanson Natural Resources Company)	Canyon Fuel Company, LLC	12/16/10
Cunningham / Tracy	Canyon Fuel Company, LLC	5/22/98

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The legal descriptions of the above listed coal leases are:

Federal Coal Lease Serial #Utah-020305

T. 13 S., R. 6 E., SL Meridian. Utah

Sec. 13:	SW-1/4 SW-1/4 (Lot 7);
Sec. 14:	SE-1/4 SE-1/4;
Sec. 23:	E-1/2 E-1/2; (relinquished)
Sec. 24:	W-1/2 NW-1/4, SE-1/4 NW-1/4, S-1/2;(SE1/4 relinquished)

Sec. 25: All (Lots 1 thru 4, S-1/2 N-1/2, S-1/2);(relinquished)
Sec. 26: E-1/2 E-1/2;(relinquished)
containing 279.4 acres;

Federal Coal Lease Serial #Utah-044076

T. 13 S., R. 6 E., SL Meridian. Utah
Sec. 26: W-1/2 E-1/2, W-1/2;
Sec. 27: Lots 1, 2, 3, 4, E-1/2, E-1/2 W-1/2,
Sec. 34: Lots 1, 2, 3, 4, 5, 6, 7, 8, and S-1/2
Sec. 35: Lots 1, 2, 3, 4, 5, 6, 7, NE-1/4, E-1/2 NW-1/4, NE-1/4 SW-1/4, N-1/2 SW-1/4;
containing 2,489.32 acres;

Federal Coal Lease Serial #Utah-0142235

T. 13 S., R. 6 E., SL Meridian. Utah
Sec. 11: S-1/2 S-1/2;
Sec. 14: W-1/2, SW-1/4 SE-1/4;
containing 520.00 acres;

Federal Coal Lease Serial #Utah-0147570

T. 13 S., R. 6 E., SL Meridian, Utah
Sec. 10: Lots 3 and 4, E-1/2 SW-1/4 and SE-1/4;
Secs. 15 and 22: All;(relinquished all of Sec. 15 except E1/2NE1/4)
Sec. 23: W-1/2 E-1/2 and W-1/2;
containing 1,532.70 acres;

Federal Coal Lease Serial #Utah-073120

T. 13 S., R. 6 E., SL Meridian, Utah
Section 13: Lots 1, 2/ 3, 4, 5, 6, 8;
Section 14: NE-1/4, N-1/2 SE-1/4;

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Federal Coal Lease Serial # UTU - 771114

T.13 S., R.6.E., SL Meridian, Utah

Section 21, lots 1-4, E1/2E1/2;
Section 28, Lots 1-8, S1/2NW1/4, SW1/4;
Section 33, E1/2, E1/2W1/2, NW1/4NW1/4, SW1/4SW1/4;

T. 14 S., R.6 E, SL Meridian, Utah

Section 4, lots 1-4, S1/2N1/2, S1/2;
Section 5, lots 1-4, S1/2N1/2, S1/2;

Containing 2,692.16

- A copy of Lease UTU-77114 is located in Chapter 1 Appendix 118A

Cunningham / Tracy Coal Lease(s) joint ownership

Township 14 South, Range 6 East SLB&M

Section 3: Lots 3 & 4; S1/2 NW1/4; SW1/4; W1/2 SW1/4 SE1/4; SW1/4 NW1/4 SE1/4

containing 46.68 acres more or less

- Copies of the respective Memorandum of Lease are located in Chapter 1, Appendix 118A

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Legal Description of Areas Authorized for Coal Mining and Reclamation Activities Adjacent Area

Township 12 South, Range 6 East, SLBM

Section 25: SE¼NE ¼, S½SE¼, lots 3 and 4, SW¼NE¼, W½SE¼, SW¼
Section 26: S ½SE¼, SE¼SW¼, lots 1-4, N½S½, SW¼SW¼
Section 34: Portions of the S½N½, S½, NE¼NE¼
Section 35: All
Section 36: W½ , N½NE¼,SW¼NE¼, NW¼SE ¼, N½NE¼

Township 12 South, Range 7 East, SLBM

Section 32: Portions of SE¼SE¼

Township 13 South, Range 6 East, SLBM

Section 1: Portions of S½NE¼ , W½
Section 2: All
Section 3: All
Section 10: All
Section 11: All
Section 12: W½SW¼ , W½NW¼ , NE¼NW¼
Section 13: W ½ , portions S½SE¼
Section 14: All
Section 15: W½NE¼
Section 21 lots 1-4, E1/2E1/2
Section 22 All
Section 23: W½, NE¼, W½SE ¼
Section 24: NW ¼, portions of NE¼
Section 25: Portions of SE¼SW¼
Section 26: W½, W½E½
Section 27: All
Section 28: lots 1-8, S1/2NW1/4, SW1/4
Section 33: E1/2, E1/2W1/2, NW1/4NW1/4, SW1/4SW1/4
Section 34: All
Section 35: All
Section 36: Portions of N½NW¼

Township 13 South, Range 7 East, SLBM

Section 4: Portions of W½ ,
Section 5: Portions of NE¼
Section 6: Portions of S½N½

Section 17: Portions of S½S½
Section 18: Portions of S½S½
Section 19: Portions of N½NW

Township 14 South, Range 6 East, SLBM

Section 2: W½NW¼
Section 3: E½NE¼
Section 4: lots 1-4, S1/2N1/2, S1/2
Section 5: lots 1-4, S1/2N1/2, S1/2

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Total acres approved for Underground Coal Mining and Reclamation activities: 13,425.54

The acreage of 10,733.38 acres is an AutoCad ® generated number from drawing number 1.6-3 . The acreage includes active leases and areas within the permit boundary. The acreage does not include the ½-mile buffer identified around the Waste Rock disposal site.

North of Graben (NOG) Bleeder Shaft

The NOG Bleeder Shaft consists of approximately 3.00 acre permit area located on a south-facing slope approximately 200 feet below the existing Granger Ridge USFS road. The total watershed area contributing to the pad is approximately 0.8 acres. The site includes a 0.19 acre topsoil stockpile area,a short access road, the pad, and a minor re-routing of the existing road to utilize flat ground on top of the ridge to minimize the disturbance associated with the pad. Surveys were conducted to identify T&E species of both plants and animals. Surveys (provided in Appendix A-2)did not note any such species. Although habitat for the three-toed woodpecker exists in the area, none were identified.

Flat Canyon Lease

Statements regarding cultural and historical resources found within
The Flat Canyon Lease area are addressed within the USDA January 2002 Flat Canyon Coal Lease Tract Final Environmental Impact Statement (EIS). A minimum of ten (10) Class I inventories have been complete in the leasing area, with additional reconnaissance being conducted for the EIS (Elkins and Montgomery, 2001). Of six (6) historic sites inventoried, only one site was recommended as eligible for the National Registery. This site is located on private lands within the project area. A copy of the EIS is included in Appendix A-4 Volume 2.

According to the Record of Decision (ROD) issued for the Flat Canyon Coal Lease Tract EIS, "No effects to cultural resources are anticipated." Potential effects to historic resources on private
lands would be mitigated in accordance with the National Historic Preservation Act in consultation with the State Historic Preservation Office." In addition, "No effects to significant paleontological resources are expected. Prior to conducting surface operation disturbance surveys are required."

Additional SHPO concurrence was confirmed in 2016 during an Environmental Assessment conducted by Office of Surface Mining (OSM). See Appendix A-4 for concurrence letter.

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Ch. 2 Sec. 2.2
Geology

Major faults are nearly vertical, trending north-south to northeast-southwest in the area. The largest of these, the Connvelville Fault, forms much of the eastern boundary of the permit area. Within the fault block east of the Connelville Fault, the Belina Mine has encountered very small displacement, east-west faults which deviate from vertical with hades of up to 30 degrees. Of the three major fracture/fault features known to have displacement, only the Connelville Fault is sufficiently developed to displace structural contours. The faults, known locally as the Valentine Fault and the North Joes Valley Fault, are thought to have considerably less displacement than the Connelville Fault. Both of these faults are located outside the permit area to the south and southeast. The Valentine Fault trends northeast and is located east of the Electric Lake Dam in Valentine Gulch. The North Joes Valley Fault dies out south of Electric Lake. The Connelville gradually disappears north of the permit area. The Connelville and Valentine Faults are vertically displaced downward to the west, and the North Joes Valley fault is vertically displaced downward to the east.

The O'Connor Fault is located approximately one to 1.5 miles east of and roughly parallel to the Connelville Fault and is offset down to the west. Both the O'Connor and Connelville Faults slowly die out to the south of the permit area. The Connelville Fault enters the Electric Lake basin north of Coal Canyon and the O'Connor Fault enters the Electric Lake basin south of Cox Canyon, just northwest of the dam. West of Electric Lake, a similar series of smaller southwest-northeast trending faults extend to the Gooseberry Fault, which appear to disappear north of Swens Canyon.

The Connelville Fault is a complex fault zone with a width of up to 1,000 feet. The cumulative displacement across the zone appears to increase from approximately 55 feet in the Winter Quarters Mine north of Skyline to 250 feet or more near the southern edge of the Skyline permit area. Individual faults within the zone have much smaller, and highly variable displacement. The Connelville Fault, as shown in Plate 2.2-1, is near the western edge of a complex zone, although segments of the zone may be encountered west of the map location shown.

Four major jointing and fracture orientations have been mapped on the leasehold. The most common orientation observed within the coalbeds and immediate roof and floor strata are a set of joints spaced approximately 1 to 3 feet apart with a N80°W orientation. This joint set is only occasionally observed in surface outcroppings. A second joint orientation observed in the mines as well as in surface outcroppings are a set of N5W to N5E joints, spaced from 1 foot to over 10

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feet apart at the surface. They are only occasionally observed at coalbed depths. The last two orientations are a system of conjugate shear fractures and joints which are more commonly observed on the surface but occasionally appear at depth and are oriented at approximately N60W and S70W respectively.

As illustrated in Drawings 2.2.1-1 and 2.2.1-2, the majority of the approximately north-south trending faults west of the Connelville die out or terminate in the area of an east to west trending fault in Sections 22, 23, and 24, Township 13 South, Range 6 East. North of this fault, the majority of the faults and fractures trend approximately east to west. These faults appear to be sub parallel to the Fish Creek Graben located a few miles north of the North Lease area. While mining activities were occurring in Mine #3, the in-situ stress were measured in the rocks. The results of the test indicated the rocks were in compression in an east-west direction (Oral Communication, Mark Bunnell, Skyline Mine Geologist, July, 2002). Similar measurements were taken in Mine #2, and while less successful, the results of the testing indicated the rocks were in extension in an east- west direction. Most of the north-south trending faults appear to be normal faults with vertical offset and a slight amount of horizontal offset. The east-west trending faults can have both vertical and horizontal offsets. Mines #2 and #3 are separated by the east-west trending fault in Section 22, 23, and 24 (Mines #1, #2, and #3 are illustrated on Drawing 2.2.7-7). The change in the stresses appears to have a direct impact on the ground water inflow to the mine. Since the north-south trending faults are in extension, it is theorized that the water held under piezometric pressure within the sandstone units of the Star Point is released at mine faces where fault gouge is weak or gaps are present between fracture faces. The extensional forces would allow for the water to be forced into the space created by "pulling apart" the rocks. In the area where the rocks are in compression, the east-west trending faults do not have the same "gaps" as formed in the extensional areas and thus the water does not appear to have pathways through the fractures and faults within the Star Point Sandstone. Drilling records and interviews with well site geologist indicate that in almost all areas of the mine, significant water is not encountered within the Blackhawk Formation. This suggests that the Blackhawk Formation continues to function as an aquitard whether the rocks are in the state of compression or extension.

As mining advances west of Electric Lake in the Flat Canyon Coal Lease, it is anticipated that water under pieziometric pressure will be encountered in north-south trending faults. This has been accounted for in the Mine Plan.

Section 2.2.7, Mineable Coal Deposits, is confidential and consequently has been removed and submitted to the Division in a separate folder.

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	Southwest Reserve - Flat Canyon LBA		
	L. O'Connor B	L. O'Connor A	Flat Canyon
Sulfur Forms (Dry Basis)	Percent	Percent	Percent
Pyritic	0.11	0.42	0.02
Sulfate	0.01	0.01	0.05
Organic (Diff.)	0.29	0.47	0.25
TOTAL	0.40	0.90	0.32

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- The standard wet chemical analysis (ASTM D 2492) determines iron soluble in nitric acid, and calculates from this the pyrite content. This test does not separate marcasite values from pyrite values and merely reports the total as pyrite.

- On a dry basis the three mineable seams average from 0.55 to 0.62 percent total sulfur by weight. On the same basis, pyritic sulfur averages from 0.07 to 0.21 percent. Even if all the pyritic sulfur were marcasite, it would not be sufficient to cause acid mine drainage problems.

- The Permittee consulted with Commercial Testing and Engineering Laboratories, Inc. in Denver, Colorado, and Standard Laboratories, Inc. in Charleston, West Virginia, and did not find an accurate and quantitative method to determine marcasite content in coal.

The North Lease is a continuation of mining the Lower O'Connor "A" seam as was previously performed in Mine #3 (the existing Mine #3 workings are located within 50 feet horizontally of the planned new works of Mine #3 in the North Lease), the same geochemical conditions are anticipated. Lab analysis from drill holes in the North Lease of the floor, roof, and coal indicate the potential for generating acid or toxicity are low. Results are included in Appendix Volume A-3 Volume 2. Testing of material transported to the waste rock disposal site indicates that only a very small percentage of material that would be classified as acid and toxic forming has been found in the Lower O'Connor "A" seam. The handling of waste rock and material determined to be acid or toxic forming is described in Sections 4.4.5 and 4.16 of this M&RP.

The Flat Canyon Lease provides the same low potential for generating acid and toxicity from the mining of the coal. The merged Flat Canyon / Lower O'Connor A, and Lower O'Connor B seams will be mined. Lab analysis from drill holes support the coal and surrounding rock are consistent with the materials generated in Mines #1 and #2 located to the east and Mine #3 in the North Lease. Table 2.2.8-2 has been updated to illustrate the sulfur and acid-forming potential in the seams to be mined. Plate 2.3.4-1D provides a fence diagram of the stratigraphy and the seams to be mined. Chemical and acid-base potential analysis of the roof, coal, floor of selected drill holes are provided in Appendix A-3. Locations for holes 95-21-1, 95-28-1, 99-33-1, and 98-3-2C are available on Plate 2.3.4-1D; sites used in the fence diagram. Analysis for hole/monitoring well 15-21-2 was also added to Appendix A-3. 15-21-2 was not illustrated in the fence Plate 2.3.4-1D as it is located less than ½ mile from 95-21-1 and provided no additional data.

2.2.9 Waste Rock Disposal Site

The stratigraphy of the waste rock disposal site area is very similar to that of the minesite permit area, consisting of inter- bedded sandstone, siltstone, and shale, with numerous carbonaceous and coaly zones. In November of 1976, Sanders Exploration drilled a borehole about 1,300 feet east of the waste rock permit site located in the SE 1/4, NW 1/4, Sec 4, T 13S, R 7E. The drill hole report for the site identified as S-4 can be found in Appendix Volume A-4.

Geotechnical

The geotechnical data report by Dames and Moore dated October 30, 1979 is included in its entirety in Appendix Volume A-3. Much of that report is interpretive in nature and deals with facilities that have since been constructed.

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2-3
Groundwater
Hydrology

averaging 700 feet per mile was encountered in the southern portion of the lease area. This anomaly is probably associated with a fault zone which passes through one of the observation well sites. The fracture has apparently connected the sandstone lenses of the Blackhawk Formation with the underlying Star Point Sandstone, thereby significantly increasing the water yield characteristics of the rock at this point and influencing the piezometric head in the area.

The differences between the elevation of water in the observation wells and that of surrounding springs indicates that two ground water systems occur in the Skyline project area. A shallow system, very local in extent and discontinuous, provides water to numerous seeps and springs through thin sandstone layers in the Blackhawk Formation. A deep ground water system is present in the saturated rocks surrounding and below the coal. Except where it out crops and supplies spring flow to Eccles Creek below the O'Connor fault (Vaughn Hansen Associates), this deep system has little apparent effect on the surface hydrologic regime of the permit area since the water is located well below the perennial streams of the permit area. The system continues to dip to the west and southwest beyond the permit area and remains below the Sanpete Valley floor. It is not known to outcrop down dip. A fence diagram depicting the relationship of the wells with their location and with the geology may be found in Drawing 2.3.4-1 A through 1D.

Beginning in March 1999 and continuing through October 2002, the potentiometric surface within the Star Point Formation began to change as a result of ground water inflows to the mine. A new potentiometric map (Drawing 2.3.4-2) was drawn in November 2002 to graphically illustrate the changes to the potentiometric surface. The new surface has a gradient toward 9, 11, and 12 A and B panels of the mine. It is anticipated this gradient will continue until Skyline completes mining in the Mine #2 area and the abandoned workings are allowed to flood.

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Drawing 2.3.4-2 illustrates a potentiometric surface of the water in the Star Point Sandstone. The potentionmeteric surface is based on data from wells completed in the Star Point Sandstone throughout the permit area. Drawing 2.3.4-2 is based on geologic information provided in Section 2.2.6, and the numeric hydrologic model presented in the PHC Appendix J and K that provides additional information indicating the gradient of the Star Point Sandstone regional aquifer is from south to north. The original 2006 illustration has been updated with 2010, 2013, and 2016 data to demonstrate the regional aquifer has not significantly changed with the dewatering associated with mining.

Springs in the Blackhawk Formation are fed from perched water in shallow sandstone lenses underlain with shale well above the regional ground water level.

Useable quantities of water from wells in either the Storrs Sandstone or the lower tongues of the Star Point Sandstone are unlikely unless a fracture zone is encountered. Drawdown and recovery tests, which were conducted at two different depths in an open test well located in the proposed portal area, indicated that the transmissivity of the Blackhawk Formation is approximately 18 gallons per day per foot (Volume A-1, Hydrology). No significant difference in transmissivity exists between the coal zone and the Aberdeen Sandstone. The low transmissivities and discharge rates (approximately 5 gallons per minute) indicate that the Blackhawk Formation is, at best, a poor aquifer.

Potentiometric surfaces are below the ground surface, even in the canyon bottoms, with the deeper holes under the Blackhawk showing a generally higher potentiometric surface than the shallower holes. East of the permit area, where the Star Point Sandstone is exposed, the potentiometric surface intersects the ground surface in the canyons, thereby producing springs along the bottoms of the canyons. Water table conditions exist primarily in shallow alluvial deposits along larger perennial streams. Potentiometric surfaces, as currently understood, are shown on Plate 2.3.4-2 and

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on Plates 7, 11, and 12 of the Hydrology report - Appendix Volume A-1. Comparison of the 1992 Plate 2.3.4-2 and the 1980 Plates 7, 11, and 12 showed little change in the shape of the potentiometric surface overtime. However, static water level data (Volume 4) indicates that the water table had fallen by 30 to 40 feet from 1982 to 1992. This decrease in water levels in the monitoring wells was likely due to on going drought conditions (Climatology Data, Volume 4) and dewatering associated with mining operations (see the PHC for further discussion).

Hydrographs of water levels in the nine monitoring wells drilled into the Blackhawk-Star Point aquifer are presented in the 1991 Annual Report. As indicated by these hydrographs, seasonal water-level fluctuations are typically less than 3 feet, but range as great as 15 feet. The seasonal fluctuations correlate well to snow melt and rainfall events, but in some cases there is a lag time of one to two months. Seasonal fluctuations that are in direct response to precipitation intersect faults or fractures. Lag times of one to two months are caused by association with fracturing, but have no direct connection to these fractures. Due to scale and contour interval of the potentiometric surface map, fluctuations of this magnitude are too small to be seen.

Since water was encountered in the western portion of Mine #2 in 2000, all of the monitored wells south of Mine #3, within the Mine #2 area, and to the west of Mine #2 have shown increased drawdown (July 2002 Addendum to the PHC). This drawdown is the result of the dewatering of the Star Point Sandstone beneath the mine through the intercepted faults and fractures.

Prior to intercepting water in Mine #2, the potentiometric surface gradient was to the west in the southern permit area. After 16 years of pumping water from Mine #2, continued well monitoring, and extensive numeric hydrologic modeling of the Starpoint Sandstone it appears the potentiometric surface gradient is now may be generally trending south to north (Drawing 2.3.4-2). The numeric hydrologic model incorporated data from 17 wells, of which eight (8) were still operational during the study. This added data provided a somewhat better understanding of the potentiometric gradient than from the original limited data, however due to the complexity of this inactive hydrologic system is difficult to predict. Although the SRK model conducted the most comprehensive look at the data, Mayo and Associates (1996) did not construct a piezometric surface map because they considered the deep water systems as discontinuous and the water surface correlations were not meaningful.

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The cone-of-depression centered along the fault system encountered in Mine #2 in the potentiometric surface will likely remain unless the surface drops below the lowest levels of the mine in the southern portion of the permit area.

A number of wells in the permit area have become non-functional over time, whether through mining or other factors causing a breach in the well. Wells no longer in service that are abandoned or scheduled for abandonment include W79-35-1A and -1B, W20-4-2, W20-4-1, W99-28-1, and W99-21-1. Well W15-21-2 monitors the Star Point Sandstone west of proposed mining in Little Swens Canyon. Wells 79-35-1A and -1B, 20-4-1, 20-4-2, have not been replaced with other wells in the area adequately monitoring the Star Point groundwater surface.

Water levels measured in the two monitoring wells located in the North Lease area, 91-26-1 and 91-35-1, exhibit very little fluctuation in the ground water surface within the upper Star Point Sandstone since the wells were completed. As described by Mayo in the PHC prepared for the North Lease area, the sandstones beneath the coal in this area appear to have low transmissivity. This has remained true until mining north of Winter Quarters started to take place. In 2012 Well 91-35-1 was breached at approximately the previous depth to water level (~1,250 ft. This well is no longer monitored and is scheduled for abandonment. In 2014 Well 91-26-1 was breached and is scheduled for abandonment. Well 16-24-1 monitors the Star Point Sandstone north of both the two (2) wells and proposed mining. As stated in Section 2.2 of this document, the east-west trending fractures and faults are the result of compressional forces which do not result in the opening of the fracture faces and thus do not appear to easily conduct water.

The history of the inflows to the mine and measured ground water levels suggest the northern portion of the permit area, Mine #3, is distinct from the southern portion of the permit, Mine #2. The separation appears to occur at the fault between the two mines. Though the fault has only a few tens of feet of offset, it essentially forms the terminus of the north-south trending faults. South and west of the east-west trending fault in sections 22, 23, and 24, heavy water flows from the mine floor at faults and fractures were encountered and the monitoring wells both within the southern portion of the permit area and to the west in the Flat Canyon area have experienced increased drawdown that appears to have stabilized. Although the two wells completed in the North Lease area have shown some drawdown, the effect of the southern drawdown of the potentiometric surface within the Star Point appears to be unrelated. Additionally, flows into Mine #3 historically came from sandstone channels overlying the coals seam and typically dried after a short period of time. Very few inflows came into the mine through the floor and were typically less than a hundred gallons. It is anticipated that the same ground water conditions encountered in Mine #3 will be encountered as mining moves into the North Lease area.

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Wells W22-2-2 and W14-2B and W14-2A (2011-2016 apparent communication with surface run off) have failed casings associated with subsidence. Well W22-2-1 is the shallow well paired with W22-2-2. At the time of the Vaughn Hansen Associates (1979) report, the deeper of these two wells had an artesian potentiometric head which rose to a level above the water level in the shallower well. By 1982 the water level in W22-2-2 had dropped below that of W22-2-1. This was probably due to both the drought and dewatering of the area by the mining operations.

As of 2013 almost eight (8) years of mining have been completed in the North Lease. Groundwater conditions have remained consistent with minimal, short-lived inflows being encountered in the Mine. As 900-1300 feet of overburden separate the mine workings from the springs and streams, no impacts to the water resources are anticipated. Water Rights 91-3917 and 91-1039 and will be added to the Skyline water monitoring program as sites S26-1 and S25-32, respectively. These sites are located directly above longwall mining activity and should identify any impacts due to mining. Water Rights 91-1043 and 91-1044 will be monitored with site CS-26 located in Lower Wife Creek. See PHC Addendum Appendix L for baseline water monitoring in the area. As has been demonstrated in the 30 years of water monitoring in Mines 1 and 2 located in the Huntington drainage, and the multiple years of water monitoring in the Winter Quarters areas of Mine #3, there has been no adverse effects to water quality. Summarized in the Petersen Report (located in Appendix L), the low concentrations of TDS, total iron, and low manganese are due to a combination the flow regime, and abundance of carbonate minerals in the Blackhawk formation. Also, when increased total iron and total manganese concentrations have typically been noted they have been associated with high flow, high suspended sediment events, suggesting the increased load is associated with the presence of sediments in the surface water and not the stream water itself. The stiff diagrams included in the Petersen report identify how the water chemistry of the water monitoring sites is similar with the monitoring sites throughout the Skyline area.

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2.3.4.5 Mine #4 - Flat Canyon Lease Area

As mining moves west of Electric Lake into the Mine #4 area and the Flat Canyon lease, the initial mining will be conducted in the merged Flat Canyon - Lower O'Connor A seam (FC-LOA) which is located stratigraphically approximately 65 feet below the Lower O'Connor B seam (LOB) which is the primary mining unit in Mine #4. The FC-LOA seam area may be used as a sump for any mine water that needs to be discharged from the mine while mining the LOB seam (see Plate 3.3-4). As has been stated previously, based on the Cretaceous to Tertiary-age bedrock formations outcropping the Flat Canyon area there are two distinct groundwater systems in the area. The active-zone near surface groundwater system includes the North Horn Formation through the Blackhawk Formation, and the Star Point Sandstone and Mancos Shale representing the inactive-zone groundwater system. Skyline Mine has been actively monitoring both systems since increased inflows into the mine were encountered. The aquifer characteristics of these two systems were reevaluated in 2014 using both baseline information for the Flat Canyon tract and groundwater monitoring information. The information is discussed in detail in by Petersen Hydrologic, Inc. in PHC Addendum Volume 2 in Appendix N, Appendix O, and Appendix P, respectively.

As briefly discussed in Section 2.3.2 - Characteristics of Seeps and Springs, aquifer characteristics in the Mine #4 - Flat Canyon lease area are similar to what has been observed in Mines #1 and #2 located east of Electric Lake. The active-zone, near surface geology of the Blackhawk formation provides recharge to the creeks in the Huntington basin. The lower-inactive zones of the Blackhawk act as an aquitard for modern, meteoric water contributing no significant water to the Star Point Sandstone aquifer due to the interbedded and discontinuous nature of the sandstone, mudstone, and shaley units. This is supported by rock testing cores of shales from the Blackhawk Formation by the United States Geologic Survey that indicated impermeability to water (in both vertical and horizontal directions) even at pressures of 5,000 psi (UDOGM 2013). A primary difference from Mines #1 and #2 is with the regional dip trending to the west, the mineable coal seam is separated from the surface with more overburden, ranging from 700 to 1,900 feet, which further reduces the likelihood of potential impacts to the surface hydrology associated with subsidence. The near-surface groundwater system in the Blackhawk Formation will be monitored in a number of ways. A total of ten (10) springs will be monitored in the Little Swens, Swens and Boulger canyons to monitor not only the Blackhawk Formation, but also the overlying Price River and Castlegate Formations. The Quaternary-age alluvium in Boulger Canyon will be

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monitored with springs, increased stream flow monitoring, and a series of piezometers designed to monitor the near-surface groundwater adding to the creek. No monitoring of the inactive zones of the Blackhawk takes place since no distinct aquifer exists due to the discontinuous nature of the beds. Exploration drilling of the lower, inactive Blackhawk formation typically does not encounter sufficient saturated zones to warrant a monitoring well. This is supported through mining where water is rarely encountered coming from the roof of the mine. When roof-water is encountered it typically is sourced from a channel-sand, with a short duration of flow.

Below the mine is the Star Point Formation which acts as the regional aquifer. The Star Point Formation is an approximately 1,500-ft thick massive, fine- to medium-grained sandstone that is moderately well consolidated. Two sandstone members of the Star Point Formation, the Storrs and Panther, interfinger with basal portions of the Blackhawk Formation in the Skyline Mine area. Groundwater flow through the unfractured Star Point Formation is very slow to non-existent with hydraulic conductivities ranging from 1.46×10^{-6} to 2.25×10^{-5} cm/sec (Mayo and Associates, 1997a). This slow movement is supported by radiocarbon and tritium data (Petersen Hydrologic 2016, PHC Appendix P). The Star Point Formation provides a confined aquifer in the Mine #4 - Flat Canyon area. As described in detail in Section 2.5 Hydrologic Impacts of Mining Activities and July 2002 Addendum to the PHC (modified October 2002, April 2003, and June 2004) the Star Point does not transmit water easily. However, fractures located along fault zones often provide a source of high transmissivity within the sandstone. Wells JC-1 and JC-2 provide clear evidence of the disparity between the fractured-unfractured transmissivity of the Star Point Formation. JC-1 is a pumping well completed in a fracture zone located below the mine and is able to produce 4,000 gpm consistently. Conversely JC-2 was drilled immediately adjacent to JC-1, did not encounter a fracture zone, and produce only minimal water.

six (6) monitoring wells (W98-2-1, JC-2, W99-4-1, W20-28-1, W15-21-2, and W16-24-1) that currently monitor the regional Star Point Formation aquifer below the coal seams to be mined. The ground water wells are located in Little Swens (W15-21-2), Swens (W20-28-2), Boulger Canyon (W99-4-1), wells located east of Electric Lake (W98-2-1 and JC-2), and north in Andrew Dairy Canyon (W16-24-1). Well 15-21-2 was added in 2015,

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and well 16-24-1 was added as a replacement well to monitor the Star Point Sandstone north of the mining area. Five (5) other wells that previously monitored the aquifer are blocked and have been abandoned or scheduled for abandonment. A fence diagram depicting the relationship of the wells with their location and with the geology are illustrated on Plate 2.3.4-1D. Well 15-21-2 was not added to the fence diagram because it is located within ½ mile of well 95-21-1 and didn't modify the illustration significantly. The currently monitored wells illustrate a potentiometric gradient surface ranging from 700 to 1000 feet above the coal seam (Plate 2.3.4-2). The potentiometric gradient has remained consistent since 2001 when pumping from Mine #2 began. As observed in Mine #2, it is possible that water from the underlying Star Point aquifer may be transmitted into the mine through fault gouge in the associate southwest-northeast trending faults. As illustrated on Plate PHC A-2, Mine Inflow Map (PHC Addendum - Vol.1), faults are encountered numerous times during the mining process but only act as a conduit for water from the Star Point Formation when the fault conditions are favorable. Attempts to conduct advanced drilling to specifically encounter water have been unsuccessful. Any groundwater that is encountered will be diverted from the mine into Eccles Creek.

Additional details of the groundwater monitoring for both the near-surface active-zone and deeper, inactive zones are addressed in Section 2.3.7 - Groundwater Monitoring Program of this M&RP.

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2.3.5 Uses of Water in the Aquifers

2.3.5.1 Surface Water Rights

The water rights on and adjacent to the Skyline property which were on record with the Utah Division of Water Rights as of, July, 2002 are listed in Volume 4. The locations of these water rights can be found on Plate 2.3.5.1-1.

In the Mine #4 Flat Canyon lease expansion, eleven (11) surface water rights are identified in the Little Swens, Swens, and Boulder drainages. Ownership is divided between private holdings, the Utah Division of Wildlife Resources, and the USFS with the beneficial use being stockwatering and wildlife.

In addition to those existing water rights identified in Volume 4, the Forest Service has water rights claims pending action in District Court for the Seventh Judicial District in and for Emery and Carbon Counties. The claims for U.S.F.S. water rights in Upper Huntington Creek, Upper Fish Creek, Eccles Creek and the South Fork of Eccles Creek are recognized by the Utah Division of Water Rights as perfected rights by diligence of use. However, these rights have not yet been recognized by the Seventh Judicial District Court. Therefore, they are still pending rights; however, they will be treated as an actual rights until the court makes its decision. The U.S.F.S.

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respectively. The landowner agrees with the monitoring locations

and felt monitoring of spring 91-3916 was not necessary since it has less consistent and lower flow and is not developed for use as the other two (2) springs. Based on DOGM request water rights 91-1043 and 91-1044 will be monitored with Lower Wife Creek named CS-26.

Also shown on Plate 2.3.5.2-1 are exchanges of Scofield Reservoir water for ground water in Pleasant Valley Creek Basin. These are also listed in Volume 4. All exchanges are wells, with the exception of 91-940. Most of the exchanges serve the industrial and domestic needs for mining companies in the area.

Groundwater Rights in the Mine #4 Flat Canyon lease area include nine (9) Groundwater rights that are primarily privately owned. Four (4) of the sites are proposed to be added as water monitoring sites, and will be assigned site numbers SW32-276 (and SW32-277), SW4-429, SW33-268, and SW4-173 (and SW4-169), respectively. Spring sites SW32-277 and SW33-268 are located west of the project area and are not anticipated to be impacted. Spring 4-173 is undeveloped, will be undermined, and will be monitored throughout mining to document any chances. Spring SW4-429 is developed as the drinking water source for the Flat Canyon campground. Monitoring is somewhat problematic in that sampling is conducted at the overflow at the source. If use at the campground is high, there may not be overflow at the source. This hasn't been an issue to-date. In addition, prior to conducting any mining in the area a thorough evaluation of the water delivery system (from the spring to the campground) will be conducted to evaluate the baseline condition of the system. This will provide information for any mitigation that may need to take place after mining. Baseline information, additional monitoring during mining, and mitigation plans will be shared and discussed with both DOGM and USFS personnel.

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The analysis reports are arranged by seam, i.e., McKinnon, Upper O'Connor, and Lower O'Connor A; and then by sample location, e.g., roof, floor.

The locations of the exploration holes at which these samples were taken are shown on Plate 2.3.6-1.

Obtaining ground water data from abandoned mines in the area has been investigated but found not practical. The only abandoned portal in the permit area is the old Eccles Canyon Mine. This portal was sealed and covered during construction of the Skyline portal area surface facilities and is no longer accessible.

There are several abandoned mines in the adjacent area, located in Winter Quarters, Pleasant Valley and Boarding House Canyons. A search of UDOH and EPA (Storet) records did not reveal any discharge data from these old portals.

2.3.7 Groundwater Monitoring Program

Use of the Groundwater and Surface-Water Monitoring Plans

The purposes of groundwater and surface-water monitoring plans are to provide verification that mining-related impacts to groundwater and surface-water systems do not occur, and to determine the magnitude and character of potential impacts if they do occur. Comparisons between monitoring data (for the parameter of interest or concern) collected during baseline pre-mining conditions should be made with monitoring data (for the same parameter or interest of concern) collected during the operational and/or reclamation phase of mining to determine impacts. When changes to monitored parameters subsequent to mining in an area are observed in the monitoring data, an analysis of all data should be performed to determine the cause(s) of the change in the hydrologic condition. In utilizing the monitoring data to detect or quantify potential mining-related impacts, it is necessary to evaluate all factors relevant to the prevailing hydrologic conditions together with the monitoring data. This is because other factors, which are not related to the mining activity, may cause changes in the prevailing hydrologic conditions. In particular, climatic variability (which may result in increased or decreased groundwater and surface-water flow rates, changes in water levels in wells, and changes in water quality) should be carefully evaluated together with the monitoring data. Other factors that may influence coal mine hydrology include grazing practices, land use, and range condition. A convenient and useful means of evaluating regional climatic data is through the use of the Palmer Hydrologic Drought Index, which is a monthly value that indicates the severity of wet and dry spells that is generated by the National Climatic Data Center and available on-line at http://www1.ncdc.noaa.gov/pub/data/cirs/drd964x.phdi.txt.

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The ground water monitoring program outlined in this section is a continuation of a program approved with the original Mining and Reclamation Permit Application. It incorporates practices designed to provide the baseline data necessary to validate the determination of the probable hydrologic consequences of proposed and existing mining and reclamation operations. The program also is designed to meet site specific requirements and incorporates the flexibility for change if necessary. Selection of the monitoring sites was an arduous process using the following criteria. An original baseline survey or Hydrologic Inventory was compiled in 1979, utilizing data collected from 1974 through 1979, where all possible springs, seeps and streams were monitored. Additional water monitoring data was collected for the North Lease from 1991 through 1993. Following the completion of the inventory and consultation with both DOGM and the U.S. Forest Service (USFS), representative monitoring sites were selected. Important parameters included geologic unit, critical area where damage may occur, quantity of flow, reasonable year round access, and representative distribution.

A monitoring program is being conducted at each of the ground water stations identified on Table 2.3.7-3 and depicted on Plate 2.3.6-1. Samples are collected quarterly, with the 1st Quarter (January-March) having a shortened list of sites due to inaccessibity during winter months. Also due to weather conditions, sampling in the 2nd quarter (April-June) can be conducted through July 15 in years when snowmelt conditions prohibit monitoring completion by July 1.

In areas where mining has been completed and only field measurements are required, baseline laboratory

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analyses is conducted during the 3rd Quarter (July-September) every five (5) years beginning in 2010 and successively in 2015, 2020, 2025, etc. In other than the stated years, 3rd Quarter sampling will be identical to 2nd and 4th Quarter laboratory analyses. 4th Quarter monitoring (October-December) should be conducted prior to December due to snow conditions eliminating access.

Water quality samples are collected from the 33 selected springs in the project area. The samples are comprehensively analyzed each year for the parameters listed in Table 2.3.7-1 and Table 2.3.7-2. All water samples collected for use in this permit have been collected and analyzed according to methods in either the "Standard Methods for the Examination of Water and Wastewater" or the 40 CFR parts 136 and 434. A listing identifying the station types is shown on Table 2.3.7-3.

In addition to the collection of the outlined water quality data, water level data has been collected from each of the wells (if functional) as scheduled on Tables 2.3.7-1, 2.3.7-2,and 2.3.7-3, and noted on Plate 2.3.6-1. Water quality samples will be collected from the Waste Rock Disposal Site Well 92-91-03. Summary information on these observation wells is found on Table 2.3.7-4. Six (6) wells, W79-10-1A,79-14-2B 20-4-2, 99-28-1,79-22-2-1 and 79-22-2-2 have experienced casing failures, and have been properly abandoned. There are no plans to replace these wells.

The amount of water discharged from each mine on each monitoring occasion will also be monitored at the mine mouth through the use of a totalizing flow meter or similar device. Significant changes in the source of water in the mine will be noted during the period of operation. Underground water pumped from each mine will be monitored for water quality. Mines #1,#2 and #4 (Flat Canyon lease)discharge is sampled at Station CS-14. Mine #3 discharge from the North Lease is sampled at Station CS-12. Mine #2 water is also discharged at JC-3.

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Should the concentrations result in a discharge which exceeds the UPDES discharge permit limitations or indicates potential disturbance to the hydrologic balance, an attempt will be made to isolate the contributing source and an evaluation made of possible appropriate remedial action. The best alternative remedial action will be implemented as soon as practicable to ensure protection of Eccles Creek water quality. A copy of pertinent sections of the current UPDES permit (expires April 30,2020) is appended to this section as Exhibit 2.3-1. The permit is renewed every five (5) years.

As required, ground water quality data collected from the property area will be submitted to the Utah Division of Oil, Gas, and Mining. Such reports will be submitted within 90 days after completion of the quarterly monitoring program. An annual report which will include a summary of water quality data and water well level data for the previous year will be submitted within 90 days of the end of each year.

In 2002, several new sites were added to the monitoring program. Sites MC-1, MC-2, MC-3, MC-4, MC-5, and MC-6 are surface water sites on Mud Creek (Site MC-6 was added in November 2002 as agreed upon by the operator and the Division). These sites were identified as part of a study to determine the impacts of increase mine discharge on Mud and Eccles Creeks. EarthFax Engineering, Inc. was contracted to write and implement a work plan to evacuate the impacts in July 2002. A copy of the work plan is included in Volume 4 of this M&RP. The study calls for establishing and characterizing reference sites on Eccles and Mud Creeks to: 1)determine depth to ground water at the sites, 2) obtain historic flow data for the stream for comparative purposes, 3) gather and evacuate historic aerial photos of the streams, 4) collect additional water quality data, 5) evaluate bank stability indexes along with vegetation information, and conduct long-term monitoring at the selected sites. The initial field work for this project was

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should be accessible for the next several years. The results of the analyses will be monitored for changes in ages that may indicate changes in the source of the mine water inflows. These samples will be obtained as outlined in Table 2.3.7-1.

Samples of water discharging from springs 8-253 (Flat Canyon area), 2-413 (James Canyon), S24-1 (Sulfur Spring in Huntington Canyon), and S15-3 (Upper Huntington Creek) will be collected during the 2nd Quarter(April - June) and 4th Quarter(October - December) monitoring period and analyzed for tritium content. Additional tritium samples will be obtained from EL-1 (inflow to Electric Lake above JC-1 and JC-3 discharge) and EL-2 (outflow from Electric Lake) during the 2nd, 3rd, and 4th Quarter water monitoring periods. These samples will be collected for a period of three years beginning in the spring of 2004. The purpose of collecting these tritium samples, along with the tritium samples from JC-1, is to monitor the change in tritium content, if any, in the local aquifers and Electric Lake during spring, summer, and fall and over the three year period.

Surface-water will be monitored in the vicinity of the Winter Quarters Ventilation Facility (WQFV) by two (2) stream sites located both up- and downstream of the site, CS-20 and CS-24, respectively. The stream sites will monitor the surface- water ensuring neither the shaft or slope is compromising the surface water system. Groundwater Well 08-1-5 screened from 297-317 feet below the surface and will monitor the water elevation below the coal seam. No springs exist on the south facing slope where the WQVF pad is located. Spring WQ1-1 is located on the north-facing slope, is approximately 1/4-mile east of the WQVF pad and monitors near surface groundwater south and east of the WQVF site.

Both surface-water and groundwater monitoring sites were added in Woods Canyon as mining was extended to the east in Section 36, T12S, R6E. CS-25 will monitor stream flow downstream of all mining activity. Shallow ground water along Woods Canyon Creek will be monitored by piezometers WC-1, WC-3, WC-5, WC-7 and WC-9. The shallow ground water wells were discontinued after the 2016 field season as mining was completed in 2015 (See Plate 2.3.6-1a for historic WC- locations). Spring WQ36-1 will monitor groundwater within the Blackhawk formation above active mining areas.

Mine #4 Flat Canyon Area Monitoring

The monitoring site selection criteria has remained relatively consistent throughout the years with representative sites being selected from the baseline data. With the addition of the Flat Canyon lease, initial seep and spring data was collected beginning in 1997 in preparation of the Flat Canyon EIS. Baseline sampling in the Mine #4 - Flat Canyon lease area resumed in 2006 and continued through 2016. The number of sites were refined based on proposed mining by adding some stream sites upstream of mining and selecting spring sites representative of the geologic units in areas proposed for undermining.

In the Mine #4 - Flat Canyon lease area the groundwater monitoring will include the addition of ten (10) springs in the near-surface active zone. Springs SW32-276 and SW32-277 are located in the Price River formation, SW33-268, SW4-429, and SW5-590 are in the Castlegate Sandstone, and SW21-104, SW28-110, SW28-111, SW4-169, SW4-174 are in the Blackhawk Formation.

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respectively. Spring SW21-104 was added to provide a spring in Little Swens Canyon in the area to be subsided. Spring S33-268 is an important spring since it is used by the campground, yet problematic because it is monitored at the storage tank overflow - the only accessible location. When use at the campground is high, the spring cannot be monitored because the tank is not overflowing due to demand.

To monitor the shallow Quaternary alluvial groundwater in the Boulger Canyon area a total of six (6) shallow piezometers will be added in 2017. Piezometers P17-4-1 (E & W), P17-33-1 (E & W), and P17-34-1 (N & S) are located adjacent to stream monitoring sites CS-30 and CS-33 (upstream of Boulger Reservoir) and CS-34 (below Boulger Reservoir). Plate 2.3.6-4 will provide the baseline potentiometric gradient information from wells once the information is collected.

Monitoring in the deeper inactive-zone of the Star Point Sandstone, both Wells 15-21-2 and JC-2 have been added to monitor water levels. To monitor water quality of the Star Point Formation, JC-1 has added operational lab analysis to the analytical schedule. Microscopic Particulate Analysis (MPA) has also been added to JC-1 to be collected during baseline sampling to check for communication with active-zone surface waters. Similar to monitoring in Mine #2, if sustained significant flows of groundwater (flows greater than 800 gpm) are encountered in the headgates or tailgates of panels in Mine #4, both lab analysis and tritium will be obtained and sampled on a quarterly basis as long as the sites are accessible. An MPA sample will also be collected from the in-mine site during baseline sampling if it is accessible. Plate 2.3.6-3 Mine Inflow Map will identify where inflows are encountered.

Surface Water Monitoring

Surface-water monitoring for the Flat Canyon lease area includes the addition of upstream-of-mining sites on the following creeks: Little Swens (CS-27), Swens Creek (CS-28), Flat Canyon (CS-29), Boulger above the reservoir (CS-30), and CS-31 on upper Boulger Creek above mining, respectively. To provide in-stream-flow information, stream sites CS-32 through CS-34, and CS-35 have been added to sections of Boulger Creek and Swens Creek, respectively, to monitor individual sections streams and tributaries. This is in addition to stream, springs, and wells that have been included in the Water Monitoring program for a number of years (See Appendix A-1, Volume 2 for baseline water analysis).

Table 2.3.7-1 provides the comprehensive water quality analytical schedule for all surface- and groundwater stations; Table 2.3.7-2 outlines field, operational lab, and baseline lab analysis; Table 2.3.7-3 groups the monitoring stations by drainage basin; Table 2.3.7-4 provides a summary of well information on the groundwater monitoring wells, and Plate 2.3.6-1 graphically illustrates the location of all the hydrologic monitoring stations. Plate 2.3.4-2 will provide the baseline potentiometric gradient information from wells

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Table 2.3.7-1
Comprehensive Water Quality Analytical Schedule
(Surface and Ground Water Stations)

Sample Site	1st Quarter							2nd[2] / 3rd[3] / 4th Quarters												
	Lab Analysis*[a]	Field parameters only*[1]	Monthly Flow	Dissolved Oxygen	TDS,TSS, T-P	TDS,TSS	O & G	Lab Analysis*[a]	Qtrly Field parameters* only[1]	Quarterly Flow	Monthly Flow	Monthly Seasonal Flow	Quarterly Water Level Only	Dissolved Oxygen	TDS,TSS, T-P	TDS,TSS	O & G	Carbon 14	Tritium	Deuterium	Oxygen 18
Streams																					
CS-3								X									X				
CS-6**	X			X			X	X						X			X				
CS-7 (F-5)									X												
CS-8									X												
CS-9								X													
CS-10 (C-1)									X												
CS-11								X									X				
CS-12	X							X													
CS-13	X							X													
CS-14***	X							X													
CS-16 (C-3)								X									X				
CS-17 (C-2)								X													
CS-18 (C-4)								X													
CS-19								X													
CS-20								X									X				
CS-21								X													
CS-22										X											
CS-23										X											
CS-24								X						X			X				
CS-25								X													
CS-26								X													
CS-27								X													
CS-28																X	X				
CS-29 (C-6)								X													
CS-30 (C-8)								X													
CS-31								X													
CS-32										X											
CS-33										X											
CS-34										X											
CS-35										X											
MD-1			X	X		X					X					X					
SRD-1			X								X										
F-10									X												
UP&L-10								X													
VC-6	X			X			X	X						X			X				
VC-9	X			X			X	X						X			X				
VC-10		X							X												
VC-11										X											
VC-12										X											

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Table 2.3.7-1
Comprehensive Water Quality Analytical Schedule
(Surface and Ground Water Stations) (continued)

Sample Site	1st Quarter								2nd[2] / 3rd[3] / 4th Quarters													
	Lab Analysis*[a]	Field parameters only*[1]	Monthly Flow	Dissolved Oxygen	TDS,TSS, T-P	O & G			Lab Analysis*[a]	Qtrly Field parameters* only[1]	Quarterly Flow	Monthly Flow	Monthly Seasonal Flow	Quarterly Water Level Only	Dissolved Oxygen	TDS,TSS, T-P	TDS,TSS	O & G	Carbon 14	Tritium	Deuterium	Oxygen 18
Streams (cont.)																						
WRDS #1									X									X				
WRDS #2									X									X				
WRDS #3									X									X				
WRDS #4									X									X				
EL-1																				X		
EL-2																				X		
Springs																						
S10-1									X													
S12-1									X													
S13-2										X												
S13-7									X													
S14-4										X												
S15-3										X										X		
S17-2									X													
S22-5										X												
S22-11										X												
S23-4										X												
S24-1 Sulfur Spring										X										X		
S24-12										X												
S25-32										X												
S26-1										X												
S26-13										X												
S34-12										X												
S35-8										X												
S36-12										X												
SW21-104									X													
SW28-110									X													
SW28-111										X												
SW4-169										X												
SW4-173									X													
SW4-429									X													
SW5-590									X													
SW32-276										X												
SW32-277									X													
SW-33-268									X													
2-413										X										X		
3-290										X												
8-253																				X		
WQ1-1										X												
WQ1-39									X													
WQ3-6									X													
WQ3-26									X													
WQ3-41									X													
WQ3-43									X													
WQ4-12									X													
WQ36-1									X													

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Table 2.3.7-1
Comprehensive Water Quality Analytical Schedule
(Surface and Ground Water Stations) (continued)

Sample Site	1st Quarter: Lab Analysis*[a]	1st Quarter: Field parameters only*[1]	1st Quarter: Monthly Flow	1st Quarter: Dissolved Oxygen	1st Quarter: TDS,TSS, T-P	1st Quarter: O & G	2nd[2] / 3rd[3] / 4th Quarters: Lab Analysis*[a]	2nd[2] / 3rd[3] / 4th Quarters: Qtrly Field parameters* only[1]	2nd[2] / 3rd[3] / 4th Quarters: Quarterly Flow	2nd[2] / 3rd[3] / 4th Quarters: Monthly Flow	2nd[2] / 3rd[3] / 4th Quarters: Monthly Seasonal Flow	2nd[2] / 3rd[3] / 4th Quarters: Quarterly Water Level Only	2nd[2] / 3rd[3] / 4th Quarters: Dissolved Oxygen	2nd[2] / 3rd[3] / 4th Quarters: TDS,TSS, T-P	2nd[2] / 3rd[3] / 4th Quarters: TDS,TSS	2nd[2] / 3rd[3] / 4th Quarters: O & G	2nd[2] / 3rd[3] / 4th Quarters: Carbon 14	2nd[2] / 3rd[3] / 4th Quarters: Tritium	2nd[2] / 3rd[3] / 4th Quarters: Deuterium	2nd[2] / 3rd[3] / 4th Quarters: Oxygen 18
Wells																				
JC-1			X					X		X				X			X	X	X	X
JC-2												X								
JC-3			X					X		X				X						
ELD-1			X							X										
W79-10-1B												X								
W79-26-1												X								
W2-1(98-2-1)												X								
W99-4-1												X								
W20-28-1												X								
92-91-03							X													
08-1-5												X								
15-21-2												X								
16-24-1												X								
P17-4-1 (E&W)												X								
P17-33-1 (E&W)												X								
P17-34-1 (N&S)												X								
Sustained In-mine flow >800 gpm							X											X		

* Field Measurements and Laborotory Analyses are defined in Table 2.3.7-2

[a]Field parameters will be taken in conjunction with samples collected for Lab Analyses

[1]Sites with at least two (2) years of laboratory analysis data will be sampled once every five (5) years for the currently approved laboratory parameters in Table 2.3.7-2 beginning in 2010. If field parameter monitoring indicates any trending changes, regular laboratory analysis may be resumed until trend is adequately characterized.

[2]2nd Quarter sampling may extend to July 15 in years when spring snow conditions do not allow access before June.

[3] Baseline Lab Analysis will be conducted every five (5) years beginning in 2010 in the 3rd quarter. (ie. Years 2010, 2015, 2020, etc.) (JC-1 and In-mine shall include Microscopic Particulate Analysis (MPA))

** Flow measurements discontinued at CS-6 in 12/2009, lower Eccles flow documented with VC-9
*** CS-14 represents mine in-flows and discharges from Mines #1, #2, and #4 (the SW districts of the Mine.

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Table 2.3.7-3

MONITORING STATION IDENTIFICATION

ECCLES CANON/MUD/FISH CREEK DRAINAGES

STREAM STATIONS			15 Stations			
CS-3	CS-6	CS-9	CS-11	CS-19	CS-20	CS-24
CS-21	VC-6	VC-9	VC-10	VC-11	VC-12	CS-25
CS-26	NL - sites (varies)					

HUNTINGTON CANYON

STREAM STATIONS			21 Stations		
CS-7 (F-5)	CS-8	CS-10	CS-16	CS-17	CS-18
CS-22	CS-23	UPL-10	F-10	EL-1	EL-2
CS-27	CS-28	CS-29	CS-30	CS-31	CS-32
CS-33	CS-34	CS-35			

MINE DISCHARGE STATIONS — 4 Stations

CS-12 (Mine #3) — CS-14 (Mines #1, #2, #4) — MD-1 (Composite CS-12 & CS-14)

SRD-1 (Total Mine Site Discharge to Eccles Creek/Scofield reservoir)*

FRENCH DRAIN STATIONS — 1 Station

CS-13

WASTE ROCK DISPOSAL SITE

STREAM STATIONS		4 Stations			
	WRDS #1	WRDS #2	WRDS #3	WRDS #4	

GROUNDWATER STATIONS

SPRINGS		39 Stations				
S10-1	S12-1	S13-2	S13-7	S14-4	S15-3	S17-2
S22-5	S22-11	S23-4	S24-1 Sulfur	S24-12	S36-13	S34-12
S35-8	S36-12	2-413	3-290	WQ1-39	WQ3-6	WQ3-26
WQ3-41	WQ3-43	WQ4-12	8-253	WQ1-1	WQ36-1	S25-32
S26-1	SW21-104	SW28-110	SW28-111	SW4-169	SW4-173	SQ4-429
SW5-590	SW32-276	SW32-277	SW33-268			

WELLS (MONITORING)** — 17 Well Stations

W79-10-1B	92-91-03	W79-26-1	W2-1 (98-2-1)	W99-21-1	W99-4-1
JC-1	JC-2	JC-3	W20-28-1	W08-1-5	15-21-2
ELD-1 (Total of JC-1 and JC-3)	P17-4-1	P17-33-1	P17-34-1		

WELLS, CULINARY -Referenced but not monitored

W13-1	W13-2	W17-1	W17-3	W24-1	

NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES)

001 Portal Area — 002 Loadout — 003 Waste Rock Area — 004 Winter Quarters — JC-3 James Cyn

* Sites are monitored for total flow only and the results are reported to the Division on a monthly basis

** See Table 2.3.7-4 for well detail

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TABLE 2.3.7-4
SUMMARY INFORMATION ON GROUNDWATER OBSERVATION WELLS

Well Designation	Other Designation	Year Drilled	Monitored yes/no	Operational Status	Aquifer Represented/ Monitored Formation Name & Type	Screened Interval, Top & Bottom Elevations, Mean Sea Level	Total Depth Drilled (FT)	Collar Elev Ground Elevation (FT)	Total Depth of Well Elevation(FT)	Top of Casing (FT) above collar	Date & Current Water Level Elevation, Mean Sea Level	Historical Range of Water Level Elevation, Mean Sea Level	Name of Associated Coal Seam	Vertical Distance from Screened Interval to Associated Coal Seams (Above or Below)	Well Location, Township, Range, & Section
W10-1	W79-10-1A*	1979	No	Abandoned	Star Point - Sandstone (Storrs Tongue)	7393.0-7373.0 5	2190	9379.4	7189.4	2.8	Sept. 2002; 9017.3	9034.6-8891.7	Lower O'Connor "A"	Through Coal Seam	T 13 S, R 6 E, Sec. 10
	W79-10-1B*	1979	Yes	Active	Blackhawk		1110	9382.8	8272.8	2.8	6/15/16; 8950.4	9039.3 - 8891.7			T 13 S, R 6 E, Sec.10
W14-2	W79-14-2A*	1979	Yes	Active	Blackhawk	8342.0-8322.0	122	9051.7	8929.7	3	6/24/16; 9028.51	9049.1 - 8963.1	Lower O'Connor "A"	Through Coal Seam	T 13 S, R 6 E, Sec. 14
	W79-14-2B*	1979	No	Casing failed 6/89	Starpoint		965	9047	8082	3					T 13 S, R 6 E, Sec. 14
W22-2	W79-22-2-1*	1979	No	Blocked	Blackhawk		585	9040	8455	2.5					T 13 S, R 6 E, Sec. 22
	W79-22-2-2*	1979	No	Casing failed 9/85	Starpoint		1395	9041.8	7646.8	2.5					T 13 S, R 6 E, Sec. 22
W26-1	W79-26-1*	1979	Yes	Active	Blackhawk - Sandy Siltsone	8411.0-8391.0	200	9012	8812	2.8	6/15/16; 8949.5	8976.5 - 7598.3	Lower O'Connor "B"	Through Coal Seam	T 13 S, R 6 E, Sec. 26
W35-1	W79-35-1A*	1979	No	Blocked	Star Point - Sandstone (Storrs Tongue)	8092.0-8072.0	1000	8726.4	7726.4	2.5	8/27/12; 8296.1	8557.7 - 8171.6	Lower O'Connor "A"	5' Below Coal Seam	T 13 S, R 6 E, Sec. 35
	W79-35-1B*	1979	No	Blocked	Blackhawk - Sandy Siltsone	8542.4-8504.4	220	8726.4	8506.4	2.5	10/29/14; 8611.2	8618.5 - 8534.6	Not associated with coal seam		T 13 S, R 6 E, Sec. 35
W2-1	98-2-1	1998	Yes	Active	Starpoint - Sandstone (Panther Tongue)	8030.4-8000.4	1519	9271	7752		6/10/16; 8403.31	8551.4-8325.3	Lower O'Connor "B"	Through Coal Seam	T 14 E, R 6 E, Sec. 2
JC-1	n/a	2001	Yes	Active	Star Point - Sandstone (Storrs Tongue)	7918.0-7858.0	1000	8797	7797		No Current Data	No Current Data	Lower O'Connor "B"	11.5' Below Coal Seam	T 13 S, R 6 E, Sec. 35
JC-2	n/a	2002	Yes	Active	Star Point - Sandstone (Storrs Tongue)	7886-7946	1000	8796	7796		No Current Data	No Current Data	Lower O'Connor "B"	Below Coal Seam	T 13 S, R 6 E, Sec. 35
JC-3	n/a		Yes	Active	Star Point - Sandstone (Storrs Tongue)	8061.7-8018.0, 7730.5-1-7711.1					No Current Data	No Current Data	Lower O'Connor "B"	Though Coal Seam	T 13 S, R 6 E, Sec. 35
99-4-1	n/a	1999	Yes	Active	Star Point - Sandstone (Storrs Tongue)	7551.0-7521.0	1470	8842	7372		6/10/16; 8533	8562.1 - 8483.6	Lower O'Connor "B"	Through Coal Seam	T 14 S, R 6 E, Sec. 4
99-21-1		1999	No	locked	Star Point - Sandstone (Panther Tongue)	7431.3-7401.3	2050	9347	7297		12/18/14; 8287	8320.3 - 8277.3	Flat Canyon (Middle Seam)	Through Coal Seam	T 13 S, R 6 E, Sec.21
99-28-1	n/a	1999	No	Abandoned	Star Point - Sandstone (Panther Tongue)	7477.0-7447.0	2100	9351	7251		11/21/08; 8420.8	8420.8 - 8343.3	Flat Canyon (Middle Seam)	ThroughCoal Seam	T 13 S, R 6 E, Sec. 28
20-4-1	n/a	2000	No	Blocked	Star Point - Sandstone (Storrs Tongue)	7491.0-7464.0	1570	8874	7304		10/24/14; 8798	8798 - 8448.1	Lost Core	Lost Core	T 14 S, R 6 E, Sec. 4
20-4-2	n/a	2000	No	Abandoned	Star Point - Sandstone (Storrs Tongue)	7574.0-7544.0	2200	9554	7354		6/19/10; 8472.53	8478.7 - 8383.2	Lower O'Connor 'A"	16' Below Coal Seam	T 14 S, R 6 E, Sec. 4
20-28-1	n/a	2000	Yes	Active	Star Point - Sandstone (Panther Tongue)	7420.0-7390.0	1690	8871	7181		6/24/16; 8371	8393.7 - 8355.4	Lower O'Connor "B"	Through Coal Seam	T 13 S, R 6 E, Sec. 28
91-26-1	North Lease	1991	No	Blocked	Starpoint	7698.1-7668.1	1876.7	9235	7358.3		6/19/15; 7851	7956 - 7802.7	Lower O'Connor "B"	Through Coal Seam	T 12 S, R 6 E, Sec. 26
91-35-1	North Lease	1991	No	Blocked	Starpoint	7616.9-7586.9	2450	9262	6812		11/8/12; 7955	8021.3 - 7911.2	Lower O'connor "B"	Through Coal Seam	T 12 S, R 6 E, Sec. 35
92-91-03	n/a	1992	Yes	Active	Starpoint	7728.5-7977.5	132	7720	7852	3	6/14/16; 7977.5	7921.7 - 7867.9	Lower O'Connor "A"	Below Coal Seam	T 13 S, R 6 E, Sec. 4
8-1-5	n/a	2008	Yes	Active	Starpoint		327	8144	8140.5		6/14/16; 7868	7834.5-7972.3	Lower O'Connor "B"	Below Coal Seam	T 13 S, R 6 E, Sec. 1
15-21-2	n/a	2015	Yes	Active	Star Point - Sandstone	7014.0-7044.0	2142	9186	7044		10/20/16; 8350.4	8313.8 - 8350.4	Lower O'Connor "A"/ Flat Canyon	Below Coal Seam	T 13 S, R 6 E, Sec 21
16-24-1	n/a	2016	Yes	Active	Star Point - Sandstone	Approx. 7541.0-7571.0	600	Approx. 8111	Approx. 7511		**	**	Lower O'Connor "A"	Below Coal Seam	T 12 S, R 6 E, Sec 24

Note: * The screen interval was determined by using the lowest minable coal seam; the screen was placed 3 feet below top of the coal seam; and a 20 foot screen was installed.
Denotes wells not in monitoring program
** New well, data will be reported to DOGM

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Sec. 2.4
Surface Water
Hydrology

2.4 SURFACE WATER HYDROLOGY

As previously discussed, the Skyline permit area is located in the headwaters of the Price and San Rafael River Basins. Snowmelt is the primary source of water for the perennial streams in the two basins, with only a small amount of the total flow in the region being derived from rainfall. As a result, flow volumes per unit area are high in the headwaters and low near the mouths of the two basins.

The quality of surface water in the headwaters region is excellent, with total dissolved solids (TDS) concentration normally varying between 100 and 400 milligrams per liter. However, this quality deteriorates rapidly as the streams cross the saline Mancos Shale downstream and receive irrigation return flows from Mancos-derived soils. TDS concentrations in the Price and San Rafael Rivers, near their confluence with the Green River, generally vary between 1,500 and 4,000 milligrams per liter. Sediment yields in the two basins experience similar geographic variations, with the bulk of the sediment yielded at the mouths of the two major rivers coming from those areas which are underlain by the highly erodible Mancos Shale. Data summaries presented in this section are taken from the Skyline water quality monitoring program, Mundorff (1972) and Southeastern Association of Governments (1979). Information presented in this section summarizes and updates the original consultant's reports found in Appendix Volume A-1.

2.4.1 Drainage Basin Characteristics

Portions of five perennial watersheds drain the Skyline project area reporting to Scofield Reservoir include the Eccles Canyon, Green Canyon, Winter Quarters Canyon, Woods Canyon (all tributaries of Mud Creek in the Price River Basin) and Upper Huntington Creek (a tributary of the San Rafael River)reporting to Electric Lake include Little Swens Canyon, Swens Canyon and Boulger Canyon. Channels draining the permit area form dendritic patterns, with stream channels of

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the area flowing in all four major directions. All surface streams have been classified by the Utah Division of Health as follows:

- 1C - protected for domestic use with prior treatment process,
- 2B - protected for secondary contact recreation,
- 3A - protected for cold water aquatic life, and
- 4 - protected for agricultural uses including stock watering.

Electric Lake has been classified as 2B, 3A and 4 while Scofield Reservoir has been classified as 1C, 3A, 4, and 2B.

Slopes on the permit area are steep, averaging approximately 31 percent. Dominant drainage aspects are to the west in the Huntington Creek Basin and to the east in the Price River Basin. The landscape varies greatly, with most of the permit area being covered with conifer and aspen vegetative communities.

Because of the climatological conditions of the area (high precipitation and low evapotranspiration resulting in excess water), there are numerous water sources in the Skyline project area. Most of these are undeveloped springs, seeps and streams. The one notably developed water body located in the project area is Electric Lake, a 31,200 acre-foot reservoir whose upstream tip covers a portion of the southwest section of the project area in the Huntington Creek Basin. This reservoir is owned and operated by Utah Power and Light Company as a storage facility for water used at coal-fired power plants. Upstream of Electric Lake, Boulger Reservoir is primarily managed as a recreational fishery by the DWR. In the event Boulger Reservoir is undermined, mitigation of both the dam and reservoir will be done through prior consultation with the respective regulatory agencies. Drainage of the reservoir may be necessary during mining. Perennial sections of the streams are identified on Figure 4-1, page 2-41a.

The thick vegetative cover on the project area has resulted in a well-maintained soil of high organic matter content, thus developing a more open soil structure with high infiltration rates. As a result, the potential for runoff from a rainfall event on the project area is low. Thus, snowmelt produces most of the runoff from the area during periods when soils are frozen and/or saturated.

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2.4.2 Flow Characteristics

The seasonal distribution of flows in the perennial streams draining the project area is typical of western high elevation, snowmelt streams, where the majority of the flow occurs within a relatively short period of time in late spring and early summer (April, May and June). Flows in Huntington Creek above Electric Lake can be expected to vary from 1 to 100 cubic feet per second while those of Eccles Creek above Mud Creek normally vary between 1 and 50 cubic feet per second and those in Mud Creek vary between 5 and 380 cubic feet per second.

The watersheds draining the project area yield an average of approximately 13.5 inches of water annually to the Price River Basin. However, because the relatively impermeable Blackhawk Formation underlies all of the Huntington Creek Basin above the southern boundary of the project area (either on the surface or directly beneath the surface member), the yield to the San Rafael River Basin is slightly higher (averaging approximately 16 inches per year).

A significant surface water quality sampling program has been conducted in Eccles Creek, Burnout Creek, Flat Canyon Creek, Boulger Creek, and Huntington Creek as well as Winter Quarters Creek, Woods Creek and others in a representative sampling of seeps and springs throughout the Skyline permit area. The following briefly describes the major water quality characteristics of the permit area.

Surface water in the Skyline project area is of a calcium bicarbonate type. Total dissolved solids concentrations in the area are generally lowest during the months of April through June when flows are highest and affected by the diluting effect of direct snowmelt. As flows decrease and the majority of the flow is derived from seepage of local groundwater systems, the dilution effect becomes less pronounced and dissolved solids concentrations tend to increase. As a result, the dissolved solids content of surface water in the area varies from less than 100 milligrams

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per liter (headwaters of Huntington Creek during the high flow season) to slightly greater than 500 milligrams per liter (Eccles Creek during low flow conditions). Suspended solids concentrations in the area tend to vary proportionately with flow rate. During the snowmelt runoff season, concentrations are also naturally higher in Eccles Canyon than in the Huntington Creek drainage basin. Channel erosion, although relatively low throughout the area, appears to be more extensive in the steeper Eccles Canyon than in the Huntington Creek Basin and is probably the source of most of the increased sediment concentrations. Mud slides, when present, add considerably to the suspended solids concentration.

Hydrogen ion activity (pH) tends to be rather constant in the surface waters on and adjacent to the Skyline project area, varying normally between 6.5 and 8.6. The basic condition of the water with low acidity and high alkalinity indicates that acid drainage problems do not develop as a result of mining in the permit area.

Total and dissolved iron measurement values vary widely throughout the area, with the potential source being the iron contained in Blackhawk Formation cementing agents. Total iron, which varied in measurements from less than 0.01 to over 45 milligrams per liter during the observation period, tends to be somewhat directly related to the flow rate, and is associated with sediment loading. In contrast, dissolved iron tends to be much more constant.

Total manganese concentrations in the area were low, varying normally between 0.01 and 2.0 milligrams per liter with occasional higher concentrations associated with sediment loading. No distinct seasonal variations were noted.

The Burnout Creek area was the subject of a subsidence study directed by the U.S.F.S. A portion of the study included monitoring the flows in the stream biweekly and performing annual stream gradient surveys. Four surface water monitoring points were monitored in this

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area and in the adjacent Upper Huntington Creek since 1981 as a part of the surface water monitoring program. Eight flumes, F-1 through F-8 (Plate 2.3.6-1) were installed and are presently being monitored as part of the modified subsidence study. However, only one flume, F-5, is currently part of the quarterly water monitoring program. Flume F-5 is the same sampling point as CS-7 of the quarterly water monitoring program. In general, stream flow rates were never found to be affected by the undermining of the creek. Portions of the mine works underlying Burnout were filled with water beginning in 2003. Water samples from all four monitoring stations are of a calcium-bicarbonate character. Chemical concentrations have remained relatively consistent through time.

Baseline concentrations of various constituents were normally well within the State of Utah standards for waters of the Skyline project area.

A summary documenting the water quality data in the mine area may be found in Volume 4.

Additional baseline data has been collected in the James Canyon drainage as part of the Burnout Canyon study. Flows have been obtained from flume F-9 since 1993 in James Canyon. This information is contained in Volume A-1, Hydrology. Laboratory Analysis was added to Stream Site F-10 due to the facilities associated with the construction of the JC-wells drill pad. Water quality samples collected since the early 80's and 90's from streams that have been undermined by the Skyline Mines (Burnout, Eccles, other tributaries of Upper Huntington Creek, Plate 2.3.6-1 and 2.3.6-1a) indicate water quality is not noticeably affected by underground mining activities.

Prior to March 1999, Skyline Mine discharged water to Eccles Creek at an average rate of approximately 350 gpm. From March 1999 through November 2002, the discharge rate gradually increased to between 9,500 and 10,500

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- All disturbance is a minimum of two (2) stream widths from the stream eliminating a need for a Stream Alteration Permit.
- Drainage from the upper undisturbed road was improved to minimize storm run off to the site.
- A sediment pond with associated UPDES permit has been designed that any storm water entering the site will be treated prior to discharge.
- ASCA's 37 and 38 are established to treat disturbed area storm water runoff until vegetation is re-established and the sediment pond is operational.

2.4.4 Monitoring Program

The surface water monitoring program outlined in this section has been updated based on the findings and conclusions of the 1996 PHC by Mayo and Associates and as a result of a cooperative effort between the operator, the Division, and the Forest in an effort to better understand and monitor the effect of increased ground water inflows to the mine and mine discharge. It incorporates practices designed to provide the baseline data necessary to validate the determination of the probable hydrologic consequences of proposed and existing mining and reclamation operations. The program also is designed to meet site specific requirements and have the flexibility for change if necessary. Specific attention has been given to insure that proper upstream and downstream monitoring is included within the monitoring program for all disturbed areas, and that adequate sampling of potentially impacted flow regimes is completed. Selection of the monitoring sites was an arduous process using the following criteria. An original baseline survey or Hydrologic Inventory was compiled in 1979, utilizing data collected from 1974 through 1979, where all possible springs, seeps and streams were monitored. Additional water monitoring data was compiled for the North Lease area from 1991 through 1993, including the North Lease modification from 2011-2014. Following the completion of the inventory and consultation with both DOGM and the U.S. Forest Service (USFS), representative monitoring sites were selected. Important parameters included geologic unit, critical area where damage may occur, quantity of flow, reasonable year round access, and representative distribution. In the Mine #4 - Flat Canyon lease area, the original seep and spring surveys were conducted beginning in 1997, with almost continuous monitoring be conducted from 2006 through 2016. Operational monitoring locations were selected in conjunction with a PHC study conducted by Petersen Hydrologic, Inc. (PHC Addendum Volume 2 Appendix N) and DOGM personnel while acquiring the Flat Canyon lease.

A PHC study completed in 1996 entitled "Investigation of Surface and Groundwater Systems in the vicinity of the Skyline Mines, Carbon, Emery,and Sanpete Counties, Utah; Probable Hydrologic Consequences of Coal Mining at the Skyline Mines and Recommendations for Surface and

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Surface water stations in Eccles Canyon were sampled more frequently than those on Huntington Creek during the initial phases of mining.

With the addition of the Flat Canyon lease, a total of eight (8) stream sites were added to the water monitoring program to insure any impacts to the surface hydrology of the area were documented. The sites were primarily added in locations upstream of areas proposed for mining, with stream locations already being monitored downstream of the proposed areas to be mined. Sites added upstream of mining include Little Swens (CS-27), Swens (CS-28), Flat Canyon (CS-29), and Boulger above the reservoir (CS-30), respectively. To monitor tributaries of the prominent streams within the areas to be mined, flow-only sites were added to auxiliary tributaries in Swens (CS-35) and Boulger Creek (CS-32 through CS-34). The added sites provide additional sites to monitor any potential in-stream impacts.

As additional monitoring for the stream flows (and required in Special Stipulations for Coal Lease UTU-77114 #27), the stream gradient of perennial streams to be undermined will be monitored as outlined in Section 4.17.4 Mitigation of Subsidence Effects of the M&RP. Monitoring of the sections of perennial streams being undermined using longwall mining methods will be monitored both before and after mining takes place, with the information being added to Appendix A-1. The method of monitoring will include an on-ground survey using survey-grade equipment. Monitoring of the vegetation along the streams is also outlined in Section 2.7 of the M&RP if specific low-flow criteria are encountered.

Stream monitoring station CS-24 was added in Winter Quarters Canyon, with the addition of sediment pond discharge point UPDES-004 from the Winter Quarters Ventilation Facility. Stream site CS-24 is located downstream of the ventilation facility pad, and UPDES-004 represents the discharge from the pad site. Sampling frequency and analysis are located in Tables 2.3.7-1 and 2.3.7-2, respectively.

Stream monitoring station CS-28 was added in Swens Canyon upstream of the Swens Canyon Ventilation Facility. Site CS-16, located at the mouth of Swens Canyon, which previously had been reduced to field parameters-only analysis will return to 2nd-4th quarter lab analysis monitoring with CS-28. Refer to Tables 2.3.7-1 and 2.3.7-2 for monitoring details.

Stream monitoring station CS-25 was added in Woods Canyon as mining progressed east in Section 36, T12S, R6E. CS-25 is located downstream of any mining activity. In addition, nine (9) piezometers (WC-1 through WC-9N) were added in the canyon to monitor the near surface groundwater associated with Woods Canyon Creek.

Sampling will continue at all surface water stations throughout the post-mining period and until the reclamation effort is determined successful by the regulatory authority. Samples will also continue to be analyzed for the parameters outlined in Tables 2.3.7-1, 2.3.7-2, and 2.3.7-3 throughout the post-mining period, unless deletions in the list of parameters is determined to be appropriate.

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Several monitoring stations were added to the monitoring schedule with the incorporation of the North

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Lease Tract. CS-19 and CS-21 have been added to monitor the quantity and quality of the water in

Woods Canyon Creek and CS-20 has been added to monitor the quantity and quality of the water in Winter Quarters Creek - monitoring both mining upstream and water quality upstream of the Winter Quarters Ventilation Facility (WQVF). CS-24 was added in Winter Quarters Creek below the (WQVF) to monitor any affects associated with the pad.

As part of the Skyline Mine subsidence monitoring plan, a total of 42 new water monitoring sites have been identified in the North Lease area (Plate 2.3.6-2 Table 2.3.7-2A). Sites NL-1 through NL-42 have been selected to monitor flows on the perennial reaches of both Winter Quarters and Woods Canyon drainages one year prior to , during,and one year following longwall undermining of the perennial section of stream. The sites will be monitored monthly in June through October. Ifaccessible earlier than June or later than October, the mine will monitor the sites. The results of the monitoring will be reported with the other required monitoring data. The purpose of this monitoring is to determine the effects, if any, on the stretches of perennial streams in the Winter Quarters Creek and Woods Canyon Creek drainage that will be subsided due to mining. Monitoring points, in perennial reaches running perpendicular to the longwall panels, are positioned above the gate-roads and center of each panel. Longwall panels are approximately 850-feet wide, creating a flow-monitoring spacing of approximately 425-feet. Monitoring points in perennial reaches running parallel to the longwall panels are spaced at approximately 850-feet. Since monitoring is dependent on the timing of mining, monitoring points will be added and dropped as mining advances. As mining advances through the perennial sections of the drainage, and the monitoring indicates no affects to flow, the Permittee may modify the spacing of the monitoring points. This monitoring will also help indicate if mitigation is required for loss of surface or ground water and, subsequently, habitat associated with the water. The program was discontinued after the 2016 field season as mining in the 11-Left panel undermining Woods Canyon creek was completed in May 2015.

Skyline has conducted field studies to determine the location of the perennial portions of both Winter Quarters and Woods Canyon Creeks, The perennial nature of the streams were determined using a variety of parameters including vegetation and surface flow monitoring. Field studies were initiated and completed in October and November 2002 and October 2003. Copies of the studies are included in Volume A-1, Volume 2 Hydrology Section. The studies will be used by the Forest in their environmental assessment of the potential effects of undermining Winter Quarters and Wood Canyon Creeks. As mining progressed north of Winter Quarters Canyon, the longwall panels were rotated 90 degrees which extended mining further east. Agapito Associates, Inc. conducted an evaluation of the impacts to the surface based on extending mining to the east. The study indicated longwall mining can be safely extended to the east as outlined without having adverse affects to the surface. The study is located in Appendix A-1, Volume 2.

Sampling will continue according to Tables 2.3.7-1, 2.3.7-2, and 2.3.7-3 as approved at all surface water stations throughout the post-mining period and until the reclamation effort is determined

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Stations will be located both above and below the rock waste disposal site in each of the drainages. (See Drawing 2.3.6-1.)

2. When flow is present, these stations will be monitored, when accessible, at the same frequency and for the same constituents as the stations in Eccles Creek. The data will be tabulated and reported in the same manner as the Skyline water quality data.

3. The data from these stations will be evaluated for non-point source contribution from ground water aquifers. This procedure offers the best potential for detection of ground water contamination.

The Upper O'Connor seam required a breakout to improve ventilation. The breakout is on a south facing slope in a side canyon of the South Fork of Eccles Creek (see map no. 3.2.11-1). A new road was built across this canyon to gain access to the breakout area. The conyon flows water in all but the driest of years. During construction, the creek was sampled above and below the site of a daily basis. The samples were tested for total suspended solids and settleable solids as n aid to regulating construction activities and in implementing control measures. Construction related solids fluctuations were encountered throughout this phase of the project.

The volume of water discharged from the mine increased significantly in August 2002 after large volumes of ground water were encountered within the mine. The mine was concerned about what effects the increased flows might have on Eccles and Mud Creeks. EarthFax Engineering, Inc. was contracted to perform a stream bank stability analysis on the streams using flows ranging between 5,000 and 30,000 gpm. The initial results of the report indicated that the stream banks would be stable at flows up to 30,000 gpm for short periods of time, but would compromise culverts at road crossings. Further study was requested by the Division and EarthFax was again contracted to continue the study of the effects on Mud and Eccles Creeks of sustained increased discharges from the Skyline Mine. The

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study will continue as long as the mine is discharging flows in excess of the pre-September 2001 rates plus one year. Mine discharge decreased below a sustained 5,000 gpm in December 2003. The last update was submitted with the 2006 Annual Report. The study consisted of the following:

Reference sites were established on Eccles and Mud Creeks corresponding to cross sections used in previous investigations (EarthFax Engineering, 2002)and were monitored from 2002 through 2005. The reference sites were established in general conformance to the recommendations of Harrelson et al. (1994). This involved the following:

- Establishing benchmarks at each site. Benchmarks will consist of cement or boulder monuments, with a metal marker stamped with the site number.
- Establishing monumented cross sections. The endpoints of cross sections will be marked with roof bolts or steel reinforcing bar that has been driven into the ground. These bars will be painted to increase visibility.
- Surveying the channel at each site. Surveying will be performed using a level and survey rod, with both the cross section and longitudinal profile of the stream being surveyed.
- Establishing photo points. As recommended by Harrelson et al. (1994), convenient locations will be selected to take photographs

  upstream, downstream, and across the channel at each cross section location.
- Collecting streamflow data. The flow will be measured at each site, using standard procedures, with a rotating-cup flow meter. Indicators of bankfull stage will also be gathered.

Samples of the bed and bank materials were collected at the newly established stations to evaluate geomorphic and stability relationships at those locations. Similar samples were collected in February 2002 at the remaining sites (EarthFax Engineering, 2002) and are still considered valid.

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these samples are analyzed for total dissolved solids (TDS), total suspended solids (TSS), and total phosphorus.

As field information is gathered, sufficient data will be gathered to determine the bank erodibility hazard (Rosgen, 1996; 2001) for each reference site. These data will include measurements of the following values:

- Bank height
- Bankfull depth
- Rotting depth
- Root density
- Bank slope
- Degree of surface protection of the bank

The in-stream velocity gradient (between the core of maximum velocity and the stream bank) and the ratio of average hydraulic stress and near-bank hydraulic stress will also be calculated. Each of these indexes will be compared with typical values provided by Rosgen (1996; 2001) to provide another assessment of bank stability in addition to that provided previously (EarthFax Engineering, 2002).

Flow and water-quality data (TDS, TSS, total phosphorus) are collected at the monitoring points on a seasonal basis and will continue to be until one year following a sustained reduction in mine-water discharge to a rate of 5,000 gpm or less (i.e., pre-September 2001 levels). Channel cross sections and longitudinal profiles will be collected from each reference site annually during the same period. The study was discontinued after the 2006 data collection and report.

The study was re-established in 2015 based on two (2) reasons. Following the 2006 survey, no appreciable changes had been noted from 2003 - 2006. Base flows from 2006-2015 have consistently ranged from 2000 - 5000 gpm, and the Mine wanted an update on the stability of the channel. Also, with the addition of Flat Canyon lease UTU-77114 there is a potential for increased discharges from the Mine. The 2015 survey indicated the mine discharge had no significant erosional impact to the morphology of the stream channel. On the contrary, the channel showed aggradation at all three (3) surveyed locations. Using Rosgen (1996) criteria, Earthfax calculated in their 2001 report that the bankfull discharge of approximately 15,000 gpm is the most effective in channel maintenance. The Earthfax October 2001 report also indicated that infrequent flows of 30,000 lending support to the initial prediction that the creek can safely handle 30,000 gpm is correct (See Appendix A-1 Volume 1 for the Earthfax report).To be consistent with previous reports, annual surveys will be conducted if sustained mine discharges are in excess of 7,500 gpm. The flow rate increase from 5,000 gpm to 7,500 gpm for initiating was a collaborated decision between the Division and Mine personnel based on the aggradation of the monitored stations over the 10+ years between surveys and information from the 2001 Earthfax report. These surveys will be submitted in the respective Annual Report.

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Unnamed Upper Huntington Creek Drainage

Little Swens Canyon Drainage

Swens Canyon Drainage

Unnamed Huntington Creek Drainage

Flat Canyon Drainage

Upper Gooseberry Creek Drainage

Boulger Canyon Drainage

Lower Boulger Canyon Drainage

Cunningham Drainage

488896.7
2068040.6

484769.1
2064569.2

482567.5
2070190.3

479678.2
2062668.9

471876.8
2059160.8

470723.6
2065188.1

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LEGEND

- PERENNIAL STREAM EXTENT (GPS Fall 2015)
- 470723.6 2065188.1 PERENNIAL STREAM EXTENT NAD 27 (GPS Fall 2015)
- PERENNIAL STREAM EXTENT
- DRAINAGE
- FLAT CANYON COAL LEASE TRACT

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – MS6147

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

DATE	No	REVISIONS	BY	CHKD.

Flat Canyon Coal Lease
Watershed Boiundaries and Perennial Stream Reaches

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435-448-2632	DATE: 6-30-16	CK.BY:G.Galecki	REVISION:
CAD FILE:	SCALE: FULL	DR.BY:J.Armstrong	0
DWG. NO.: Figure 4-1			12-30-16

Sec. 2.5
Hydrologic
Impacts

2.5 HYDROLOGICAL IMPACTS OF MINING ACTIVITIES

Presented in the following subsections are summaries of the hydrological impacts of the mining activities of the Skyline project. The details backing the conclusions stated in this section and supplemental discussion can be found in the PHC evaluations included as part of this section, and within the Hydrology Section of Appendix Volume A-1 Volumes 1 and 2. Details of the consultant's flow calculations may be found in the flood plan calculations also in Appendix Volume A-1. The PHC was also updated in July 2002 October 2002, April 2003, and June 2004 and 2016 by the addition of the Addendum to the PHC associated with the drilling of the wells in James Canyon, the significant inflows to Mine #2, and the ground water model prepared by HCI, including updates to much of this information in 2016 with the addition of the Flat Canyon Lease. Additional PHC supporting studies for both the North Lease modification and the Flat Canyon Lease are located in **Addendum to the Probable Hydrologic Consequences – Volume 2, Appendix L** through **R,** respectively.

The potential hydrologic impacts discussed herein represent the latest information available and, generally, correspond to the consultant's original report. (See General Hydrologic Consideration Related to Coal Development and Subsequent Impacts, Vaughn Hansen Associates, February 1981, found in Appendix Volume A-1. Updated analyses of the "Probable Hydrologic Consequences" reflecting all current data are appended to this section.

- **Exhibit A of Section 2.5**, "Probable Hydrologic Consequences of Mining at the Skyline Mines, Carbon and Emery Counties, Utah"; prepared by Earthfax Engineering, Inc., Salt Lake City, Utah; dated September 30, 1992.
- **Addendum to the Probable Hydrologic Consequences, July 2002 (James Canyon Update - further updated in October 2002, April 2003, and June 2004)**.
- **Appendix A-1, Volume 2** (September 2002), "Investigation of Surface and Groundwater Systems in the Vicinity of the Skyline Mines, Carbon, Emery, and Sanpete Counties, Utah: Probable Hydrologic Consequences of Coal Mining at the Skyline Mines and Recommendations for Surface and Groundwater Monitoring".

2.5.1 Potentially Affected Water Rights

Surface and groundwater rights in the general project area are primarily for stockwatering and irrigation. Stockwatering rights are located almost entirely and directly on the streams. The nearest irrigation rights are centered around the two areas of Scofield and in Flat Canyon, southwest of the permit area. Irrigated lands consist primarily of pasture. The pastures identified in Flat Canyon are located primarily west of proposed mining, and due to the glacio-lacustrine sediments deposited there, affects to the water rights are not anticipated. The pastures identified in Flat Canyon are located primarily west of proposed mining, and due to the glacio-lacustrine sediments deposited there, affects to the water rights are not anticipated. Only stockwatering rights are present in the Skyline permit area. A limited number of wells are located in the general area, none of which are located directly on the property or within the permit area. Recent large mine inflows to Mine #2 has resulted in concern voiced by local government and private interests that water entering the mine is coming from nearby Electric Lake. However, data collected and analyzed by Skyline Mine for the purpose of determining the source of the inflows strongly indicates there is no significant connection between the surface waters and the mine waters. As discussed in the July 2002 Addendum to the PHC (modified in October 2002, April 2003, and June 2004), the Star Point does not transmit water easily. Fractures within the Star Point in the mine area has allowed the sandstone to begin dewatering by discharging to the mine. The Star Point does not appear to have a significant discharge point located immediately down gradient of the mine. Indeed, the age of

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the water in the sandstone suggests it takes several thousand years to move through the aquifer in spite of the high transmissivity of the fractures within the sandstone. Therefore, it is unlikely any surface or ground water rights are being adversely affected. Because it is not certain that the ground water discharges into the Huntington Creek drainage, there is no evidence that water is being removed from that drainage to Eccles Creek, part of the Price River drainage. Tritium analysis of the water in the 10 Left area of Mine #2 and water from the James Canyon well JC-1 indicates a minor amount of modern water is being pumped from the well and the mine. However, this water is not necessarily originating from Electric Lake. Therefore, there does not appear to be a significant volume of surface water being transferred between drainage basins.

Mine #4 Flat Canyon Lease Area

Prior to acquiring the Flat Canyon Lease, studies were conducted to evaluate whether any impacts to water rights had occurred in the 1999-2014 within the Upper Huntington drainage associated with mining of the Skyline #1 and #2 mines. PHC Addendum Appendices N through R investigate both the effects to the active-zone groundwater and surface-water systems in the Flat Canyon Tract, and the inactive-zone groundwater conditions in the Star Point Sandstone in the vicinity of Skyline Mine. This is in addition to baseline water quality data included in Appendix A-1, Volume 2. The studies are updates to information provided in 2002 through 2005 that evaluate both the characteristics of the fault-related groundwater inflows encountered in the mine, and the numeric groundwater model of the area. The studies reaffirmed there are no apparent adverse effects to existing water rights. Based on the information provided in the studies, the Flat Canyon lease can be mined without adverse impacts to existing water rights which exist within the active-zone groundwater and surface-water hydrologic system. This is also supported by the quarterly monitoring data submitted to the Division.

In the event existing State water rights are confirmed to be impacted during mining activities conducted west of Electric Lake in the Mine #4 area, the Mine is committed to replacing any impacted delivery of water while mining is conducted. It is noteworthy to mention that the JC-1 well has delivered approximately 500 ac-ft. of water per month to Electric Lake since about 2005 in the absence of any water rights being impacted by mining. Methods of water delivery may include mine-water discharge to the surface in the Huntington Creek drainage (assuming water quality standards are met), completion of a well similar to the JC-1 well to intercept water prior to entering the Mine, or any other best technology currently available (BTCA). Any method of water delivery will be done in consultation with the Mine, UDOGM, Utah Division of Water Rights, and U.S. Forest Service personnel

2.5.2 Mining Impact on Water Quantity

Due to the high shale content of the Blackhawk Formation, recharge to the deep ground water system through the Blackhawk Formation is slow. Fractures in the formation seal readily due to swelling of the bentonitic shale when wet. As a result, the impact of mining (including subsidence) on the quantity of water in the permit area will be minimal. This has been verified through the results of the subsidence study in Burnout Canyon. (A discussion of the mining impacts on the aquatic resources may be found in Section 2.8.) The Burnout Canyon study resulted in the determination that no significant impacts had occurred to the stream drainage as a result of mining induced subsidence. While the gradient of the stream was flattened in a few locations and slightly increased in others, the overall change in the stream morphology was not significantly different than changes that occur in

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similar stream systems naturally. Biweekly flow monitoring and aerial photographic surveys continue each year as mining continues in the area. Additionally, three years of macroinvertabrate studies and two years of fish population surveys have been conducted starting in 2000. These studies are described in greater detail in Section 2.8.1.

The purpose of the Burnout Canyon study was to determine the impacts of undermining perennial streams in the Skyline Mine area. The intent of the study was to determine if significant impacts would occur by undermining the Burnout stream and, if no significant impacts occurred, then the Forest would consider allowing the undermining of perennial streams with similar geologic and geomorphic conditions to occur. Skyline Mine intends to undermine Winter Quarters Canyon based on the positive results of the Burnout Canyon study. Skyline has collected or committed to collect additional baseline data necessary to adequately monitor environmental parameters possibly affected by subsiding Winter Quarters Canyon.

When subsidence occurs, the subsidence cracks tend to seal rapidly, preventing the deep percolation and subsequent loss of water previously destined for springs and other water sources. The location of a spring may change by a few feet, but no significant loss of water is anticipated. The sealing of potential cracks will be accelerated where subsidence occurs under stream bodies, due to the natural deposition of silt in the stream channel along with the swelling of the shale.

Although the Blackhawk Formation contains partially or completely saturated sandstone channels above the proposed mine workings, a relatively small quantity of water is being encountered in the mine due to the impermeable nature of the formation, which limits the recharge rate and the ability of the rock to readily yield water. Ground water within the Blackhawk formation above the mine workings was determined in the 1996 PHC to be found within highly localized perched aquifers. The 1996 PHC evaluation failed to locate a regional ground water aquifer within the immediate area. The relatively small quantity of water being encountered in the mine was believed due to 1) the general impermeable nature of the formation, which limits the recharge rate and the ability of the rock to readily yield water, and 2) the local nature of local perched aquifer systems.

The inflow to the mine had been less than 100 gallons per minute per active face, with mine entries generally dry approximately 100 to 200 feet up-dip from the face. Some roof bolt holes, however, continued to flow up to 2 GPM for an extended period of time. However, in 2002 a fractured

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channelized sandstone was encountered during mining of the southwestern permit area which produced approximately 1,400 gpm. This was repeated at several locations in areas of Mine #2 until the mine was discharging approximately 8,500 to 9,500 gpm in August 2002 and 9,000 to 10,500 gpm in October 2002. Even though the large inflows have significantly subsided since October 2002, the near future mining activities have been directed toward the North Lease area.

The PHC for the Skyline Mine was updated by an Addendum to the PHC dated July 2002 and further updated in October 2002, April 2003, and June 2004. The addendum contains significant information regarding the large inflows to the mine. To better understand the hydrologic system and the water within the Star Point Sandstone, Skyline Mine contracted with Hydrologic Consultants, Inc. of Lakewood, Colorado produce a ground water model of the Star Point Sandstone. This model endeavored to delineate the possible areal extent of the aquifer, the volume of water contained in the aquifer, and the potential sources and discharge locations of the aquifer. The model has been used to help determine what, if any, impacts are occurring to the waters available in the mine area, including State appropriated water rights. The model was completed and improved in June 2004 and a copy of the report describing the results of the modeling effort has been added to the PHC.

As described in the July 2002 Addendum to the PHC, draining of the ground water contained within the Star Point Sandstone does not appear to have a significant impact on discharges of ground water in the mine or adjacent area nor does it appear that the water entering the mine is causing a loss of surface water in the Huntington or Price River drainages. The majority of the flows into the mine enter through faults and fractures that trend generally north-south to northeast-southwest. The flows move up through the floor of the mine in almost all cases. The water is apparently stored in the Star Point Sandstone under significant potentiometric head. Ages of the water indicate that water moves very slowly through the Star Point system in spite of the fractures and faults that appear to be open enough to allow water to flow freely into the mine in isolated locations. This suggests that the aquifer does not have a discharge point that releases large volumes of water nor is the aquifer replenished at a high rate of inflow. While the Star Point is exposed in out crop north, south, and east of the mine, significant volumes of water would need to be entering the system at an elevation great enough to create the potentiometric head encountered in the Star Point beneath the Mine #2 workings. Plate 2.3.4-2 illustrates changes to the potentiometric surface of the regional aquifer as result of extracting water from the mine from 2001 through 2013. During that period, the potentiometric surface has changed very little. The plate, in conjunction with studies by Petersen Hydrologic, Inc. (PHC Appendix M) suggest Skyline continues to monitor stream flows in Winter Quarters, Woods, Huntingtion, Eccles, and Mud Creeks to identify any impacts if they occur in these drainages related to the mine inflows. Plate 2.3.4-2 illustrates changes to the potentiometric surface of the regional inactive Star Point Sandstone aquifer as result of extracting water from the mine from 2001 through 2016. During that period, the potentiometric surface has changed very little while even showing a small recovery. Section 2.3.4 discusses qualifiers of using the potentiometric surface in complex geologic conditions.

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Mine #4 Flat Canyon Lease Area

In preparation of acquiring the Mine #4 Flat Canyon Lease area, additional investigations were conducted to evaluate impacts to both the active-zone groundwater and surface water systems of the Flat Canyon Tract, and the groundwater conditions in the Star Point Sandstone in the vicinity of the Skyline Mine. Appendix N – Investigations of Groundwater and Surface-Water Systems in the Flat Canyon Tract and Adjacent Area; Probably Hydrologic Consequences of Coal Mining in the Flat Canyon Tract, Sanpete County, Utah, utilizes multiple years of data to demonstrate minimal effects to the hydrologic balance are anticipated to both the quality and quantity of the near-surface, active-zone groundwater and surface waters due primarily to the geology, and based on over 30-years of mining in the area. The potential for loss of surface waters to the deep groundwater system are minimal based on 1) overburden thicknesses greater than 1,000 feet, and 2) the underlying bedrock formations have low permeability, are lenticular, and discontinuous. PHC Addendum Appendix O and P (Petersen Hydrologic, Inc. 2016 and 2017) reinforce previous studies that indicate the primary source of the water encountered in the floor of the mine is from a large inactive, body of water, fed by faults that have the ability to draw water from a significantly large area, transporting the water using a system of regional faults. This is dual-porosity hydraulic conductivity is demonstrated in how the local potentiometric surface does not continue to draw down with pumping, yet shows relatively good recovery when pump water from the mine is reduced.

The availability of groundwater and surface waters should not be impacted by mining in the Flat Canyon tract when considering 1) the water monitoring data in the Star Point Sandstone and Blackhawk Formation, 2) reviewing the stable and unstable isotopic analysis, 3) the Microscopic Particulate Analysis (MPA), 4) the aquifer temperature data, and 5) the chemical data, Appendix P (PHC Addendum Volume 2) provides an updated detailed discussion of these criteria. The evaluation of the information continues to suggest the active-zone, near-surface groundwater system (primarily of the Blackhawk Formation) and the inactive-zone deep, groundwater system (Star Point Sandstone) are not in direct communication, with water in the Star Point Sandstone having a residence time measured in thousands of years. The water monitoring of the active-zone surface springs and streams have shown no sign of impact while the water encountered in the mine continues to indicate the water discharged is thousands of years old. As an additional qualifier stated in PHC Appendix N, the groundwater storage reservoir for the Star Point Sandstone is more than 1,000 feet thick, and covers a minimum of 36 square miles in the vicinity of the Mine. Although approximately 3.4 billion cubic feet of water has been discharged from the mine, it theoretically represents approximately a 22-foot thick sandstone portion of a sandstone 1000-feet thick.

As mining continues in Mine #4 west of Electric Lake and further down-dip in the Blackhawk Formation, it is likely mining will encounter water as fault-zones are encountered. Similar to conditions observed in Mine #2, these fault-zones can often act as a conduit for water from the inactive Star Point Sandstone to enter the mine. "In some cases, the fault plane and any associated damaged zones can facilitate the movement of water along these structures. In other instances, particularly where faults intersect clay-rich strata, the potential for groundwater movement through the fault and its associated fault gouge is low (Petersen Hydrologic, 2017)." Mining experience has demonstrated that a fault can be drilled or mined through numerous times. In anticipation of this inflow of old-age water (noted in detail in Appendix P), mine personnel have engineered a pumping system to manage up to approximately 15,000 gpm of discharge.

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The 15,000 gpm is based on inflows experienced in Mine #2 where a maximum inflow was approximately 8,000 gpm. Being further down-dip the Star Point Sandstone increased inflows are anticipated. Prudent engineering suggested a doubling of the highest inflows thus far encountered were appropriate. It is noteworthy that mine-water discharges from the Mine #2 area have declined substantially from more than 8,000 gpm in early 2003 to less than 2,000 gpm in 2016. Although there are other contributing factors such as flooding much of the workings, the lowering likely reflects a local lowering in the hydraulic head of the Star Point Sandstone groundwater system (Petersen Hydrologic, 2016). The U.S.D.A. Forest Service (2002) suggests that the mechanics of the Star Point Sandstone groundwater systems are not well understood. Within the Star Point Sandstone, groundwater flow occurs primarily where the sandstone bedrock is significantly fractured or faulted. In areas of unfractured Star Point Sandstone, discharge from the bedrock as springs is rare, and major springs are only associated with fault systems (Bills, 2000). This is evident in the JC-1 and JC-2 wells where JC-1 is a smaller well yet pumps significantly more water from a fractured zone, while JC-2 completed in the unfractured Star Point Sandstone produce only a fraction of the water. However, the 13+ years of pumping from this groundwater system has had minimal effect on the local potentiometric gradient (illustrated on Plate 2.3.4-2), suggesting additional pumping from this system in Mine #4 will not depressurize the system sufficiently to change the confined aquifer characteristics significantly. Refer to Section 2.3.7 (Water Monitoring Program) for added in-mine and Star Point Sandstone water monitoring commitments.

Water pumped from the inactive Star Point Sandstone should not impact the water quantity and water quality in streams and groundwaters discharging from springs and seeps from the shallow active-zone groundwater systems in the Blackhawk Formation. Appendix P details the characterization of the Star Point Sandstone as an inactive aquifer that has not been in communication with surface waters for thousands of years. This is documented with the radiocarbon dating of in-mine waters. Similarly, the nearest proposed Flat Canyon Tract underground workings are located more than 1.5 miles northwest of locations near the dam where Star Point Sandstone bedrock is mapped beneath the reservoir. As described above, the deep, inactive-zone groundwater systems typically intercepted in the Skyline Mine underground workings are not believed to be in good hydraulic communication with overlying shallow groundwater systems. For these reasons, it is anticipated that mining in the Flat Canyon Tract will not appreciably impact shallow groundwater systems that may be present that are associated with the presence of the Electric Lake surface water body (i.e. it is considered unlikely that shallow groundwater systems near Electric Lake will be in good hydraulic communication with the deep, inactive-zone groundwaters that are anticipated to be intercepted in the proposed underground Skyline Mine workings in the Flat Canyon Tract. Further, it is considered unlikely that the Electric Lake water surface would provide a constant head source for the deep inactive-zone groundwater systems in the Flat Canyon area) (Petersen Hydrologic, 2017)

As discussed in Section 2.3.4.5 Aquifer Characteristics of the Mine #4 Flat Canyon area, due to the complex geologic system in the area the potentiometric gradient is difficult to determine (Pate 2.3.4-2). It is noteworthy to mention that due to the age of the water encountered in the Star Point Sandstone, there is no significant modern use of the water. Otherwise the water that is thousands of years old would be getting replaced with modern water. However, since the Mine induces communication with the Star Point Sandstone its impacts to the surface and near-surface groundwater system has been considered. Plate 2.5.2-2 (Mine Pools Current (2016) and Estimated Final) illustrates the projected gradient of the Star Point

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aquifer both currently and at closure. Elevations of the mine-pools are based on a combination floor elevations and groundwater elevations of wells completed in the Star Point Sandstone. Pool volumes were calculated to hold approximately 9192.6 ac-ft in Mine #3, 4243.4 ac-ft in Old Mine #3, 6195.5 ac-ft in Mine #2 and 11,884.2 ac-ft in Mine #4, respectively (See Appendix S for calculations). Also included on the plate are the elevations of the mine openings to the surface. Current projections indicate Mines #2 and #4, when flooded at closure will fill to an approximate elevation of 8500 feet which is below both the Swens Canyon Vent Shaft (elev. 8710-ft) and the Mine portals (elev. 8573-ft). The Mine #3 workings (both 'Old Mine #3 and current) will fill to elevations of approximately 8,200 feet and 8,100 feet, respectively which is below both the Winter Quarters and Mine site portals. Based on these projections the flooding of the mine workings with Star Point Sandstone water will have minimal impact to the pre-mining flow path and surface hydrology. Moreover, with the inactive groundwater zone having no communication with the surface hydrology, no impacts to water quality are anticipated.

Also in conjunction with acquiring the Flat Canyon lease, the numeric groundwater modeling exercise that was initially conducted in 2002 through 2004 was reevaluated in 2016 (PHC Addendum Volume 2 – Appendix R). As a preface to the numeric groundwater model update, Appendix Q provides a general outline of the purpose, scope, and qualifiers of the more detailed numeric model that follows. The purpose of the initial modeling exercise was to determine whether all of the groundwater being encountered in the mine during that time could be sourced from the Star Point Sandstone. A primary caveat being that a typical numeric groundwater model initially creates a 'pre-inflow' steady-state conceptual model based on a well-defined aquifer, then models the transient model based on drawdown (or inflow data). Although drawdown/inflow was actively happening during the conceptual phase, the modeling exercise determined it was possible for all the inflow being encountered to be sourced from the underlying Star Point Sandstone; although the results were considered non-unique. From 2003 through 2015 significant portions of Mine #2 were allowed to flood to elevations of 160-300 feet above major mine inflow locations. During that time, in conjunction with the inundation of the mine workings, mine inflows decreased from approximately 4,000 gpm to less than 2,000 gpm, and the monitoring wells in the Star Point Sandstone showed some recovery. Using the original conceptual model with updated inflow and well data, the July 2016 update of the groundwater flow model (PHC Appendix R), was recalibrated. Although the model was updated with approximately another decade-worth of data, the ability to define a complex, hydrologic system with a limited number of monitoring locations is difficult. The 2016 model update suggests part of the observed recovery of the Star Point Sandstone is generated from a near-surface source. Two (2) scenarios for the recharge source are suggested: 1) water originating from the 'vertical recharge through the South Gooseberry fault from the shallow groundwater system', or; 2) water from 'Electric Lake, via a splay of the Diagonal Fault'. Ultimately, the source of the recharge and its mechanism is not clear. The modeling conclusions suggested the transient calibrations of both scenarios calibrated equally as well, and a combination of the two sources may be the most likely scenario.

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No springs or water production wells in the mine permit or adjacent areas have reportedly been negatively impacted by the large mine inflows. There has been some concern voiced by local government and private interests that water entering the mine is coming from nearby Electric Lake. However, data collected and analyzed by Skyline Mine for the purpose of determining the source of the inflows strongly indicates there is no significant connection between the surface waters and the mine waters. As stated previously, this is discussed at length within the July 2002 Addendum to the PHC.

Water encountered in the mine is either utilized underground as processed water or is pumped from the mine. Procedures for handling of mine water are discussed in detail in Section 3.2. Indigenous water associated with the coal will be removed from the area. This, however, will represent only a small fraction compared to the water flowing from the Wasatch Plateau. The water pumped from the mine is added to the flow of Eccles Creek and into Electric Lake and has a positive effect on the aquatic flow systems.

The construction of surface facilities utilized in conjunction with the Skyline Mines (yard areas, roads, conveyor lines, etc.) resulted in temporary increases in the suspended sediment concentration of the adjacent stream. However, because of the regulatory requirement that sediment control measures be provided for all areas of surface disturbance, concentrations of suspended material were significantly reduced. Minimization efforts, however, met with varying degrees of success.

Sediment control structures such as sediment ponds, Alternate Sediment Control Areas (ASCAs), and Special Exemption Areas (SEAs) are discussed in detail in Section 3.2 - Components of Operations, subsections 3.2.1 and 3.2.12, respectively. Following construction, areas such as extensive outslopes of roads and ponds, sediment control will be managed by temporary devices such as silt fences, straw bales, wattles, or vegetative matting until vegetation is established.
Implementing the sediment control structures listed above, minimal to no adverse effects to the hydrologic balance are anticipated with the construction of the Swens Canyon Ventilation facility.

Over long periods of time, groundwater in the Wasatch Plateau can be expected to flow towards the lowlands if not removed, passing through saline shales and emerging to augment streamflow with a dissolved solids content that significantly exceeds the concentrations found in the headwaters area. Because the Skyline Mines will act as interceptor drains, the groundwater that is brought to the surface from the mines has a much lower dissolved solids content than would have existed if the water was to continue its downward movement through shaley layers. Thus, the mines will have some beneficial impact on the chemical quality of water in the region.

The increased stream flow resulting from mine discharges, particularly during the summer low flow period, appears to benefit the Eccles Creek fishery by creating flow and temperature stabilization. The increased flows to Scofield Reservoir most likely benefitted the fish population in the lake by maintaining a sufficient level of dissolved oxygen to avoid a general fish kill that frequently occurs in the lake during periods of drought periods, such as has been occurring in the mine area since 2000. The mine has also been discharging large volumes of water since August 2002 with TDS concentrations only slightly higher than background levels. This good quality water flows to and is

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day limit or the mine would discharge less than 7.1 tons per day of TDS if the water had a TDS concentration greater than 500 mg/l.

A UPDES permit was obtained by PacifiCorp to operate the JC-3 mine dewatering well in James Canyon. This well will discharge high quality mine water to Electric Lake. However, since it is mine water, Skyline will be obligated under SMCRA to assure the quality of the water discharged is within the UPDES permit limits assigned to JC-3. Skyline will submit the required DMRs to the Division as required in Section 2.3.7.

Periodically, due to difficult recovery conditions or roof collapse, mining equipment is abandoned underground. Prior to leaving equipment underground, hazardous materials and lubricating fluids are drained when possible. Since the equipment is steel and not too different compositionally from the roof support throughout the mine, contamination to ground water from abandoned equipment is not anticipated.

Mining equipment such as longwall mining machines, roof bolters, and continuous miners, is made of high quality steel containing chromium, and is highly resistant to corrosion. Calculations of the corrosion potential of the steel used in long wall mining machines have been performed by the University of Utah Metallurgy Department (BLM 1998s). They determined it would take thousands of years for the metal to corrode away. The University of Utah (BLM 1998a) report indicated that the general conditions required to hasten the corrosion of this metal do not exist in the Utah mining environment. A map illustrating the location of equipment left underground is provided as Drawing 2.5.2-1. The drawing includes a description of each piece of equipment.

Because of the high alkalinity and low acidity concentrations in the area (differing normally by two orders of magnitude), acid drainage problems do not occur as a result of mining. This is supported by the fact that coal in the area has a low sulphur content. The pyritic sulfur content within the coal is approximately 0.10 percent. Approximately 0.931 pounds of Iron are taken out of the ground for each ton of coal that is produced. Assuming Skyline produces 3 million tons of coal per year, approximately 1,400 tons of Iron is extracted from the formation each year with the mining of the coal. On typical year, metal roof support associated with mining – on the order of 1,300 tons per year – is left underground. Over 25 years of water monitoring of the natural waters surrounding the Mine does not show any degradation in water quality.

Skyline Mine anticipates potentially discharging approximately 2,800 gpm of mine water to Eccles Creek after the completion of mining and subsequent abandonment of the 11 Left, 12 Left A and B, and 6 Left B panels in 2004. However, this rate may vary with changes in the operation of JC-3 and because of the steady decline in potentiometric head within the aquifer discharging into Mine #2. Assumptions used in developing the discharge
amount can be found in July 2002 Addendum to the PHC in Appendix F.

The JC-3 well pumped water from the Mine from August 2003 through June 2004, and then October 2007. The pumping of the well was discontinued due to an inability of the discharge to meet the water quality standards in Electric Lake (255 mg/l, TDS). Skyline began discharging water from Mine #2 into Eccles Creek beginning in September 2004. From 2003 into 2014

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discharges from Mine #2 have significantly declined from more than 8,000 gpm to approximately 2,000 gpm.

PHC Addendum Volume 2 Appendix O assesses the groundwater conditions in Star Point Sandstone discussing impacts on the aquifer since significant inflows and pumping began in 1999. The observations include: 1) the drawdowns noted in the monitoring wells are consistent with removal of substantial quantities of groundwater from storage; 2) potentiometric levels in the Star Point Sandstone recovered significantly in mid-2003 in response to flooding the southwest portions of the mine to the 8,300 feet elevation; 3) water levels of wells completed in the Star Point Sandstone respond to pump-rate variability at JC-1 demonstrating a hydraulic interconnectedness between the two; 4) discharge rates at CS-14 (mine discharge from the flooded portion of the mine) suggest pumping variability at JC-1 impacts discharge rates at CS-14, (but not at equal rates) with CS-14 needing to increase pumping less; 5) discharge rates from CS-14 have declined substantially, reflecting a local lowering of the hydraulic head in the Star Point Sandstone; and 6) most monitoring wells have recovered substantially as water from the Star Point continues to be pumped from JC-1 and CS-14 suggest there is still a large quantity of water in the system. Based on the observations noted, it is anticipated that mining in the Flat Canyon lease will intercept water-bearing faults or fractures with considerable inflows. Moreover, the Star Point system has likely not been dewatered or depressurized sufficiently to expect appreciably reduced inflow rates or durations. Although the groundwater inflow complicates mining it is anticipated to have minimal affects to the long-term hydrologic balance of the Star Point Sandstone aquifer.

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The water consumed in operating underground equipment, dust suppression, and evaporation is obtained from ground water sources within the mine. These underground water sources are not connected to the surface waters in

portals. Monitoring at the portal site location, which lacked continuous electrical power, required portable electrical generation and supervision for each 24-hour sample period. Ten samples were taken coinciding with sampling days at the Boardinghouse Peak facility. TSP samples were also collected on a three day basis at the mouth of Eccles Canyon, near Clear Creek, Utah, which is the location of the train load-out facilities for the Skyline facilities for the Skyline Mines.

2.6.2 Synopsis of Data

A summary discussion of the Radian Corporation report follows.

The results of the meteorological and air quality studies indicate that the air quality of the Skyline project area is very good to excellent. Air in Eccles Canyon during 1979 was of poorer quality due to an unpaved dirt road leading from the mouth of the canyon up past the proposed portal site. The Permittee, in conjunction with the State of Utah, through the Utah Resource Development Act, paved this road in 1982 to accommodate traffic, which resulted in a reduction of particulate emissions from road traffic.

Presented below is a summary of the monitoring program results from JanuarYl1, 1979 through December 31, 1979.

See Section 4.22 - Air Pollution Control Plan for current Air Quality permit.

Boardinghouse Peak - Monthly averages

	Low	High	Average
Wind Speed (MPH)	11.7	17.1	14.7
Temperature (OF)	18.4	57.6	37.3
Pyranometer (Langleys)	151.2	678.5	413.5
Net Radimeter (Langleys)	31.5	294.1	150.2
Total Suspended Particulates *(ug/cu.m)*	23.0	49.5	30.3

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Vegetation

2.7.9 North of Graben (NOG) Bleeder Shaft

The NOG Bleeder Shaft is constructed to provide adequate ventilation for completion of the North of Graben mining district. The shaft was necessary due to encountered geologic conditions that required turning two (2) separate mining districts into one (1). The facility will include one (1) 5-foot diameter, unlined shaft. The area permitted for the bleeder shaft is approximately 3.0 acres, with a disturbed area of approximately 1.7 acres. Both soils and vegetation information specific to the site were collected in 2014 prior to construction. In general the NOG Bleeder Shaft site encompasses a mix of musk thistle, cheatgrass, bluebunch wheatgrass, and aspen on south-facing hillside located approximately 200 feet downhill from the existing Granger Ridge USFS road. A portion of the new access road will be constructed is located in an aspen area that had been disturbed previously by other activities, and appears to have been later re-seeded. Attempts were made to minimize the size of the pad utilizing the existing flat areas adjacent to the USFS road, but geologic conditions prohibited placing the shaft on the road. No threatened or endangered species were identified. The vegetation report is located in Appendix A-2, Volume 2 (Vegetation of the NOG Ventilation Site 2014, Mt Nebo Scientific).

2.7.9 Swens Canyon Ventilation Facility

The Swens Canyon Ventilation Facility (SCVF) was necessary to provide both ventilation and power for underground mining in the Flat Canyon Lease – Southwest Reserves portion of the mine. Both soils and vegetation information specific to the SCVF site were collected in 2014 prior to construction. In general, the SCVF pad site encompasses a sagebrush and mountain brush south-facing hillside. The existing access road up Swens Canyon was modified slightly, moving it closer to the creek to better utilize a generally flat portion of the valley upland area to minimize the disturbance of constructing the SCVF access road. No riparian vegetation was disturbed. No threatened or endangered species were identified. The vegetation report is located in Appendix A-2, Volume 2 (Vegetation of the Powerline Corridor & Swens Canyon Pad 2014, Mt. Nebo Scientific).

2.7.10 Flat Canyon Lease Area

The Flat Canyon Environmental Impact Statement (EIS) prepared by the US Forest Service (USFS) and the Bureau of Land Management (BLM) in 2002 determined there were no threatened and endangered, or sensitive species present in the lease area. In February 2013, Allen Rowley, Acting Forest Supervisor for the Manti LaSal National Forest determined the 2002 EIS was current and did not need additional updating. As described in the EIS the area is comprised of approximately 2.5% grasslands, 2% meadows/wetlands, 24% sagebrush/grass, 27.5% conifer-timber, and 44% aspen (Flat Canyon Coal Lease Tract – Final Environmental Impact Statement (FEIS), January 2002, (Section3.17 pg. 3-25. Included as Figure 2.7.9-1 (pg. 2-63b) is FEIS Figure 3.5 Vegetation Types which illustrates and broadly defines the location of vegetation communities. The EIS considered surface disturbance, there is no surface disturbance currently proposed in the Southwest Reserve Flat Canyon lease area and no impacts to the existing vegetation are Mine Vegetative Analysis of Seven Proposed Drill Sites and Seven Reference Site" is included in Appendix A-2, Volume 2. The report not only provides reference areas spread throughout the area, it also includes federally listed threatened, endangered, Candidate, and Sensitive Species for Emery and Sanpete County indicating none of the species listed are found within the project area.

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To address Special Stipulations for Coal Lease UTU-77114 #'s 8, and 27, the following vegetation monitoring program will be initiated while mining in the Flat Canyon Lease area. The vegetation community potentially impacted adversely by mining are primarily riparian areas. The only mining scenario potentially impacting the riparian areas would be where subsidence of the creeks, through longwall mining, significantly reduced the surface flow to the creek. Any significant decrease in flow will be documented through the water monitoring program outlined in Section 2.3 or the Subsidence monitoring and Stream gradient monitoring outlined in Section 4.17 of this M&RP. Since established riparian areas naturally react slowly to seasonal climatic variations, a reduction in flow potentially due to mining would elicit a similar response. Baseline riparian vegetation evaluations will be collected prior to undermining the various creeks (See Figure 2.7.9-2 (page 2-63c for baseline vegetation evaluation locations). If quarterly water monitoring flow measurements fall below the recorded historic low-flow values (not associated or explained by climatic seasonal variation) additional monitoring will continue on an annual basis until the cause of the lower flows is determined. A comparison of seasonal low-flow versus historic low-flow data observed on the creeks in the Flat Canyon area, will be included in the Annual Report. No follow up vegetation monitoring will be conducted following the baseline survey unless historic low flows are observed during mining activities. The vegetation monitoring method will follow techniques outlined by Winward (2000) incorporating data such as the Greenline Successional Status, Riparian Successional Status, and Greenline Bank Stability (see Appendix A-2, Volume 2 for detailed vegetation monitoring methods). Following the collection of the baseline data, the vegetation monitoring will continue annually until conditions improve or the need for mitigation is determined. In the unlikely event it is determined that mining-related subsidence causes material damage or a loss of riparian habitat, the Permittee commits to using the best technology currently available (BTCA) to mitigate the damage. The repair efforts will be coordinated and agreed upon by Mine, DOGM, and USFS personnel.

In Eccles Creek an opposite situation may occur with mine water discharges possibly increasing to volumes found to be erosive. A study of the geomorphology of the stream has been conducted multiple years from 2002 through 2006 where the creek appeared to be stable. This study was re-established in 2015 and will be conducted again annually if mine discharges are consistently greater than 7,500 gpm (see section 2.5 of M&RP for details). Riparian vegetation along Eccles Creek was evaluated in the baseline vegetation study conducted by Welch & Murdock in 1980, (see Appendix A-2, Vol 1). In order to make this baseline data comparable to current and future data, this data will be evaluated using the Winward (2000) criteria to determine the baseline successional state for future comparison. An interim riparian vegetation study was conducted in 2016 to evaluate the current riparian successional status. Follow up vegetation surveys will be conducted if warranted by the geomorphic studies. In the event it is determined that mining-related discharge flows cause material damage or loss of riparian habitat, the Permittee may use BTCA to mitigate any damage. The repair efforts will be coordinated and agreed upon by Mine, DOGM, and DWR personnel. It is anticipated that at the cessation of mining, stream-flow will return to the pre-mining condition, with the riparian vegetation showing a similar transition within a short time.

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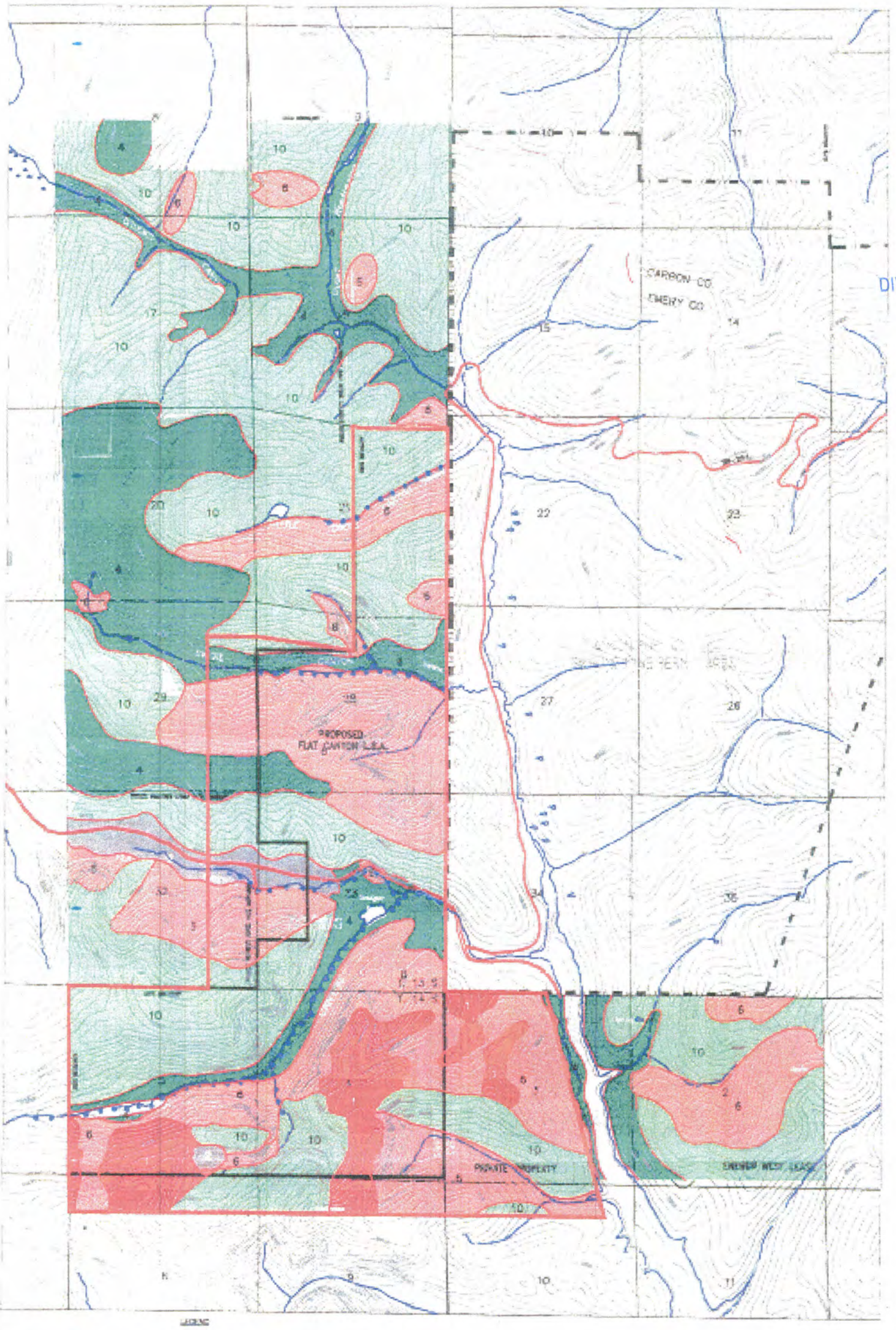

FIGURE 3.5

VEGETATIVE TYPES

DWG: VW3-1.DWG	SCALE 1" = 2000'		
DATE: 10/18/2000			

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

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Figure 2.7.9-1
Vegetattive Types

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435-448-2632	DATE: 6-30-16	CK.BY: GGalecki	REVISION: 0
CAD FILE: Figure 2.7.9-1 pg2-63b Rev0.dwg		DR.BY: BBailey	
Figure 2.7.9-1		Pg. 2-63b	12-30-16

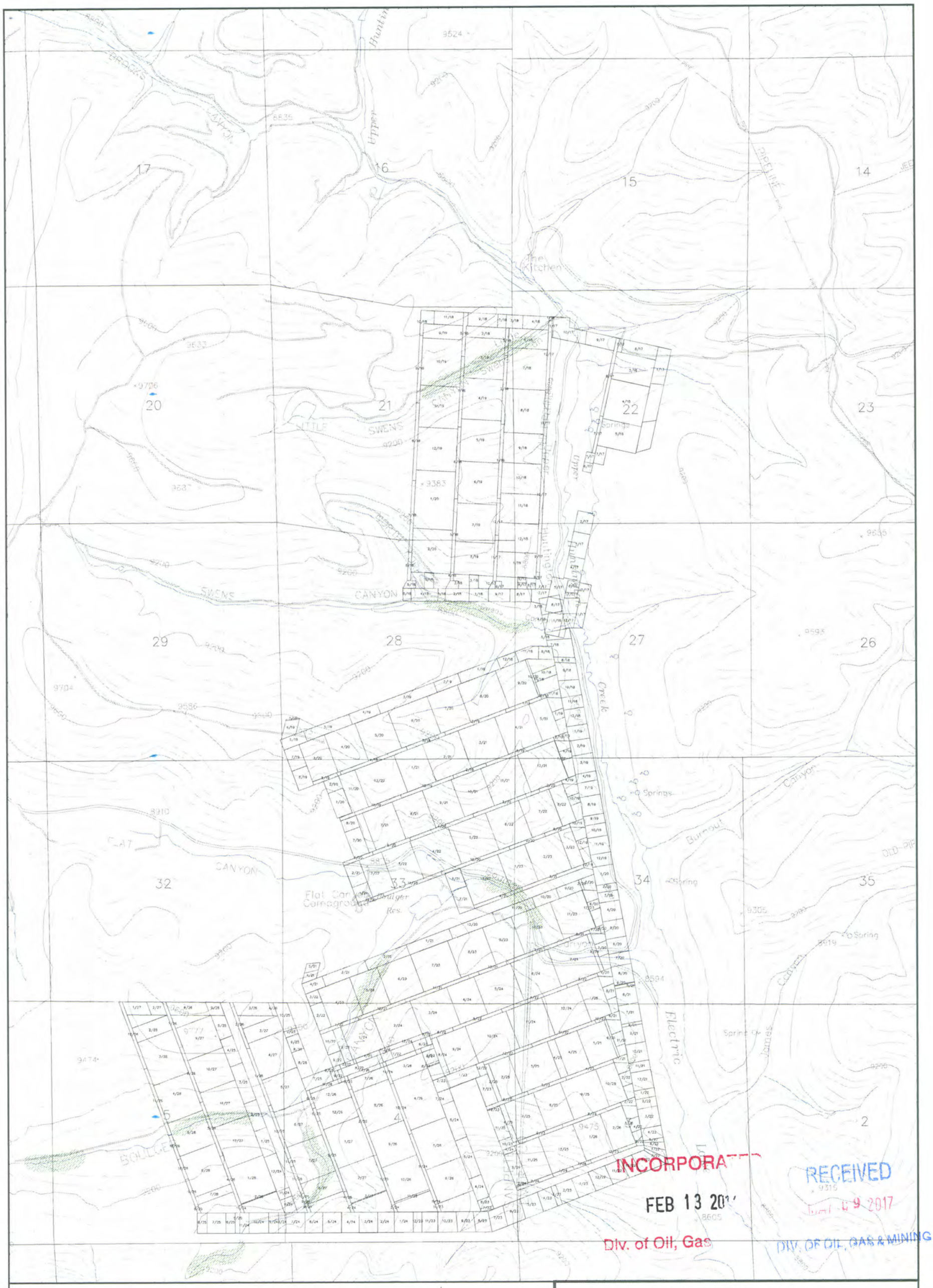

Figure 2.7.9-2
Riparian Vegetation Evaluation

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435-448-2632	DATE: 6-30-16	CK.BY: GGalecki	REVISION: 0
CAD FILE: Figure 2.7.9-2 pg 2-63cRev0.dwg		DR.BY: BBailey	12-30-16
Figure 2.7.9-2		Pg. 2-63c	

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2.8
Aquatic Wildlife

Huntington Creek has a diverse aquatic community with macroinvertebrate taxa representing all trophic levels. The successful cutthroat trout spawning and high number of resident trout evidence the high quality waters and habitat of Huntington Creek plus the ability of the macroinvertebrate community to support quality fisheries. Cutthroat trout, Tiger trout, and Kokonee salmon according to Utah Division of Wildlife Resources (UDWR) surveys, are increasing in numbers in Huntington Creek above Electric Lake. Tributaries to Upper Huntington Creek include Boulger, Burnout, Swens, and Little Swens canyons which contribute in various degrees to the habitat, with Boulger Creek providing the most suitable amount of habitat. Trout produced in Huntington Creek provide an important part of the total number of fish in Electric Lake.

Winter Quarters Canyon Creek

As indicated in the 1995 environmental assessment prepared by the Forest Service and the Bureau of Land Management Winters Quarters Canyon Creek has a moderate population of macroinvertebrates. Perennial flow in the canyon has produced Stonefly larvae as far up as Box and Bob=s Canyons. Mayfly nymphs were also found present in waters tested. Cutthroat trout were found within the creek east of the Forest Boundary on June 7, 1994 indicating fish are likely within perennial sections of the creek containing significant flows. A survey conducted in Winter Quarters Canyon Creek in October 2002 indicated similar conditions and species (See Appendix Volume A-3, Volume 2). The Winter Quarters Ventilation Facility pad was specifically designed to minimized any potential impacts to the stream. The pad was designed to stay a minimum of two(2) stream widths from the stream, (or approximately 24 feet), thus maintaining a buffer zone and avoiding impacts to both the stream and riparian areas. The macroinvertebrates are monitored on a scheduled basis to insure the health of the stream (see Plate 2.8.1-1 for locations, Table 2.8-1a for monitoring frequency). Refer to Section2.4.3 - sediment yield and next section for measures implemented to construct in the stream buffer zone.

Woods Canyon Creek

As indicated in the 1995 Environmental Assessment, Mayfly nymphs were found within the upper portions of Woods Canyon Creek in higher quantities than those found within Winter Quarters Canyon. Stonefly larvae were also found as high as the fork in the stream near the center of Section 34 (T 12 S, R 6 E). No fish were seen during the 1994 field survey although some may have been present. A survey conducted in Woods Canyon Creek in October 2002 indicated similar conditions (See Appendix Volume A-3, Volume 2). Another fish survey was conducted in 2010 to serve as baseline information for expanded mining located approximately ½ mile east and further downstream than previously conducted. Similar with the earlier surveys the stream is relatively shallow and does not provided ideal fish habitat, however a total of eight (8) fish were identified. An addition of both a macroinvertebrate and a fish monitoring location were set up to insure monitoring stations are established downstream of mining activities to fully evaluate any impacts from mining. Details are outlined later in this section.

Fish Creek

The North Lease area was extended in 2013 to include approximately 770 acres in the Fish Creek drainage.

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2.8.1 Aquatic Monitoring Program

An aquatic monitoring program has been conducted to meet the intent of the requirements of R614-301-311. The main purpose of the monitoring program is to gain sufficient knowledge to prevent and/or minimize impacts through wise project planning. Monitoring has: (1) described existing resources; (2) detected existing perturbations; and (3) provided the basis for wise project planning, operation and resource restoration.

The biological (macroinvertebrate and fish) and habitat (sediment and channel surveys) monitoring stations on Eccles Creek are shown in Figure 2.8-A. Sampling dates are limited by weather, but June and late October samplings are usually possible. Two seasonal sampling dates per year are required to differentiate natural seasonal intrastand variance from impact induced changes. Samples were taken annually through the project planning and early development. The biological sampling has been performed in conjunction with normal stream water monitoring so that comparative analysis is possible.

Seven stations on Eccles Creek were selected in relation to impact areas, UDWR fish sampling stations, existing macroinvertebrate and sediment stations, and water quality monitoring stations. At each station on the scheduled sample date (Table 2.8-1), four macroinvertebrate samples were taken from selected optimal substrates with a modified Surber Sampler. Three sediment samples were taken from potential spawning grounds. Replicate samples were taken to enable an analysis of variance between samples.

Habitat surveys, following methodologies used by USBLM and USDFS fisheries habitat specialists, were made annually throughout construction at critical Eccles Creek stations (Table 2.8.1). Measurements included: stream bank stability, channel substrate composition; stream gradient; riparian vegetation (type, relative cover); water width, depth and velocity at various discharges (Q) and channel width and tortuosity.

Fish surveys are usually made in August so year class I fish will be large enough to sample and young-of-year fish are large enough to observe. Fish are measured as to total length and weight, counted and then released. These data are compared with earlier UDWR collection records, thus illustrating present fish population conditions compared with years past.

Table 2.8-2 summarizes the stream monitoring data. A summary of the sediment composition data, taken in accordance with the schedule on Table 2.8-1, is shown on Table 2.8-3. The UDWR reports have been added to the Aquatic Wildlife section of Volume A-3.

Macroinvertebrate and fish monitoring was conducted by independent contractors from 2000 through 2013. The program was evaluated in detail with consultation with DOGM, USFS, UDWQ, and CFC personnel with modifications being initiated in 2015. As discussed later in this section, for each creek individually, Eccles Creek the macroinvertebrate sampling frequency was modified while both the macroinvertebrate and fish monitoring surveys were discontinued in both Winter Quarters and Woods Creek.

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James and Burnout Creeks

A fish and macroinvertebrate monitoring program for James and Burnout Creeks were implemented prior to undermining the lower portion of James Canyon. The fish survey consisted of multi-pass electro fishing to estimate fish populations in the streams for one year and then every third year thereafter. The fish surveys were performed in the fall of each third year on or about the same date, and were continue through a minimum of two (2) years following active subsidence. The fish survey was initiated on October 16, 2000 and completed in 2007.

A macroinvertebrate survey of Burnout Creek was performed twice a year for two consecutive years and then every three years thereafter. This survey was performed in the fall and spring of each year, with the fall macroinvertebrate survey being performed in conjunction with the fall fish survey. The macroinvertebrate survey was initiated on October 16, 2000 and completed in 2008.

A macroinvertebrate survey of James Creek initiated on October 16, 2000 was performed twice a year for two consecutive years and then every three years thereafter or for a period determined by Canyon Fuel Company, LLC, DOGM, USFS and the DWR, to be long enough to provide data to establish population trends . This survey will be performed in the fall and spring of each year on or about the same date. The fall macroinvertebrate survey will be performed in conjunction with the fall fish survey. (See Table 2.8-1a for Sampling Scheduled).

The following methods have been used previously on this creek and will continue to be used for future macroinvertebrate sampling. Slight variations to the methods may occur during the field work or based on comments from regulatory agencies.

Three benthic sites will be sampled. They will be located beginning approximately 162 meters (528 feet) above the reservoir. Refer to Plate 2.8.1-1 for all macroinvertebrate sample site locations. Note that macroinvertebrate sites sample reaches of a stream - site locations are plotted at the approximate mid-point of the reach of the sample site.

Quantitative samples will be taken with a modified box sampler. The three samples taken will be field preserved in 70% ethyl alcohol and returned to the laboratory for processing. The samples will be sorted and invertebrates identified to the lowest possible taxonomic level using the keys of Merritt and Cummins (1996). Those of questionable identity will be further examined and identified under magnification. The mean, standard deviation, density per square meter, and standing crop will be calculated and estimated using the same methods as in previous analysis.

Calculations of the USFS Biotic Condition Index (Winget and Mangum 1979) will be completed using the abundances of the benthic taxa to generate the dominance weighted community tolerant quotient (CTQd). The predicted community tolerant quotient (CTQp) will be calculated using water chemistry data provided in Winget (1972) for the Huntington Creek drainage

Cluster analysis will be run using the Bray-Curtis dissimilarity index with the UPGM clustering algorithm.

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Boulger, Swens, and Little Swens Canyon Creeks

As indicated in the 2002 Flat Canyon Environmental Impact Statement (EIS) prepared by the US Forest Service (USFS) and the Bureau of Land Management (BLM) all three (3) creeks are considered third order streams providing varying contributions to the aquatic habitat. Both Swens and Little Swens provide little habitat for fish due to the shallow pools and predominance of riffles in the reaches potentially affected by undermining. Based on the combination of minimal habitat and minimal reaches being undermined, only Boulger Creek will be monitored for fish. A fish monitoring program for Boulger Creek will be implemented prior to undermining the lower portion of the creek. The electro fish survey will estimate the fish populations in the stream for one year and every third year thereafter. The fish survey will begin one year prior to undermining any portion of the creek. Unless otherwise noted, sampling methods will be consistent with surveys conducted previously on James, Burnout, Eccles, Woods, and Winter Quarters creeks.

Boulger Reservoir is an artificial, man-made fishery that is restocked with fish on a regular basis throughout the fishing season. In the event Boulger Reservoir is undermined additional permitting will outline the mitigation of possibly draining the reservoir. All necessary regulatory agencies concerns will be addressed prior to undermining.

Winter Quarters Canyon and Woods Canyon Creeks

From Fall of 2002 through early Summer of 2004 fish and baseline macroinvertebrate data for the perennial reaches within Winter Quarters Canyon and Woods Canyon Creeks in the North Lease area were gathered. Copies of the reports are included in Appendix Volume A-3, Volume 2.

A macroinvertebrate survey of portions of Winter Quarters Canyon and Woods Canyon Creeks was performed twice a year for two consecutive years and then every third year thereafter or for a period determined by Canyon Fuel Company, LLC, DOGM, USFS, and the DWR, to be long enough to provide data to establish population trends. This survey was performed in the fall and spring of each year on or about the same date and completed in 2011.

Based on adequate data being collected, and the completion of longwall mining in Winter Quarters Canyon, macroinvertebrate surveys were terminated in both Winter Quarters and Woods Canyon creeks in concurrence with the various regulatory agencies in 2015. No impacts to the macroinvertebrate community based on mining were observed. Information supporting the ending of the surveys is available in Appendix A-3 (Skyline memo) and the individual macroivertebrate reports located in the Annual Reports. Monitoring in either creek could be re-established should conditions related to mining change.

In 2010 the Winter Quarters Ventilation Facility (WQVF) was added to the permit area approximately 2 mile downstream of the existing macroinvertebrate monitoring stations. Consultation with Dr. Shiozawa who directs the Skyline marcoinvertebrate monitoring program, indicated the portion of stream in the vicinity of the WQVF pad is not conducive to a macroinvertebrate study due to low gradient and inundation of fine sediment. He recommended a electro-fishing monitoring program which is outlined later in this section.

As mining progressed north of Winter Quarters Canyon, the longwall panel orientation was rotated 90 degrees to maximize coal recovery. The rotation expanded mining approximately ½ mile to the east. To accommodate the modification, an additional macroinvertebrate station and fish monitoring station were set up in Woods Canyon to insure monitoring stations are extablished downstream of mining activities to fully evaluate any impacts from mining. The additional electro-fishing monitoring station was added to Woods Canyon creek in 2010 although the stream is marginal fish habitat due to the shallow nature. Sampling frequency will continue every 3rd year unless future sampling confirms

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the habitat is unsuitable to sustain a viable fish population. See Appendix Volume A-3, Volume 2 for 2010 fish density report.

The following methods have been and will be used for macroinvertebrate sampling. Slight variations to the methods may occur during the field work or based on comments from regulatory agencies.

Three benthic sites will be sampled in each creek. Following the first survey a map with these stations will be prepared and submitted with the next sample report (included in the following year=s annual report). Quantitative samples will be taken with a modified box sampler. The samples taken will be field preserved in 70% ethyl alcohol and returned to the laboratory for processing. The samples will be sorted and invertebrates identified to the lowest possible taxonomic level using the keys of Merritt and Cummins (1996). Those of questionable identity will be further examined and identified under magnification. The mean, standard deviation, density per square meter, and standing crop will be calculated and estimated.

Calculations of the USFS Biotic Condition Index (Winget and Mangum 1979) will be completed using the

abundances of the benthic taxa to generate the dominance weighted community tolerant quotient (CTQd). The predicted community tolerant quotient (CTQp) will be calculated using water chemistry data provided in Winget (1972) for the Huntington Creek drainage.

Cluster analysis will be run using the Bray-Curtis dissimilarity index with the UPGM clustering algorithm.

An electro fishing study was conducted in 2002 to examine 1) the species present in Winter Quarters Canyon; 2) determine if fish were present in Woods Canyon; and 3) determine how far upstream fish extended into either canyon. The one-time survey was conducted on request by the U.S. Forest Service (See Appendix A-3, Volume 2 for report).

Based on the addition of the Winter Quarters Ventilation Facility, beginning in 2010 two (2) electro fishing sites were established Winter Quarters Creek. Two sampling runs (150 meters in length), one upstream and one downstream of the WQVF pad, will be tested on an tri-year basis to monitor the general aquatic health of Winter Quarters Creek. Sampling is minimized to every third year to reduce the stress on the fish population. The fish studies were terminated after the 2013 survey due to adequate baseline information being collected, and the minimal impact from the Winter Quarters site. Electro fishing surveys could resume should conditions change, such as adding mine water discharge to the creek. Information supporting the ending of the surveys is available in Appendix A-3 (Skyline memo) and the individual fish reports located in the Annual Reports.
In the event mining causes quantifiable damages to fish populations, stream flows, or other negative impacts on fish or wildlife habitat, the mine will identify, research and implement measures sufficient to correct the problemsAreas where there is potential for habitat loss from subsidence are shown on Plate 4.17.3-1a. The consumption rate of water from mining activities is provided in Section 2.5.2.

Future aquatic monitoring is planned only on an as needed basis. Need will be established in conjunction with DOGM, USFS,, UDWR, and Skyline personnel and will be required only in case of a major perturbation in fish populations or other anomalous conditions. Monitoring data will be reviewed for mining related impacts, and, if found, a mitigation plan will be developed in conjunction with UDWR and UDOGM personnel. The Permittee will cooperate with UDWR in the investigation of any such conditions. This approach to future monitoring is consistent with the requirements recommended by the UDWR, Price office.

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Table 2.8-1a

Fish

Sample Site	End Date	2000 Spring	2000 Fall	2001 Spring	2001 Fall	2002 Spring	2002 Fall	2003 Spring	2003 Fall	2004 Spring	2004 Fall	2005 Spring	2005 Fall	2006 Spring	2006 Fall	2007 Spring	2007 Fall	2008 Spring	2008 Fall	2009 Spring	2009 Fall	2010 Spring	2010 Fall	2011 Spring	2011 Fall
Burnout	F, 2007		C		C						C						RC								
Eccles	ND				C						C						C						C		
James	F, 2007		C		C						C						RC								
Winter							C																C		
Woods	RC						C																C		

		2012 Spring	2012 Fall	2013 Spring	2013 Fall	2014 Spring	2014 Fall	2015 Spring	2015 Fall	2016 Spring	2016 Fall	2017 Spring	2017 Fall	2018 Spring	2018 Fall	2019 Spring	2019 Fall	2020 Spring	2020 Fall	2021 Spring	2021 Fall	2022 Spring	2022 Fall	2023 Spring	2023 Fall
Eccles	ND				X						X						X						X		
Winter	RC - 2013				RC																				
Woods	RC - 2013				RC																				
Boulger																	X						X		

		2024 Spring	2024 Fall	2025 Spring	2025 Fall	2026 Spring	2026 Fall	2027 Spring	2027 Fall	2028 Spring	2028 Fall	2029 Spring	2029 Fall	2030 Spring	2030 Fall	2031 Spring	2031 Fall	2032 Spring	2032 Fall	2033 Spring	2033 Fall	2034 Spring	2034 Fall	2035 Spring	2035 Fall
Eccles	ND				X						X						X								
Boulger					X						X						X								

Macroinvertebrate

		2000 Spring	2000 Fall	2001 Spring	2001 Fall	2002 Spring	2002 Fall	2003 Spring	2003 Fall	2004 Spring	2004 Fall	2005 Spring	2005 Fall	2006 Spring	2006 Fall	2007 Spring	2007 Fall	2008 Spring	2008 Fall	2009 Spring	2009 Fall	2010 Spring	2010 Fall	2011 Spring	2011 Fall
Burnout			C	C	C	C	C	C	C	C							RC	RC							
Eccles	ND				C	C	C	C	C	C	C						C	C							C	C
James			C	C	C	C	C	C	C	C							RC	RC							
Winter	2yr ptm						C	C	C	C							C	C							RC	RC
Woods	2yr ptm						C	C	C	C							C	C							RC	RC*

		2012 Spring	2012 Fall	2013 Spring	2013 Fall	2014 Spring	2014 Fall	2015 Spring	2015 Fall	2016 Spring	2016 Fall	2017 Spring	2017 Fall	2018 Spring	2018 Fall	2019 Spring	2019 Fall	2020 Spring	2020 Fall	2021 Spring	2021 Fall	2022 Spring	2022 Fall	2023 Spring	2023 Fall
Eccles	ND								X		X						X		X						X
Boulger																	X		X						X

		2024 Spring	2024 Fall	2025 Spring	2025 Fall	2026 Spring	2026 Fall	2027 Spring	2027 Fall	2028 Spring	2028 Fall	2029 Spring	2029 Fall	2030 Spring	2030 Fall	2031 Spring	2031 Fall	2032 Spring	2032 Fall	2033 Spring	2033 Fall	2034 Spring	2034 Fall	2035 Spring	2035 Fall
Eccles	ND		X						X		X						X		X						
Boulger			X						X		X						X		X						

Key: C = completed, X = scheduled, ND = no end date, F = Fall, RC = requirements completed *

* (will re-initiate monitoring if conditions change significantly)

Reports located in the Annual Submitted to the Division of Oil, Gas, and Mining.

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Sec. 2.9
Terrestrial Wildlife

no fan is planned for the facility. The power line is buried through Upper Huntington to minimize visual impacts. Habitat loss through the power line corridor will be minimal as vegetation should be re-established in the following growing season. Habitat disturbed by the SCVF will be re-vegetated at reclamation at a lower woody-species density with an increased forb and grasses density to provide a better post mining habitat. Areas used for wildlife, logging, and grazing will be returned to their historic uses. Skyline commits to adhereing to any wildlife seasonal exclusionary restrictions that the US Forest Service employs.

2.9.7 WILDLIFE OF THE SOUTHWEST RESERVE - FLAT CANYON LEASE

Tables 2.9-1 through 2.9-7 provide both historic and current (2015) species list of mammals, amphibians, and reptiles whose published ranges exist in the general area of the Skyline Mine. A separate US Fish and Wildlife species list by counties identifies the threatened and Endangered species for the area and the likelihood of their presence (See Appendix A-3, Volume 2 for Alpine Ecological report). The list does not identify any specific species of concern for the project area. Figure 2.9.3-E illustrates the ranges for the Greater Sage Grouse. Brood-rearing habitat for the Greater Sage Grouse exists to the west of areas to be mined in the Flat Canyon lease with winter habitat existing to the northeast of the Skyline project area. However, No leks have been identififed in the lease or adjacent areas.

The Flat Canyon Environmental Impact Statement (EIS) prepared by the US Forest Service (USFS) and the Bureau of Land Management (BLM) in 2002 determined there were no threatened and endangered, or sensitive species present in the lease area. In February 2013, Allen Rowley, Acting Forest Supervisor for the Manti LaSal National Forest determined the 2002 EIS was current and did not need additional updating. A raptor/wildlife/sensitive species survey of the area was conducted in 2011 and 2012 which updated both the raptors and other wildlife in the area to meet the Special Coal Lease Stipulations #3 and #4 of Coal Lease Tract (UTU-77114) – (See Appendix A-3, Western Land Services, Inc. reports for details). The area is designated as crucial summer habitat for both mule deer fawning and elk calving. Although habitat for amphibians such as the boreal toad was found, no species of concern were present. An additional presence/absence survey was conducted in 2014 with no amphibians being found (report located in Appendix A-3 Volume 2). No impacts to Wildlife are anticipated with the Flat Canyon lease as no surface disturbance is associated with the lease.

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Sec. 2.10
Raptors

2.10.3 Raptors of the Flat Canyon Lease

The Flat Canyon Environmental Impact Statement (EIS) prepared by the US Forest Service (USFS) and the Bureau of Land Management (BLM) in 2002 determined there were no threatened and endangered species, or sensitive species present in the lease area. In February 2013, the Acting Forest Supervisor for the Manti LaSal National Forest determined the 2002 EIS was current and did not need additional updating. Although some habitat exists for the Bald Eagles (winter), migratory birds, Flammulated Owl, and the Three-toed Woodpecker exist in the area, no sightings have been noted. In addition, a raptor/wildlife/sensitive species survey of the area was conducted in 2011 and 2012, which updated the information for the area to meet the Special Coal Lease Stipulations #3, and #4, and #15 as outlined in the Flat Canyon Lease Tract (UTU-771114). (See Appendix A-3, Volume 2 for the Western Land Services, Inc. report for details). Because no surface disturbance is planned for the Flat Canyon lease area, no impact to endangered, threatened or otherwise sensitive species should occur.

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Sec. 2.12
Land Use

2.12 LAND USE

INTRODUCTION

The Skyline property, located in the northern end of the Wasatch Plateau coal field, is the site of a system of underground coal mines developed by Canyon Fuel Company, LLC. The general area of the Skyline property lies within Carbon, Sanpete, and Emery counties in Townships 12, 13, and 14 South and Ranges 6 and 7 East, approximately seventy-eight air miles southeast of Salt Lake City, Utah and twenty-two air miles northwest of Price, Utah (refer to Figure 2.12-A). The portal and yard area are located in Eccles Canyon just west of and within the National Forest boundary line. A Utah State highway (SR-264) runs past the portal yard area east down Eccles Canyon to a coal loadout facility located at the canyon mouth. A conveyor system parallels the road from the mine to the loadout facility at the mouth of Eccles Canyon. West of the town of Scofield, a facility which includes substation and fan is located in Winter Quarters Canyon.

2.12.1 Existing Land Uses

Pre-mining land uses of the Skyline property and adjacent area consist of wildlife habitat, grazing, recreation, natural gas transmission and forestry.

Wildlife Habitat

A listing of wildlife thought to inhabit the permit area may be found in Table 2.9-1. A more detailed discussion of the wildlife may be found in the consultants report in Volume A-2.

Grazing

Seven (7) National Forest Sheep allotments are contained partially within the North lease area (refer to Map 2.12.1-1). The addition of the Flat Canyon lease includes portions of the Eccles, Swens, Bear Canyon, and Boulger allotments. The numbers of livestock and season of use data for each allotment are contained in Table 2.12.1-1.

Private lands east of the National Forest boundary and west of the Flat Canyon Lease in Sanpete County (and within the USFS boundary) are grazed by similar numbers of sheep both before and after 7/1 to 9/30 (U.S. Geological Survey, 1979).

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TABLE 2.12.1-1

SHEEP ALLOTMENT DATA FOR THE FOUR ALLOTMENTS CONTAINED PARTIALLY WITHIN THE COAL LEASE AREA WITHIN THE NORTH LEASE AREA OFTHE SKYLINE MINE

Allotment	Sheep Numbers	Season of Use
Eccles Canyon	627	7/13 - 9/30
Granger Ridge	950	7/1-9/30
Bean Ridge	1048	7/1-9/30
Mansion	850	7/1-10/10
East Gooseberry	269 (USFS land)	7/1-10/10
East Gooseberry	581 (Private land)	7/1-10/10
French Creek	800	7/1-9/30
Swens	900	7/1 – 9/30
Bear Canyon/Birch Creek	1100	7/6 – 9/30
Boulger/Beaver Dams	1200	7/6 – 10/5
Burnout	942	7/1 – 9/25
Monument Peak	333	7/1 – 9/30
Bob Wright	1013	7/20 – 9/5
Trough Springs	1000	8/15 – 9/30

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Recreation

Recreational use of the lease area affected by surface operations consists primarily of hunting big game, game birds, and small game species; fishing in Eccles Canyon below the portal area; from the south fork to the mouth of the canyon sightseeing, snowmobiling, and cross country skiing. Limited camping and picnicking also occurred in the mouth of Eccles Canyon (U.S. geological Survey, 1979).

Eccles Canyon Road provides the only direct access from Scofield Reservoir to Huntington Canyon and is used as an access route from the Scofield Reservoir recreation area to the recreational use areas at higher elevations in the northern end of the Wasatch Plateau (U.S. Geological Survey, 1979). Mining in the vicinity of Boulger Reservoir and the adjacent Flat Canyon campground may potentially impact recreation in the future. At the time of lease acquisition, no undermining of Boulger Reservoir or the Flat Canyon campground is planned. An existing spring collection system that provides water to the campground may be impacted due to subsidence. In the event transmission of water is interrupted, the mine is committed to repairing any breaks to the line and will provide water as outlined in Section 2.5.3. Prior to any proposed undermining of either the reservoir or campground, specific mitigation will be determined in consultation with the Utah Division of Wildlife Resources, Utah Division of Oil, Gas, and Mining, US Forest Service (campground), and Canyon Fuel Company. Per Special Lease Stipulation #25 of lease UTU-77114, Prior to undermining, a plan will be submitted that outlines type of mining, when and how the dam will be taken out of service while subjected to mining-induced acceleration of 0.1g and greater, and what mitigation measures will be taken to place the dam and reservoir back into full service

Natural Gas Transmission

A natural gas pipeline traverses the permit area from southeast to northwest. Additionally, an abandoned gas well is located in the Eccles Canyon portion of the permit area. A small building associated with Gas Well No. 8 is located in Eccles Canyon. The location of these features are all shown on Map 2.12.1-1.

Forestry

Forest uses are limited primarily to cutting firewood and fence posts. Occasional timber sales from National Forest lands are made to salvage insect-killed spruce timber. One such sale, totalling 2.5 million board feet, was made in the Kitchen Creek drainage basin on the west side of the coal lease area in 1977.

Private Land - Winter Quarters Canyon, Flat Canyon Lease

Both current (20098) and historic Land uses of private land in Winter Quarters canyon are varied and include grazing, wildlife habitat, recreation - primarily hunting big game, game birds, and small game species, forestry or timber production, and mining related activities. Addition of the ventilation facility in 2010 is consistent with the historic uses. Land Uses of the private land in Flat Canyon include grazing, wildlife habitat, and recreation with the proposed mining not impacting the historic uses. Plate 2.12.1-1 has been updated to identify structures, primarily cabins located west of lease UTU-77114.

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Sec. 2.14
Prime Farmland

2.14 PRIME FARMLAND INVESTIGATION

A pre-application investigation was conducted by the Permittee to determine if any prime farmland would be impacted within the area of the proposed surface facilities in Eccles Canyon, and within Woods and Winter Quarters Canyons of the North Lease Tract. Based on the criteria in 30 CFR 783.27 paragraph (b), items 1 and 5, the Eccles Canyon area cannot be classified as prime farmland. This opinion is substantiated by Dr. Therom B. Hutchings, State Soil Scientist for the Soil Conservation Service (See Exhibit A).

A similar finding was made by the Natural Resources Conservation Service for the North Lease Tract (See Appendix Volume A-2). As shown in the Exhibit, Ano prime farmland or farmland of statewide importance occurs on the recently acquired North Lease@. Therefore, a negative determination for prime farmland classification of the Skyline project area is requested.

Leland Sassor of the Natural Resource Conservation Service (NRCS) was contacted in December 2008 concerning a Prime Farmland Determination in the location of the proposed Winter Quarters Ventilation Facility. Provided the information, he researched the area and confirmed (verbally) later that no Prime Farmland is identified in the area of the pad location. This is consistent with earlier determinations.
Joe Dyer of the NRCS was contacted in 2012 concerning a Prime Farmland Determination in the North Lease Modification expansion area. He determined no Prime Farmland exists in the lease expansion area (See Appendix Volume A-2 for his correspondence).

Joe Dyer was contacted again in 2014 for a Prime Farmland Determination for the Swens Canyon Ventilation Facility. A 'No Prime or unique farm lands' determination is included in Appendix Volume A-2, Volume 2 for both Swens Canyon and the Flat Canyon Lease area in the form of an email correspondence.

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Sec. 3.1
Operation Plan

Main entries in the mines are advanced so that mining panels may be developed on one or both sides. These panels are usually 2,500 to 7,000 feet long and 400 to 800 feet wide. The panels will be mined by driving rooms or by retreat-type operations where coal is mined as Room and Pillar Mining. Where feasible, the coal will be removed by a longwall operation. The panels will then be "pulled" consecutively to the barrier, leaving the main entries intact.

The mains developed to access the North Lease area will be driven through the SW1/4 SW 1/4 of Section 12, Township 13 South, Range 6 East. Multiple entries will be driven north from existing workings within the unsealed southeastern portion of Mine 3 workings (Drawing 3.1.8-2). As the mains approach the northeast portion of the abandoned Mine 3 workings, they will be angled downward to go under the abandoned workings instead of through. This portion of Mine 3 was flooded by pumping water from Mine 2 into Mine 3 beginning in March 1999. This pumping continued until August 2002. At that time, the water level in the abandoned Mine 3 was reduced in the abandoned portion of Mine 3 to an elevation below the northeast corner of Mine 3 and at or below the level of the new entries. Draining of Mine 3 continues as mining advances north, west and down dip of the Mine 3 workings. Removing the water from the abandoned portion of Mine 3 removes the risk of flooding the new entries from water in Mine 3.

The abandoned Winter Quarters Mine workings are illustrated on Drawing 3.1.8-2. The new entries to the North Lease area are driven at least 300 feet horizontally from the closest point in the abandoned Winter Quarters Mine. As required by MSHA, exploratory drilling was conducted at required intervals to ensure Skyline Mine does not intercept the abandoned Winter Quarters Mine.

In the North Lease, longwall mining is scheduled to commence in early 2006. Undermining of portions of Winter Quarters Creek and Woods Canyon creek are planned, but only minor surface subsidence is anticipated. A portion of land, approximately 397-acres, located on the north side of Winter Quarters Creek is identified as a potential first-mining area. Based on BLM recommendations for Maximum Economic Recovery (MER), the area will be mined by conventional methods should suitable conditions exist. No subsidence is anticipated in this area, should this area be determined to be mineable.

In 2007, due to a change in the longwall panel configuration in the North Lease located north of Winter Quarters Canyon an Incidental Boundary Change (IBC) modification was added to the permit. Development / conventional mining in portions of the S1/2S1/2 of Section 36, Township 12 South, Range 6 East, the W1/2 of Section 1, the W1/2SE1/4 Section 1, the N1/2 NW1/4 of Section 12, and the SW1/4NW1/4 of Section 12, Township 13 South, Range 6 East was added. The lease was modified again in 2013-2014 to include additional reserves in Sections 25, 26, and 34, Township 12 South, Range 6 East. No subsidence or surface disturbance is anticipated in this area based on the proposed activity.

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In 2014 rehabilitation of the West Mains location in Section 23, T13S, R6E began in preparation of longwall mining in the Flat Canyon lease, which includes mining of existing lease U-0147570 and Flat Canyon lease UTU-77114. This area of new development, leases U-0147570, UTU-77114, and other leases located west of Electric Lake is collectively named Mine No. 4. A portion of two-seam conventional mining was implemented in lease U-0147570 to drive a slope down to the Lower O'Connor A seam. The MSHA-approved slope interburden between seams was greater than 40-feet. Conventional mining will be used for development of longwall panels on the existing lease and for accessing lease UTU-77114 west of Huntington Creek. Longwall mining is scheduled to begin in approximately 2019 (See Plate 3.1.8-3 for timing). As outlined in Special Stipulation #10 for Coal Lease UTU-77114, "limited subsidence zones consisting of perennial streams in the lease, Boulger Reservoir/Dam, SR-264, and Flat Canyon Campground are specifically approved for subsidence resulting from a single-seam of full-extraction mining." Any future second-seam of full-extraction mining of Boulger Reservoir and Flat Canyon Campground will require approval of a specific plan including mining methods, monitoring of the various structures, and a detailed mitigation plan for both facilities as outlined in Special Stipulations for Coal Lease UTU-77114. The plan will be approved by the Authorized Officer (AO) of the BLM, with consent of the USFS, and any requirements by DOGM. In the initial permitting of the Flat Canyon lease submitted in 2016, no undermining of Boulger Reservoir or Flat Canyon campground is proposed. Any future undermining of the two facilities will require approval of a specific plan including mining methods, monitoring of various structures, and a detailed mitigation plan as outlined in the Special Stipulations.

Undermining of SR-264 will also planned for an approximately 4,500-foot section beginning approximately 1,500 feet east of the Electric Lake access and heading west. Overburden ranges from approximately 700-1300 feet. Using subsidence factors listed in Section 4.17 of the M&RP, the anticipated maximum subsidence will range from 0.3-0.5 feet. With the gradual effects spread over 1,300 feet, little impact is anticipated. Agreements with UDOT and how impacts will be mitigated are in Section 4.17. No longwall mining or subsidence is planned for Huntington Creek. The Flat Canyon lease, which includes mining of the two leases includes mining in Sections 21, 22, 27, 28, 29, 32, 33, and 34, T13S, R6E; and Sections 3, 4, and 5, T14S, R6E.

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The accepted procedure of superimposing certain structural features developed during the mining operations will be followed. The mains, submains and barriers will be columnized, as precisely as practical, so that the compressional forces will be transmitted from like bearing to like bearing areas in underlying seams.

The considerable experience of Europeans in multiple seam mining operations and that of U. S. operators in two seam mines has revealed that serious problems involving strata control could result if an attempt is made to extract seams separated by interburden of less than 30 feet. The Permittee will plan therefore to extract only one of the two seams in instances where interburden thickness is less than 40 feet. Development for Mine No. 4 required multiple seam mining under the West Mains, which required BLM and MSHA approval.

Mining Guidelines for Multiple Seam Mining

Generally accepted practices and design criteria and prior industry experience have been incorporated into the operational plan for ground control in the three seams in the Skyline permit area. The following practices will be used as guidelines:

1. When separated by less than 40 feet of interburden, only one coal seam will be mined.

2. Mining in a specific area of the upper seam will be completed two years before mining in the underlying area of the successively lower seam is initiated, or when subsidence is shown to have adequately stabilized.

3. Plans for three mines are laid out in a manner where protective barrier pillars for main entries, main haulways, fire barriers, primary air courses, bleeder entries and manways in each mne shall generally be superimposed regardless of vertical separation and quality of rock competency.

4. Verification will be made that major amounts of water will not be released from a mined-out area above before caving is commenced in a lower seam.

3.1.7 Plan for Protecting Oil and Gas Wells

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3.1.7 Plans for Protecting Oil and Gas Wells

There is no evidence of the presence of any active oil or gas wells except for two abandoned test wells as noted in Section 2.2.8. A detailed investigation has found no record indicating the presence of any gas or oil well which will be affected by the mining operations on the Skyline property at either the Utah State Division of Oil, Gas, and Mining or the American Stratigraphic Company at Denver, Colorado.

The Permittee has protected the abandoned test hole present at the surface facilities site and no mining activity will be undertaken in that area. The Permittee has installed an appropriate marker at the site indicating the presence of the test hole.

Portions of the Skyline permit area, however, are overlain by a natural gas pipeline belonging to Mountain Fuel Supply Company. The gas pipeline will be protected from surface subsidence by reducing reserve extraction such that no subsidence of the pipeline will occur. Because design parameters such as number and width of entries and projected lateral stresses cannot be adequately projected for a given area beneath the pipeline until mining is conducted within a reasonable proximity to that area (within approximately 1500 feet) exact pillar size cannot be projected at this time. In addition, due to the geologic complexity of the leasehold, detailed mining plans for all points beneath the pipeline are not presently feasible. Where the gas pipeline is located within a stream buffer zone the regulation and permit requirements for that zone will take precedent.

To ensure that subsidence will not occur along the pipeline, a safety factor of at least 1.5 will be utilized for pillar design when standard room and pillar design is utilized. If a yield pillar/barrier type design is used, it will be designed such that critical area has no influence on the surface

In the event of encountering unknown bore holes during mining operations which may have the potential of liberating gas or oil, all measures determined necessary by the BLM Mining Supervisor, in consultation with the appropriate BLM Oil and Gas Supervisor, will be implemented.

Records research using the interactive maps on the Utah Department of Natural Resources website and ground reconnaissance indicates no gas lines or oil wells or gas wells exist in the Flat Canyon Lease area that require protection.

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3.1.8 Mine Maps

Mine maps as required in R614-301-521.140 are provided and will be updated and submitted with the annual report. Maps 3.1.8-1 and 3.1.8-2 include mining details for mines 3 level 1 and mine 3 levels 2 and 3, respectively. Map 3.1.8-3 illustrates mining details for Mine No. 4.

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Sec. 3.3
Timing of Operation

3.3 TIMING OF OPERATION

The construction phase of the Skyline Mines project commenced in the summer of 1980. The construction phase included the dirt-work and installation of surface facilities and pre-mining activities such as driving the portal conveyor slope. The construction phase continued during 1982 with the installation of surface facilities and portals. Construction is expected to continue throughout the life of the mines to support and maintain the operation.

No. 3 mine commenced coal production in October 1981. The total period of coal production is expected to be 38 years: life of Mine No.1, 30 years; life of Mine No.2, 27 years; and life of Mine No. 3, 38 years. Plate 3.3-1 shows Mine No. 1 (Upper O'Connor Seam), Plate 3.3-2 shows Mine No. 3 (Lower O'Connor "A" and Flat Canyon Seams), and Plate 3.3-3 shows Mine No, 2 (Lower O'Connor B Seam. The timing and sequence of mining of any or all seams is dependent upon mining conditions. North Lease modifications are located on Plate 3.3-2.

Mine No. 4 was initiated in early 2015 with rehabbing portions of the West Mains and driving a slope down to the Lower O'Connor A/Flat Canyon Seam. At the completion of the first three (3) longwall panels, mining slopes back up to the Lower O'Connor B seam mining panels oriented west-southwest to east-northeast. The remaining mining in No. 4 mine slopes back down to the Lower O'Connor A / Flat Canyon with panels oriented north-northwest to south-southeast. The total period of coal production is estimated at approximately 12 years. Plate 3-3-4 illustrates the timing, sequence of mining, and the mining of the various seams in Mine No. 4. The timing and sequence of mining of any or all seams is dependent on mining conditions that are subject to change.

Cessation of Operation

Prior to any temporary cessation of the Skyline mining operations for a period of 30 days or more, or as soon as it is determined that a temporary cessation will extend beyond 30 days, the Permittee will submit to the appropriate regulatory authority a notice of its intent to cease or abandon operations.

The Permittee's notice will state the exact number of surface acres and extent of subsurface strata which had been affected by underground or surface developments in the permit area prior to cessation or abandonment of mining. The cessation notice will also state the extent and kind of surface reclamation completed to date and the backfilling, regrading, revegetation, environmental monitoring, underground opening closures completed. It will also state water treatment activities the Permittee plans to continue during the temporary cessation period. During periods of temporary cessation, the Permittee will effectively support and maintain all surface access openings to underground operations, and secure surface facilities in areas

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Sec. 4.17
Subsidence Control
Plan

area of the forest and will likely never be harvested (Carter Reed, Manti-La Sal National Forest, Oral Communication 10-2002).

Included in the Subsidence Probability Survey for Woods Canyon, Skyline contracted Agapito Associates, Inc. (AAI) to evaluate the subsidence impacts of conducting full-extraction mining in areas with as little as 400 feet of overburden (Appendix A-1, Vol.2). The AAI analysis utilizes a numerical model – Surface Deformation Prediction System (SDPS) (Agiotuantis and Karmis 2002) that incorporates, information from the Burnout Canyon area study, local geology, mining and subsidence data. The study predicted less than five(5) feet of subsidence would occur in the Woods Canyon area and mining could safely be conducted in areas with 475 feet of overburden. Other items identified in the AAI study inculde: 1) the average gradient in Woods Canyon (5.71%)is greater than in Burnout Canyon (4.12%) which suggests the hoizontal strain will be spread along a longer stream path and dampen direct impacts of tensile strain; and 2) the US Bureau of Mines (USBM) criteria for subsidence classifies Woods Canyon as having class III (shaley and silty sandstone) overburden, and the appropriate overburden thickness multiplier would be 461 feet. Incidentally, the same USBM report (1979) originated the 60 times the bodies of water of 'catastrophic' potential size such as large rivers and lakes. The 60 time the extraction thickness is a conservative generalization that somewhat mis-characterizes the USBM study recommendations.

Prior to acquiring the Flat Canyon Lease, additional mining was conducted in the Upper Huntington drainage in existing leases. The Swens Canyon Ventilation shaft was constructed to facilitate this mining. A pre-subsidence survey was conducted over the area to insure no adverse effects from subsidence would impact road SR-264, the proposed ventilation shaft or the power line. No buildings exist in the area. Plate 4.17-3-1A illustrates the anticipated areas of subsidence.

In the case of Boulger Reservoir and the Flat Canyon Campground, the existing overburden separating the coal seam from the reservoir is approximately 1,200 or roughly 120 times the extraction thickness. *No adverse impacts are anticipated, however the reservoir may be drained prior to undermining as a safety precaution.* Any necessary mitigation measures will be negotiated prior to actual undermining of the reservoir being conducted. Special Stipulations #25 and #26 for Coal Lease UTU-77114 (attached to lease in appendix 118-A outlines specific requirements that need to be met prior to undermining. Undermining of the reservoir and campground may occur at a future date.

Special Stipulations for Coal Lease UTU-77114 (#25 - #27) require prior plan approval from the Authorized Officer of the BLM, consent of USFS and other regulatory agencies prior to development of panels that would cause subsidence of the Boulger Reservoir. Specifics of the plan include type of mining, when and how the dam will be taken out of service while undermining and/or subjected to mining-induced acceleration of 0.1g and greater, and what mitigation measures will be taken to place the dam and reservoir back into full service. Similarly, a plan for undermining of the Flat Canyon Campground will require specific mitigation measures while it is out of service requiring multiple agency approval prior to mining. In addition, a detailed evaluation of the Flat Canyon campground drinking water system will be conducted to assess any future mitigation measures. The evaluation will include a detailed map of the system and any potential mitigation measures. Monitoring of perennial streams within the lease and any associated effects are discussed further in Sections 2.3, 2.7, 4.7, and 4.17.4 of this M&RP.

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4.17.2 Mining Methods

The mining methods to be used by the Permittee include longwall mining, room and pillar mining with pillar removal, and room and pillar mining with pillars left in place. Certain room and pillar mining systems are designed to provide full support and will prevent subsidence. Subsection 3.1.5 contains descriptions of the mining methods to be implemented.

Full extraction areas include room and pillar panels with pillar removal and longwall panels. Subsidence prediction work has shown the expected maximum planned and controlled subsidence will vary from 0 to 24 feet, assuming that the total cumulative extraction from the three mineable seams will not exceed 30 feet.

4.17.3 Subsidence Effect Prevention Measures

It is anticipated that the planned subsidence will result in a generally uniform lowering of the surface lands in broad areas, thereby limiting the extent of material effect to those lands and causing no appreciable change to present land uses and renewable resources. The Permittee established a subsidence monitoring program in the early stage of mining for use in reviewing the surface effect of mining and as an aid in future mine planning.

In areas where mining related subsidence would damage resources, room and pillar mining methods will be used. Wherever the pipeline and creek buffer zones coincide, creek buffer zone requirements take precedence. Where the yield pillar/barrier system is used, the critical area will not influence the surface. The width of the area of supportive mining is equal to 50 feet (25 feet on each side of the pipeline centerline no surface movement) plus the tangent of 22° draw angle as shown in the l988 Annual Report and included in Vol. 4, multiplied by the overburden depth of the mined coal bed:

- Nonsubsidence Mining Width = 50 feet + (2 X tan 22° x depth)

The width of the supportive mining area will be adjusted, as appropriate, when future information and monitoring shows it to be necessary.

The 22 degree draw angle is conservative and conforms to the Permittee's data on permit area subsidence as well as experience from other comparable mining activity in the Wasatch Plateau (Plate 4.17.3-1).

There will be no mining caused subsidence under either the Electric Lake Reservoir, Upper Huntington Creek and Boulger reservoir, and no mining from which subsidence at a 22-degree (from vertical) angle of draw would influence either these reservoir inlets or the high-water level of Electric Lake Reservoir. Any undermining of Boulger Reservoir will be permitted separately under a specific permit modification. The width of the buffer zone was calculated as follows:

- Buffer zone width = tan 22° x overburden depth

The width of the buffer zone has been calculated using the overburden depths to the coal seams. There is a very substantial tonnage of coal which lies to the west of Upper Huntington Creek and Electric Lake Reservoir, which the Permittee plans to mine.

Mains under the Huntington Creek (Drawing 3.1.8-3) will be a full support room and pillar mining system. These mains will be designed to avoid short or long-term surface affects from mining. Prior to abandonment of these mains,

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A section of a natural gas pipeline in the Burnout Canyon-Huntington Creek area was decommissioned in October 2000. Its replacement section was constructed in the pre-existing pipeline right-of-way on top of Trough Spring Ridge. Since the Trough Springs Ridge area will not be undermined again and subsidence from previous mining under this area is essentially complete, the Burnout Canyon-Huntington Creek portion of the pipeline is labeled as "old pipeline" on the mine maps and is still owned by Questar. However, it has been decommissioned by Questar to allow undermining by Skyline Mine. The future utilization and status of decommissioned portion of the pipeline is Questar's responsibility.

4.17.4 Mitigation of Subsidence Effects

Surface structures which may be affected by subsidence include the Permittee's buildings and facilities incidental to the coal operation, the natural gas pipeline which crosses the coal lease area, and roads within the area. No additional structures are located within the new UP&L lease area.

Should subsidence damage any of the surface structures despite the planned subsidence prevention measures, the Permittee will arrange for their repair. Any subsidence related damage to SR 264 will be repaired by the Permittee in accordance with the DOT Subsidence Impact Agreement dated July 17, 1989 (see Exhibit 1). With the addition of Flat Canyon Lease UTU-77114, the initial mining plan indicates approximately 4,500 linear-feet of SR-264 will potential be impacted by subsidence. The overburden ranges from approximately 700-1,300 feet with the maximum subsidence anticipated to range from approximately 0.3-0.5 feet. Spread over approximately 4,500 feet, minimal impacts are anticipated. Prior to undermining, the Permittee commits to coordinating with UDOT to insure repairs are prompt, and in accordance with UDOT standards.

Hydrologic information during a four year period (1984-1989) at the Skyline Mine indicates that there is a reasonably good correlation between the amount of mine water discharged from Mine #3 and the amount of coal mined (see Drawing 4.11.4-A). The mine water historically encountered in Mine #3 was produced from the Blackhawk Formation. Data from the approved water monitoring program Indicate mine dewatering is not affecting any surface springs or seeps. Water monitoring data suggests the migration of water through the aquifer in Mine #3 is extremely slow to the extent that the water should be considered "perched or trapped water." Since the North Lease mining will be occurring in the area adjacent to the previous Mine #3 workings and under the same geologic environment, similar inflow conditions are anticipated.

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In 2010 full extraction mining in Woods Canyon was extended ½ mile further east into areas with less than 600 feet of overburden. As a mitigating effort to monitor subsidence, a total of nine (9) piezometers or shallow groundwater wells have been established adjacent to the creek starting at the USFS boundary and extending east of the proposed mining. The piezometers were established to monitor the shallow groundwater adjacent to the stream to both determine whether Woods Canyon creek is an gaining or losing stream, and to gauge any flow impacts associated with mining.

As required in Special Stipulations for Coal Lease UTU-77114 #27, the stream gradient of perennial streams to be undermined will be monitored. Monitoring of the sections of perennial streams being undermined using longwall mining methods will be monitored both before and after mining takes place, with the information being added to Appendix A-1. The survey following mining will be conducted within the first year following complete subsidence. A report providing the pre- and post-mining survey will be submitted with the ensuing Annual Report. The method of monitoring will include an on-ground survey using survey-grade equipment encompassing the length of the stream channel beginning upstream of the anticipated zone of subsidence, through the subsidence zone, and terminating downstream of the subsidence zone. If necessary, this information will be used in any future mitigation with efforts coordinated through consultation with the Division.

If it is determined that subsidence causes material damage or a loss of flow in a perennial stream, the Permittee commits to using the best technology currently available (BTCA)to mitigate the damage. Methods may include backfilling with surrounding native material, incorporating bentonite or other water-retaining native material into the backfill, or possibly even temporarily bypassing/piping flow through impacted areas until mitigation is achieved.

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Canyon Fuel Company, LLC
A Subsidiary of Bowie Resource Holdings, LLC

Skyline Mine
Corey Heaps General Manager
HC35, Box 380
Helper, Utah 84526
(435) 448-2615
Fax (435) 448-2632

*Via Certified Mail

April 17, 2017

Mr. Rick Torgerson, Region 4 Director
Utah Department of Transportation
210 West 800 South
Richfield, Utah 84701

RE: State of Utah Highway SR-264; Subsidence Impact Agreement

To Whom It May Concern:

Canyon Fuel Company, LLC (CFC) Skyline Mines is notifying you of the mine's plan to expand mining into Sections 21, 28, and 33 in Township 13 South, Range 6 East, SLB&M, and Sections 4 and 5 in Township 14 South, Range 6 East, SLB&M. CFC recently acquired this coal lease in this area, and plans to undermine portions of SR-264 in these areas; specifically in areas north of Boulger Reservoir between mile markers approximately 4.5 to 6 (see attached map). Since SR-264 traverses areas which may be affected by subsidence from mining operations, this letter is intended to identify both the obligations and rights of CFC with respect to subsidence from mining operations, and the effects, if any on SR-264.

If accepted and agreed to by the Utah Department of Transportation (UDOT), UDOT has no objection to and will allow CFC's mining operations being conducted, as proposed by CFC, within the area of influence of SR-264. In consideration for such authorization, CFC agrees to repair promptly all damage, such as surface impacts, to SR-264 due to subsidence caused by CFC as we have done previously on other sections of the road.

If UDOT agrees to the provisions as noted, please sign both copies of this letter agreement and return one copy to Canyon Fuel Company, LLC.

If you have any questions regarding this letter or would like to discuss future mining plans for the above referenced sections, please call Gregg Galecki at (435) 448-2636 or me at (435) 448-2662.

Sincerely,

Corey Heaps

Corey Heaps
Mine Manager, Skyline Mine
Canyon Fuel Company, LLC

Agreed and accepted this _____day of _____, 2017.

_____
Rick Torgerson
Director, Region 4
Utah Department of Transportation

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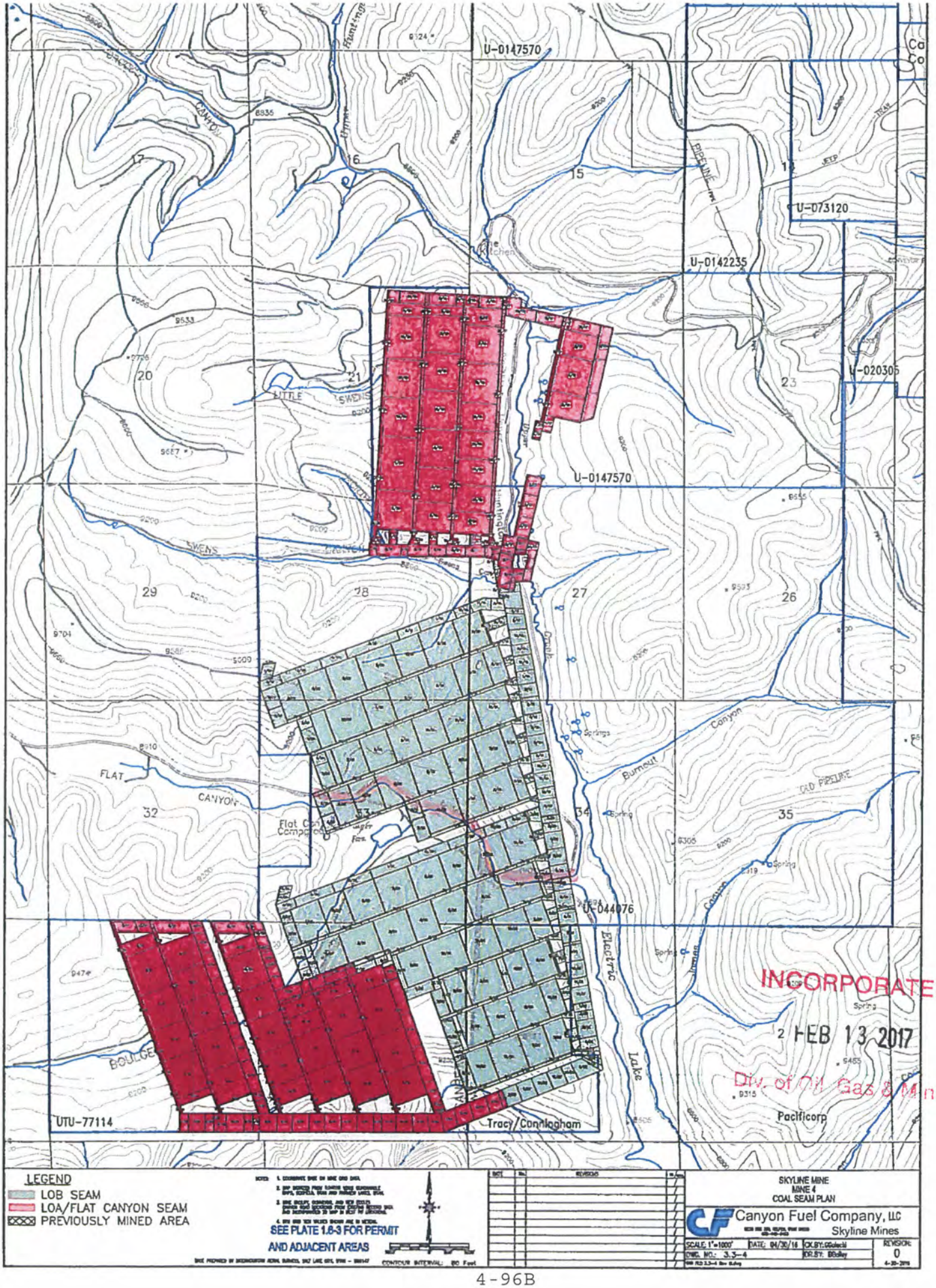

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Chapter 1
Appendix 118-A

AFFIDAVIT OF PUBLICATION

STATE OF UTAH)

ss.

County of Emery,)

I, Jenni Fasselin, on oath, say that I am the Publisher of the Emery County Progress, a weekly newspaper of general circulation, published at Castle Dale, State of Utah and County aforesaid, and that a certain notice, a true copy of which is hereto attached, was published in the full issue of such newspaper for 4 (Four) consecutive issues, and on the Utah legals.com webwsite; the first publication was on the 9th day of February, 2016, and that the last publication of such notice was in the issue of such newspaper dated the 1st day of March, 2016.

Jenni Fasselin

Jenni Fasselin – Publisher

INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

Subscribed and sworn to before me this 1st day of March 2016.

Linda Thayn

Notary Public My commission expires January 10, 2019 Residing at Price, Utah

Publication fee, $ 408.00

LINDA THAYN
NOTARY PUBLIC-STATE OF UTAH
COMMISSION# 680835
COMM. EXP. 01-10-2019

LEGAL NOTICE

Canyon Fuel Company, LLC, has filed a complete application with the Division of Oil, Gas and Mining for a revision of the existing Mining and Reclamation Plan, C/007/0005 for the Skyline Mine. Canyon Fuel Company, LLC operates the Skyline Mines with surface facilities located in Eccles Canyon which is approximately 4 miles southwest of the town of Scofield, Utah. The revision includes the addition of acreage associated with Federal Coal Lease, UTU-77114. The lease modification will increase the lease acreage by approximately 2,692 acres, with no additional surface disturbance proposed.

Underground coal mining will take place in coal reserves owned or leased by Canyon Fuel Company, LLC. A legal description of the proposed areas for additional underground mining activities is described as follows:

Proposed Additional Areas Authorized for Coal Mining and Reclamation Activities

The federal Coal Lease Tract UTU-77114 consists of approximately 2,692 acres located in:

T.13 S., R.6.E., SL Meridian, Utah
Section 21, lots 1-4, E1/2E1/2;
Section 28, Lots 1-8, S1/2NW1/4, SW1/4;
Section 33, E1/2, E1/2W1/2, NW1/4NW1/4, SW1/4SW1/4;

T. 14 S., R.6 E. SL Meridian, Utah
Section 4, lots 1-4, S1/2N1/2, S1/2;
Section 5, lots 1-4, S1/2N1/2, S1/2;

Privately-owned coal (non-federal) adjacent to the Federal Coal Lease Tract UTU-77114 consists of approximately 347 acres located in:

T.14 S., R. 6 E., SL Meridian, Utah
Section 3, Lots 3 &4, S1/2NW1/4; SW1/4; W1/2SW1/4SE1/4; SW1/4NW1/4SE1/4

Total approximate acres within the application: 3,039 acres

The address of the applicant is: Canyon Fuel Company, LLC
225 North 5th Street, Suite 900
Grand Junction, CO 81501

After filing, copies of this permit application will be available for inspection at the following location: Utah Division of Oil, Gas and Mining, 1594 West North Temple, Suite 1210, Salt Lake City, Utah; Emery County Courthouse, 75 East Main St., Castle Dale, Utah; Sanpete County Courthouse 160 North Main, Manti, Utah; and the Utah Division of Oil, Gas, and Mining website under the Coal Permit files.

Written comments or requests regarding this permit renewal must be made within 30 days of the last publication of this notice, and may be addressed to the Utah Division of Oil, Gas and Mining, 1594 West North Temple, Suite 1210, Salt Lake City, Utah 84114-5801.

Published in the Emery County Progress February 9, 16, 23 and March 1, 2016.

AFFIDAVIT OF PUBLICATION

STATE OF UTAH)

ss.

County of Carbon,)

I, Jenni Fasselin, on oath, say that I am the Publisher of the Sun Advocate, a twice-weekly newspaper of general circulation, published at Price, State of Utah a true copy of which is hereto attached, was published in the full issue of such newspaper for 4 (Four) consecutive issues, and on the Utah legals.com website, the first publication was on the 9th day of February, 2016, and that the last publication of such notice was in the issue of such newspaper dated the 1st day of March 2016

Jenni Fasselin

Jenni Fasselin – Publisher

INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

Subscribed and sworn to before me this 1st day of March, 2016.

Linda Thayn

Notary Public My commission expires January 10, 2019 Residing at Price, Utah

Publication fee, $ 571.20

LINDA THAYN
NOTARY PUBLIC-STATE OF UTAH
COMMISSION# 680835
COMM. EXP. 01-10-2019

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Published in the Sun Advocate February 9, 16, 23 and March 1, 2016.

Form 3400-12
(September 2013)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

COAL LEASE

FORM APPROVED
OMB NO 1004-0073
Expires June 30, 2016

Serial Number

UTU-77114

PART I. LEASE RIGHTS GRANTED

This lease, entered into by and between the UNITED STATES OF AMERICA, hereinafter called lessor, through the Bureau of Land Management (BLM), and *(Name and Address)*

Canyon Fuel Company, LLC
255 N. 5th Street, #900
Grand Junction, CO 81501

hereinafter called lessee, is effective *(date)* 7 / 1 / 15 for a period of 20 years and for so long thereafter as coal is produced in commercial quantities from the leased lands, subject to readjustment of lease terms at the end of the 20th lease year and each 10-year period thereafter.

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DIV. OF OIL, GAS & MINING

Sec. 1. This lease is issued pursuant and subject to the terms and provisions of the

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☒ The Mineral Leasing Act of 1920, as amended, 30 U.S.C. 181 - 287; or
☐ The Mineral Leasing Act for Acquired Lands, 30 U.S.C. 351 - 359,
and to the regulations and formal orders of the Secretary of the Interior which are now or hereafter in force, when not inconsistent with the express and specific provisions herein.

Div. of Oil, Gas & Mining

Sec. 2. Lessor, in consideration of any bonuses, rents, and royalties to be paid, and the conditions and covenants to be observed as herein set forth, hereby grants and leases to lessee the exclusive right and privilege to drill for, mine, extract, remove, or otherwise process and dispose of the coal deposits in, upon, or under the following described lands:

T. 13 S., R. 6 E., SLM, Sanpete County, Utah
sec. 21, lots 1-4, E½E½;
sec. 28, lots 1-8, S½NW¼, SW¼;
sec. 33, E½, E½W½, NW¼NW¼, SW¼SW¼;

T. 14 S., R. 6 E., SLM, Sanpete County, Utah
sec. 4, lots 1-4, S½N½, S½; (all);
sec. 5, lots 1-4, S½N½, S½; (all).

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containing 2,692.16 acres, more or less, together with the right to construct such works, buildings, plants, structures, equipment and appliances and the right to use such on-lease rights-of-way which may be necessary and convenient in the exercise of the rights and privileges granted, subject to the conditions herein provided.

PART II. TERMS AND CONDITIONS

Sec. 1. (a) RENTAL RATE - Lessee must pay lessor rental annually and in advance for each acre or fraction thereof during the continuance of the lease at the rate of $ 3.00 per acre for each lease year.

(b) RENTAL CREDITS - Rental will not be credited against either production or advance royalties for any year.

Sec. 2. (a) PRODUCTION ROYALTIES - The royalty will be 8 percent of the value of the coal as set forth in the regulations. Royalties are due to lessor the final day of the month succeeding the calendar month in which the royalty obligation accrues.

(b) ADVANCE ROYALTIES - Upon request by the lessee, the BLM may accept, for a total of not more than 20 years, the payment of advance royalties in lieu of continued operation, consistent with the regulations. The advance royalty will be based on a percent of the value of a minimum number of tons determined in the manner established by the advance royalty regulations in effect at the time the lessee requests approval to pay advance royalties in lieu of continued operation.

Sec. 3. BONDS - Lessee must maintain in the proper office a lease bond in the amount of $ 9,000.00. The BLM may require an increase in this amount when additional coverage is determined appropriate.

Sec. 4. DILIGENCE - This lease is subject to the conditions of diligent development and continued operation, except that these conditions are excused when operations under the lease are interrupted by strikes, the elements, or casualties not attributable to the lessee. The lessor, in the public interest, may suspend the condition of continued operation upon payment of advance royalties in accordance with the regulations in existence at the time of the suspension. Lessee's failure to produce coal in commercial quantities at the end of 10 years will terminate the lease. Lessee must submit an operation and reclamation plan for the BLM's approval pursuant to 30 U.S.C. 207(c) prior to conducting any development or mining operations or taking any other action on a leasehold which might cause a significant disturbance of the environment.

The lessor reserves the power to assent to or order the suspension of the terms and conditions of this lease in accordance with, inter alia, Section 39 of the Mineral Leasing Act, 30 U.S.C. 209.

5. LOGICAL MINING UNIT (LMU) - Either upon approval by the lessor of the lessee's application or at the direction of the lessor, this lease will become an LMU or part of an LMU, subject to the provisions set forth in the regulations.

The stipulations established in an LMU approval in effect at the time of LMU approval will supersede the relevant inconsistent terms of this lease so long as the lease remains committed to the LMU. If the LMU of which this lease is a part is dissolved, the lease will then be subject to the lease terms which would have been applied if the lease had not been included in an LMU.

(Continued on page 2)

Sec 6. DOCUMENTS, EVIDENCE AND INSPECTION - At such times and in such form as lessor may prescribe, lessee must furnish detailed statements showing the amounts and quality of all products removed and sold from the lease, the proceeds therefrom, and the amount used for production purposes or unavoidably lost

Lessee must keep open at all reasonable times for the inspection by BLM the leased premises and all surface and underground improvements, works, machinery, ore stockpiles, equipment, and all books, accounts, maps, and records relative to operations, surveys, or investigations on or under the leased lands

Lessee must allow lessor access to and copying of documents reasonably necessary to verify lessee compliance with terms and conditions of the lease.

While this lease remains in effect, information obtained under this section will be closed to inspection by the public in accordance with the Freedom of Information Act (5 U.S.C. 552)

Sec. 7. DAMAGES TO PROPERTY AND CONDUCT OF OPERATIONS - Lessee must comply at its own expense with all reasonable orders of the Secretary, respecting diligent operations, prevention of waste, and protection of other resources

Lessee must not conduct exploration operations, other than casual use, without an approved exploration plan. All exploration plans prior to the commencement of mining operations within an approved mining permit area must be submitted to the BLM

Lessee must carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health, or property, and prevention of waste, damage or degradation to any land, air, water, cultural, biological, visual, and other resources, including mineral deposits and formations of mineral deposits not leased hereunder, and to other land uses or users Lessee must take measures deemed necessary by lessor to accomplish the intent of this lease term Such measures may include, but are not limited to, modification to proposed siting or design of facilities, timing of operations, and specification of interim and final reclamation procedures Lessor reserves to itself the right to lease, sell, or otherwise dispose of the surface or other mineral deposits in the lands and the right to continue existing uses and to authorize future uses upon or in the leased lands, including issuing leases for mineral deposits not covered hereunder and approving easements or rights-of-way. Lessor must condition such uses to prevent unnecessary or unreasonable interference with rights of lessee as may be consistent with concepts of multiple use and multiple mineral development

Sec 8. PROTECTION OF DIVERSE INTERESTS, AND EQUAL OPPORTUNITY - Lessee must: pay when due all taxes legally assessed and levied under the laws of the State or the United States, accord all employees complete freedom of purchase; pay all wages at least twice each month in lawful money of the United States; maintain a safe working environment in accordance with standard industry practices; restrict the workday to not more than 8 hours in any one day for underground workers, except in emergencies; and take measures necessary to protect the health and safety of the public. No person under the age of 16 years should be employed in any mine below the surface. To the extent that laws of the State in which the lands are situated are more restrictive than the provisions in this paragraph, then the State laws apply

Lessee will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and the rules, regulations, and relevant orders of the Secretary of Labor. Neither lessee nor lessee's subcontractors should maintain segregated facilities

Sec. 9. (a) TRANSFERS -

This lease may be transferred in whole or in part to any person, association or corporation qualified to hold such lease interest.

This lease may be transferred in whole or in part to another public body or to a person who will mine coal on behalf of, and for the use of, the public body or to a person who for the limited purpose of creating a security interest in favor of a lender agrees to be obligated to mine the coal on behalf of the public body.

This lease may only be transferred in whole or in part to another small business qualified under 13 CFR 121.

Transfers of record title, working or royalty interest must be approved in accordance with the regulations

(b) RELINQUISHMENT - The lessee may relinquish in writing at any time all rights under this lease or any portion thereof as provided in the regulations Upon lessor's acceptance of the relinquishment, lessee will be relieved of all future obligations under the lease or the relinquished portion thereof, whichever is applicable.

Sec. 10. DELIVERY OF PREMISES, REMOVAL OF MACHINERY, EQUIPMENT, ETC. - At such time as all portions of this lease are returned to lessor, lessee must deliver up to lessor the land leased, underground timbering, and such other supports and structures necessary for the preservation of the mine workings on the leased premises or deposits and place all workings in condition for suspension or abandonment. Within 180 days thereof, lessee must remove from the premises all other structures, machinery, equipment, tools, and materials that it elects to or as required by the BLM. Any such structures, machinery, equipment, tools, and materials remaining on the leased lands beyond 180 days, or approved extension thereof, will become the property of the lessor, but lessee may either remove any or all such property or continue to be liable for the cost of removal and disposal in the amount actually incurred by the lessor. If the surface is owned by third parties, lessor will waive the requirement for removal, provided the third parties do not object to such waiver. Lessee must, prior to the termination of bond liability or at any other time when required and in accordance with all applicable laws and regulations, reclaim all lands the surface of which has been disturbed, dispose of all debris or solid waste, repair the offsite and onsite damage caused by lessee's activity or activities incidental thereto, and reclaim access roads or trails.

Sec. 11. PROCEEDINGS IN CASE OF DEFAULT - If lessee fails to comply with applicable laws, existing regulations, or the terms, conditions and stipulations of this lease, and the noncompliance continues for 30 days after written notice thereof, this lease will be subject to cancellation by the lessor only by judicial proceedings. This provision will not be construed to prevent the exercise by lessor of any other legal and equitable remedy, including waiver of the default. Any such remedy or waiver will not prevent later cancellation for the same default occurring at any other time.

Sec. 12. HEIRS AND SUCCESSORS-IN-INTEREST - Each obligation of this lease will extend to and be binding upon, and every benefit hereof will inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto

Sec. 13. INDEMNIFICATION - Lessee must indemnify and hold harmless the United States from any and all claims arising out of the lessee's activities and operations under this lease.

Sec. 14. SPECIAL STATUTES - This lease is subject to the Clean Water Act (33 U.S.C. 1252 et seq.), the Clean Air Act (42 U.S.C. 4274 et seq.), and to all other applicable laws pertaining to exploration activities, mining operations and reclamation, including the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201 et seq.)

Sec. 15. SPECIAL STIPULATIONS -

SEE ATTACHED SPECIAL STIPULATIONS

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Div. of Oil, Gas & Mining

(Continued on page 3)

Sec. 15 SPECIAL STIPULATIONS (Cont'd.) -

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FEB 13 2017

Div. of Oil, Gas & Mining

Canyon Fuel Company, LLC
(Company or Lessee Name)

E E Olsen
(Signature of Lessee)

Chief Operating Officer
(Title)

7/23/15
(Date)

THE UNITED STATES OF AMERICA

By

Jenna Whitlock
(BLM)

Acting State Director
(Title)

7/31/15
(Date)

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

(Continued on page 4)

NOTICES

The Privacy Act and 43 CFR 2.48(d) require that you be furnished with the following information in connection with the information requested by this form.
AUTHORITY: 30 U.S.C. 181 - 287 and 30 U.S.C. 351 - 359 permit collection of the information requested by this form.
PRINCIPAL PURPOSE: The BLM will use the information you provide to process your application and determine if you are eligible to hold a coal lease on public lands.
ROUTINE USES: The BLM will only disclose this information in accordance with the provisions at 43 CFR 2.56(b) and (c).
EFFECT OF NOT PROVIDING INFORMATION: Submission of the requested information is necessary to obtain or retain a benefit. Failure to submit all of the requested information or to complete this form may result in delay or preclude the BLM's acceptance of your application for a coal lease.

The Paperwork Reduction Act requires us to inform you that:
The BLM collects this information to evaluate and authorize proposed exploration and mining operations on public lands.
Submission of the requested information is necessary to obtain or retain a benefit.
You do not have to respond to this or any other Federal agency-sponsored information collection unless it displays a currently valid OMB control number.

BURDEN HOURS STATEMENT: The public reporting burden for this form is estimated to average 25 hours per response when the form is used under the authority of 43 subpart 3422 (Lease Sales), or 800 hours per response when the form is used under the authority of 43 subpart 3430 (Preference Right Leases). The estimated burdens include the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the form. You may submit comments regarding the burden estimate or any other aspect of this form to: U.S. Department of the Interior, Bureau of Land Management (1004-0073), Bureau Information Collection Clearance Officer (WO-630), 1849 C Street, Mail Stop 401 LS, Washington, DC 20240.

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Div. of Oil, Gas & Mining

SPECIAL STIPULATIONS FOR COAL LEASE UTU-77114

1. In accordance with Sec. 523(b) of the "Surface Mining Control and Reclamation Act of 1977," surface mining and reclamation operations conducted on this lease are to conform with the requirements of this act and are subject to compliance with Office of Surface Mining regulations, or as applicable the Utah program approved under the cooperative agreemne6t in accordance with sec. 523(c). The United States Government does not warrant that the entire tract will be susceptible to mining.

2. Before undertaking activities that may disturb the surface of previously undisturbed leased lands, the lessee may be required to conduct a cultural resource inventory and a paleontological appraisal of the areas to be disturbed. These studies shall be conducted by qualified professional cultural resource specialists or qualified paleontologists, as appropriate, and a report prepared itemizing the findings. A plan will then be submitted making recommendations for the protection of, or measures to be taken to mitigate impacts for identified cultural or paleontological resources.

If cultural resources or paleontological remains (fossils) of significant scientific interest are discovered during operations under this lease, the lessee prior to disturbance shall, immediately bring them to the attention of the appropriate authorities. Paleontological remains of significant scientific interest do not include leaves, ferns, or dinosaur tracks commonly encountered during underground mining operations.

The cost of conducting the inventory, preparing reports, and carrying out mitigating measures shall be borne by the lessee.

3. If there is reason to believe that Threatened or Endangered (T&E) species of plants or animals, or migratory bird species of high Federal interest occur in the area, the Lessee shall be required to conduct an intensive field inventory of the area to be disturbed and/or impacted. The inventory shall be conducted by a qualified specialist and a report of findings will be prepared. A plan will be prepared making recommendations for the protection of these species or action necessary to mitigate the disturbance.

The cost of conducting the inventory, preparing reports, and carrying out mitigating measures shall be borne by the lessee.

4. The Lessee shall be required to perform a study to secure adequate baseline data to quantify the existing surface resources on and adjacent to the lease area. Existing data may be used if such data are adequate for the intended purposes. The study shall be adequate to locate, quantify, and demonstrate the interrelationship of the geology, topography, surface and ground water hydrology, vegetation and wildlife. Baseline data will be established so that future programs of observation can be incorporated at regular intervals for comparison.

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5. Powerlines used in conjunction with the mining of coal from this lease shall be constructed so as to provide adequate protection for raptors and other large birds. When feasible, powerlines will be located at least 100 yards from public roads.

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Div. of Oil, Gas & Mining

6. The limited area available for mine facilities at the coal outcrop, steep topography, adverse winter weather, and physical limitations on the size and design of the access road, are factors which will determine the ultimate size of the surface area utilized for the mine. A site specific environmental analysis will be prepared for each new mine site development and for major modifications to existing developments to examine alternatives and mitigate conflicts.

7. Consideration will be given to site selection to reduce adverse visual impacts. Where alternative sites are available, and each alternative is technically feasible, the alternative involving the least damage to the scenery and other resources shall be selected. Permanent structures and facilities will be designed,

and screening techniques employed, to reduce visual impacts, and where possible achieve a final landscape compatible with the natural surroundings. The creation of unusual, objectionable, or unnatural land forms and vegetative landscape features will be avoided.

8. The lessee shall be required to establish a monitoring system to locate, measure, and quantify the progressive and final effects of underground mining activities on the topographic surface, underground and surface hydrology and vegetation. The monitoring system shall utilize techniques which will provide a continuing record of change over time and an analytical method for location and measurement of a number of points over the lease area. The monitoring shall incorporate and be an extension of the baseline data.

9. The lessee shall provide for the suppression and control of fugitive dust on haul roads and at coal handling and storage facilities. On Forest Development Roads (FDR), lessees may perform their share of road maintenance by a commensurate share agreement if a significant degree of traffic is generated that is not related to their activities.

10. Except at locations specifically approved by the Authorized Officer, with the concurrence of the Forest Service, underground mining operations shall be conducted in such a manner so as to prevent surface subsidence that would: (1) cause the creation of hazardous conditions such as potential escarpment failure and landslides, (2) cause damage to existing surface structures, and (3) damage or alter the flow of perennial streams. The lessee shall provide specific measures for the protection of escarpments, and determine corrective measures to assure that hazardous conditions are not created.

Limited subsidence zones consisting of perennial streams in the lease, Boulger Reservoir/Dam, SR-264, and Flat Canyon Campground are specifically approved for subsidence resulting from a single-seam of full-extraction mining. The limited-subsidence zones, where subsidence from a second overlapping seam of full-extraction mining is not approved, will be determined based on the typical angle-of-draw for past operations in the Skyline Mine Permit Area (23 degrees). "Angle-of-draw" is defined in the FEIS (pg. 4-7). The angle-of-draw will be applied to perennial stream buffer zones that include the natural floodplain and alluvium in perennial drainages, bounded by the first major slope break in the associated canyons. For structures, it will be applied to an area delineated by a 50-foot radius or distance from the major structures that could sustain damage.

The Authorized Officer (AO) can approve full extraction of multiple seams in limited subsidence zones, if the Lessee can provide information, based on actual subsidence data from the tract, that impacts can be tolerated or mitigated. The Forest Service will have to consent to the decision and issue a new record of decision.

11. In order to avoid surface disturbance on steep canyon slopes and to preclude the need for surface access, all surface breakouts for ventilation tunnels shall be constructed from inside the mine, except at specifically approved locations.

12. If removal of timber is required for clearing of construction sites, etc., such timber shall be removed in accordance with the regulations of the surface management agency.

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Div. of Oil, Gas & Mining

13. The coal contained within, and authorized for mining under this lease, shall be extracted only by underground mining methods.

14. Existing Forest Service owned or permitted surface improvements will need to be protected, restored, or replaced to provide for the continuance of current land uses.

15. In order to protect big game wintering areas, elk calving and deer fawning areas, sagegrouse strutting areas, and other critical wildlife habitat and/or activities, specific surface uses outside the mine

development area may be curtailed during specific periods of the year.

16. Support facilities, structures, equipment, and similar developments will be removed from the lease area within 2 years after the final termination of use of such facilities. This provision shall apply unless the requirement of Section 10 of the lease form is applicable. Disturbed areas and those areas previously occupied by such facilities will be stabilized and rehabilitated, drainages reestablished, and the areas returned to an acceptable post mining land use.

17. The Lessee at the conclusion of the mining operation, or at other times as surface disturbance related to mining may occur, will replace all damaged, disturbed, or displaced corner monuments (section corners, quarter corners, etc.) their accessories and appendages (witness trees, bearing trees, etc.), or restore them to their original condition and location, or at other locations that meet the requirements of the rectangular surveying system. This work shall be conducted at the expense of the Lessee, by BLM, to the standards and guidelines found in the Manual of Surveying Instructions, U.S. Department of Interior.

18. The Lessee, at his expense, will be responsible to replace any surface and/or developed ground water sources identified for protection, that may be lost or adversely affected by mining operations, with water from an alternate source in sufficient quantity and quality to maintain existing riparian habitat, fishery habitat, livestock and wildlife use, or other land uses (authorized by 36 CFR 251).

19. The Licensee/Permittee/Lessee must comply with all the rules and regulations of the Secretary of Agriculture set forth at Title 36, Chapter II, of the Code of Federal Regulations governing the use and management of the National Forest System (NFS) when not inconsistent with the rights granted by the Secretary of the Interior in the license/permit/lease. The Secretary of Agriculture's rules and regulations must be complied with for (1) all use and occupancy of the NFS prior to approval of a permit/operation plan by the Secretary of Interior, (2) uses of all existing improvements, such as Forest Development Roads, within and outside the area licensed, permitted or leased by the Secretary of Interior, and (3) use and occupancy of the NFS not authorized by a permit/operation plan approved by the Secretary of the Interior.

All matters related to this stipulation are to be addressed to:

Forest Supervisor
Manti-LaSal National Forest
599 West Price River Drive
Price, Utah 84501

Telephone No.: 435-637-2817

who is the authorized representative of the Secretary of Agriculture.

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Div. of Oil, Gas & Mining

20. Notwithstanding the approval of a resource recovery and protection plan by the BLM, lessor reserves the right to seek damages against the operator/lessee in the event (I) the operator/lessee fails to achieve maximum economic recovery [as defined at 43 CFR §3480.0-5(21)] of the recoverable coal reserves or (ii) the operator/lessee is determined to have caused a wasting of recoverable coal reserves. Damages shall be measured on the basis of the royalty that would have been payable on the wasted or unrecovered coal.

The parties recognize that under an approved R2P2, conditions may require a modification by the operator/lessee of that plan. In the event a coal bed or portion thereof is not to be mined or is rendered unminable by the operation, the operator shall submit appropriate justification to obtain approval by the AO to leave such reserves unmined. Upon approval by the AO, such coal beds or portions thereof shall not be subject to damages as described above. Further, nothing in this section

shall prevent the operator/lessee from exercising its right to relinquish all or a portion of the lease as authorized by statute and regulation.

In the event the AO determines that the R2P2 modification will not attain MER resulting from changed conditions, the AO will give proper notice to the operator/lessee as required under applicable regulations. The AO will order a new R2P2 modification if necessary, identifying additional reserves to be mined in order to attain MER. Upon a final administrative or judicial ruling upholding such an ordered modification, any reserves left unmined (wasted) under that plan will be subject to damages as described in the first paragraph under this section.

Subject to the right to appeal hereinafter set forth, payment of the value of the royalty on such unmined recoverable coal reserves shall become due and payable upon determination by the AO that the coal reserves have been rendered unminable or at such time that the lessee has demonstrated an unwillingness to extract the coal.

The BLM may enforce this provision either by issuing a written decision requiring payment of the ONRR demand for such royalties, or by issuing a notice of non-compliance. A decision or notice of non-compliance issued by the lessor that payment is due under this stipulation is appealable as allowed by law.

21. WASTE CERTIFICATION: The lessee shall provide upon abandonment and/or sealing off a mined area and prior to lease termination/relinquishment, certification to the lessor that, based upon a complete search of all the operator's records for the mine and upon their knowledge of past operations, there has been no **hazardous substances** per (40 CFR 302.4) or **used oil** as per Utah State Management Rule R-315-15, deposited within the lease, either on the surface or underground, or that all remedial action necessary has been taken to protect human health and the environment with respect to any such substances remaining on the property. The back-up documentation to be provided shall be described by the lessor prior to the first certification and shall include all documentation applicable to the Emergency Planning and Community Right-to-know Act (EPCRA, Public Law 99-499), Title III of the Superfund Amendments and Reauthorization Act of 1986 or equivalent.

22. ABANDONMENT OF EQUIPMENT: The lessee/operator is responsible for compliance with reporting regarding toxic and hazardous material and substances under Federal Law and all associated amendments and regulations for the handling such materials on the land surface and in underground mine workings.

The lessee/operator must remove mine equipment and materials not needed for continued operations, roof support and mine safety from underground workings prior to abandonment of mine sections. Exceptions can be approved by the Authorized Officer (BLM) in consultation with the surface management agency. Creation of a situation that would prevent removal of such material and by retreat or abandonment of mine sections without prior authorization would be considered noncompliance with lease terms and conditions and subject to appropriate penalties under the lease.

23. UNDERGROUND INSPECTION: All safe and accessible areas shall be inspected prior to being sealed. The lessee shall notify the Authorized Officer in writing 30 days prior to the sealing of any areas in the mine and state the reason for closure. Prior to seals being put into place, the lessee shall inspect the area and document any equipment/machinery, hazardous substances, and used oil that is to be left underground.

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The purpose of this inspection will be: (1) to provide documentation for compliance with 42 U.S.C. 9620 section 120(h) and State Management Rule R-315-15, and to assure that certification will be meaningful at the time of lease relinquishment, (2) to document the inspection with a mine map

showing location of equipment/machinery (model, type of fluid, amount remaining, batteries etc.) that is proposed to be left underground. In addition, these items will be photographed at the lessee's expense and shall be submitted to the Authorized Officer as part of the certification. The abandonment of any equipment/machinery shall be on a case by case basis and shall not be accomplished unless the Authorized Officer has granted a written approval.

24. All shafts or portals will be back filled after mining has ceased or abandoned and all designs will be approved by the AO.

25. Prior to development of the panels that would cause subsidence of the Boulger Reservoir, the Lessee shall submit a plan for approval of mining under the reservoir facilities to the Authorized Officer. This plan shall include, but not be limited to, type of mining, when and how the dam will be taken out of service while undermining and/or subjected to mining-induced acceleration of 0.1g and greater, and what mitigation measures will be taken to place the dam and reservoir back into full service. This plan shall be submitted to and be approved by the AO of the BLM, with consent of the surface management agency, and any requirements by the regulatory authority.

26. Prior to development of the panels that would cause subsidence of the Flat Canyon Campground, the Lessee shall submit a plan for approval to conduct mining under the campground. This plan shall include but not be limited to type of mining, when and how the Flat Canyon Campground will be taken out of service and what mitigation measures will be taken to place the Flat Canyon Campground back into full service. The plan shall be submitted to and be approved by the AO of the BLM, with the consent of the surface management agency, in addition to any requirements required by the regulatory authority.

27. The Lessee shall submit a plan for monitoring the gradient of the perennial streams within the lease and the associated effects to aquatic ecosystems and wetlands. The plans shall also include measures for mitigating detrimental effects discovered during monitoring. The plans shall be submitted to and be approved by the AO of the BLM, with consent of the surface management agency in addition to any requirements by the regulatory authority, prior to mining.

29. The Lessee shall immediately notify the Authorized Officer of any seismic events that trigger a Richter scale reading in excess of 3.0.

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UNDERGROUND COAL LEASE
(Skyline Tract)

THIS UNDERGROUND COAL LEASE (this "***Lease***") is made and entered into this 5th day of June, 2015 (the "***Effective Date***") by and between **PACIFICORP**, an Oregon corporation, having a mailing address of 1407 W. North Temple, Salt Lake City, Utah 84116 ("***Lessor***"), and **CANYON FUEL COMPANY, LLC,** a Delaware limited liability company, having a mailing address of 6100 Dutchmans Lane, 9th Floor, Louisville, Kentucky 40205 ("***Lessee***"). Lessor and Lessee may be collectively referred to herein as the "***Parties***" or individually as a "***Party***."

RECITALS

WHEREAS, Lessor is the sole owner of the coal estate in and underlying that certain tract of land located in Emery County, State of Utah, as more particularly described in Exhibit A and as generally depicted on Exhibit B attached hereto (the "***Leased Premises***").

WHEREAS, Lessee now desires to acquire a lease of the Coal (as hereinafter defined in Section 2) within the Leased Premises and to have the exclusive right to develop and mine such Coal.

WHEREAS, Lessor is willing to grant to Lessee a lease to mine and remove the Coal within the Leased Premises upon the terms and conditions set forth in this Lease.

AGREEMENT

NOW, THEREFORE, in consideration of the foregoing, the mutual covenants and agreements hereinafter set forth, and other good and valuable consideration, receipt and sufficiency of which is hereby acknowledged by the Parties, Lessor and Lessee agree as follows:

1. Grant of Lease. Lessor does hereby grant, demise, lease and let exclusively unto the Lessee, and the Lessee leases and takes from the Lessor, for the purposes herein specified, all Coal situated in, on or under Leased Premises, including all present interest of Lessor in the coal estate and any after-acquired, reversionary, contingent or future interest of Lessor in the coal estate. For the purposes of determining the amount of rental payments hereunder, the Leased Premises shall be treated as comprising 287.56 acres, whether it be more or less.

2. Rights of Lessee. The coal estate in the Leased Premises is hereby leased unto Lessee subject to the terms and conditions herein set forth for the purpose of prospecting, exploring, developing, testing, mining and operating for and producing by underground mining methods, whether now or hereafter existing or known, all Coal lying and situated in or under the Leased Premises, with the right to store, save, remove, transport, own and market, treat, process or otherwise utilize said Coal, together with all of the mining rights and privileges appurtenant to

the said Coal and incident to the ownership thereof, provided, however, no mining activity of any kind may occur under Electric Lake or the minimum buffer zone described below, as generally depicted on Exhibit B and Exhibit C hereto. The buffer zone shall, at a minimum, be defined as that area determined by a 22 degree draw angle to the bottom of the Coal seam being mined plus 25 ft. (measured horizontally) from the high water mark of Electric Lake, which is defined as an elevation of 8,575 feet above mean sea level. However, prior to mining, Lessee must conduct a geotechnical evaluation to determine the adequate buffer zone taking all matters into consideration to protect the integrity of Electric Lake. By way of enlargement, and not by way of restriction, the following rights and privileges are also hereby granted to Lessee to the extent Lessor has the right so to do:

a. Subject to the limitations regarding Surface Ownership as described in Section 13, and the Mitigation of Impacts as required by Section 14, the exclusive right and privilege to (i) prospect upon and under the surface overlying the portion of the Leased Premises authorized for mining for Coal; (ii) to explore, survey, conduct soil and water sampling and other environmental studies; and (iii) to mine, drill, bore, core and test and analyze by any other reasonable means; provided, however, that such operations shall not include stripping of the surface or surface mining; and provided further, Lessee shall have no right to make use of the surface underlying Electric Lake or the area of the surface contained within the subsidence buffer zone described above;

b. The exclusive right and privilege to enter upon and under, and the free and uninterrupted right-of-way into, upon, over, across and through, the Leased Premises, at such points and in such manner as may be necessary or convenient for the purpose of mining, removing, processing and marketing all of the Coal hereby leased;

c. The right-of-way, right of entry, access, ingress and egress and right to transport over, under, across and through the Leased Premises any Coal now or hereafter owned, leased or otherwise acquired by Lessee and located on lands comprising any portion of the General Mining Area (as hereinafter defined in Section 4);

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d. Subject to the limitations contained in this Lease, the right to use so much of the surface as may be necessary or convenient in conjunction with Lessee's operations hereunder, so long as Lessee does not unreasonably interfere with the use of the surface by the surface owner;

e. The right to include the Leased Premises or any portion thereof within the General Mining Area in any plan of unitization for Coal or a federal logical mining unit pursuant to any such unitization, and so that operations or mining in any portion of the Leased Premises shall be deemed operations or mining on the logical mining unit for federal diligent development and continued operations requirements; and

f. The right to subside, collapse, sink, lower, and alter the surface, subsurface, and superadjacent strata of the portion of the Leased Premises authorized for mining as a result of Lessee's permitted operations hereunder.

All the rights of the Lessee under this Lease shall continue to exist during the hereinafter specified term.

For the purposes of this Lease, the term "***Coal***" is used in its commonly accepted meaning and shall include any seam, vein, bed, strata or deposit, from the lowest grade of lignite through the highest grade of anthracite, both inclusive, and all constituent products thereof mixed with or encountered when mining Coal in whatever physical state or form produced, and all impurities and other minerals of every nature and type of substance associated or commingled therewith. Coal shall include methane or Coal bed methane and other naturally-occurring gases contained within the seam being mined, herein referred to as "***Coal Seam Gas***." Lessee shall have the right to vent any gases or Coal Seam Gas encountered in Lessee's mining operations as a safety measure without liability or accountability of any nature whatsoever to Lessor, but Lessee shall not have the right to commercially exploit any such gases or Coal Seam Gases. The rights hereby granted to Lessee shall not include mining or extraction rights with respect to oils, gases or other minerals other than Coal as defined herein, which rights are reserved exclusively unto the Lessor. The leasing, exploration for, or development of other minerals or substances other than Coal shall not unreasonably interfere with the Coal mining operations of the Lessee during the Term of this Lease.

3. Term. Subject to the other provisions herein, this Lease shall remain in effect until December 31, 2029 (the "***Term***"). At the end of the Term, the Parties shall bargain in good faith should Lessee seek a renewal of the Lease, but any such renewal shall be subject to a readjustment of terms to protect the best interests of the Lessor.

4. General Mining Area. For purposes of this Lease, the term "***General Mining Area***" shall cover and include the Leased Premises together with the following lands located in Emery and Sanpete Counties, State of Utah (hereinafter defined):

Township 13 South, Range 6 East, SLB&M
Sections: 13, 14, 15, 21 22, 23, 24, 25, 26, 27, 28, 32, 33, 34 and 35

Township 14 South, Range 6 East, SLB&M
Sections: 2, 3, 4, 5 and 6

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5. Rental. Within one (1) year from the Effective Date hereof, and on or before each anniversary date thereafter during the Term and any continuation of the Term, this Lease shall be kept in full force and effect for the next ensuing year by the Lessee's payment to Lessor of a rental in the amount of One Thousand Dollars ($1,000.00).

Subject to the right of Lessee to terminate this Lease in whole or in part, rental payments as set forth above shall be made annually whether in the Term or any continuation of the Term, regardless of whether or not there is production of Coal from the Leased Premises or the General Mining Area. Temporary suspension of actual mining and production of Coal by Lessee during

the Term shall be without prejudice to its right to resume operations as long as rental payments are made as herein provided.

Rental payments made pursuant to this Lease shall not be recouped, credited, or set off against production royalty payable under this Lease.

6. Lease Bonus Payment. To compensate Lessor for the fair market value of the interest herein leased even though the amount of recoverable tons of Coal potentially minable under this Lease is uncertain, Lessee shall pay to Lessor a lease bonus payment at the time Coal is mined, removed and sold, which payment shall be in addition to the production royalty hereinafter provided. The lease bonus payment shall be in the amount of twenty-five cents ($.25) per ton (2,000 pounds) of Coal actually mined, removed and sold from the Leased Premises and shall be payable at the same time, on the same tonnage, and in the same manner as the Production Royalty.

7. Production Royalty. Lessee shall pay to Lessor as a production royalty for all Coal actually mined, removed and sold from the Leased Premises at the sum of Eight Percent (8%) of the Gross Realization (as hereinafter defined in Section 8).

For purposes of determining the Coal produced from the Leased Premises, Lessee shall complete volumetric surveys on a monthly basis as of the last day of each calendar month of all active mining areas contributing to the commingled Coal produced from the General Mining Area and any other areas as to which Coal is commingled prior to the first certified weighing of the Coal being produced by Lessee.

A preliminary calculation of the Coal produced from the various separately owned properties shall be made by multiplying the total cubic feet of mined area during the month by Eighty (80) pounds per cubic foot and dividing by 2,000 pounds per ton to determine the number of tons of Coal produced from the Leased Premises and all other premises contributing to the commingled Coal. Based upon the preliminary calculation, the portion of the Coal produced during the month from the Leased Premises and each of the other properties shall be calculated as a percentage of total production stated to three places past the decimal (resulting in five figures). The percentage so determined shall then be used to determine the tonnage actually produced from each individual lease or area based upon certified weights. If Coal is stockpiled or otherwise delayed in any way prior to the certified weighing, Lessee shall make all calculation necessary to accurately determine the amount of Coal produced from the Leased Premises and any such formulas and calculation methods shall be subject to the approval of the Lessor before implementation. It is the expressed intent of the Parties that all weights be determined and allocated among the various properties as accurately as possible under the circumstances of Lessee's operations.

Production royalty due and payable for Coal actually mined, removed, and sold from the Leased Premises during any calendar month shall be paid on or before the last day of the next

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succeeding calendar month, and all production royalty due and unpaid for thirty (30) days shall be a lien on Lessee's equipment on the Leased Premises. In the event Lessee fails to pay any rent or royalty when due, said late payment shall be subject to the payment of interest from the due date to the date of payment at the rate of one and one-half percent (1½%) per month compounded monthly. Any amount unpaid for more than thirty (30) days after its due date shall be deemed a breach of this Lease, and Lessor shall be free to pursue any remedy available in law or at equity.

8. Gross Realization. "***Gross Realization***" shall have the same meaning as the term "Gross Proceeds" as defined from time to time in 30 C.F.R., Part 1206, Subpart F with respect to Federal Coal leases within the General Mining Area. The value and time of payment for royalty purposes with respect to Coal from the Leased Premises shall be determined under the provisions of such subpart applicable to federal ad valorem Coal leases, including amendments thereto and administrative and judicial interpretation thereof which shall include, without limitation, any deductions, adjustments or allowances now existing or hereafter permitted in calculating royalty due under federal Coal leases.

9. Records and Accounts. Lessee shall keep a true and correct record of all Coal mined, removed, and sold from the Leased Premises, the General Mining Area and all other areas used in the calculation of royalties. Lessee shall maintain accurate and complete accounting records in support of all royalties paid with respect to production from the Leased Premises in accordance with the standard for federal royalties as set out in 30 C.F.R., Part 1206, Subpart F and generally recognized accounting principles and practices.

On or before the last day of each calendar month following the month during which Lessee shall commence actual mining operations on the Leased Premises and for the remaining Term, Lessee shall furnish Lessor, at the address shown in Section 28(d), a true and correct statement showing the tons of Coal actually mined, removed, and sold during the preceding calendar month from the Leased Premises, the General Mining Area, and all other areas whose production is commingled with Coal produced from the Leased Premises prior to the first certified weighing of Coal being produced by Lessee. Lessor, or its audit representatives, shall have the right at any reasonable time or times to examine, audit, and reproduce the records, vouchers and their source documents which serve as the basis for royalty payments.

Lessee shall assist Lessor with preparing necessary audit material and will allow Lessor to review any work papers prepared by independent auditors as allowed by professional standards.

Audit findings by Lessor or Lessor's representative will be considered final and conclusive by Lessee for the period audited. Any overpayments shall be returned to Lessee or under payments paid to Lessor within thirty (30) days from the date of notice of over/under payment.

Lessee shall also provide to Lessor, without cost, no less frequently than quarterly, copies of mine maps and other records pertaining to mining. Such maps and records shall be in the

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same form and format as provided to the Bureau of Land Management with respect to federal Coal leases in the General Mining Area. All such maps and records of Lessee kept in the ordinary course of its business, and all payments made in accordance therewith, shall be presumed to be accurate after a period of three (3) years if Lessor has made no objection to the content of such maps and records by that date.

10. Covenants, Conditions and Obligations related to Water. In its operations on the Leased Premises, Lessee shall strictly adhere to the following covenants, conditions and obligations relating to water:

a. At any time mining has approached within 500 feet of Lessee's projection as to the expected location of the Connelville Fault, Lessee will probe by horizontal drilling at least 100 feet ahead of mine development workings. If the horizontal drilling identifies any fault or aquifer containing sufficient water to cause a disruption of normal mining procedures, then Lessee agrees that it will not allow development workings to approach closer than 100 feet from said fault or aquifer. For the purposes of this Lease, the reference to the Connelville Fault shall mean and have reference to the fault and/or fault zone depicted on Exhibit C running generally in a northeast/southwest direction and located in the vicinity of the Northeast Corner of Section 35, Township 13 South, Range 6 East, SLB&M.

b. Prior to the conduct of any mining operations on the Leased Premises, Lessee shall establish a water monitoring plan which shall provide for the periodic measurement and chemical analysis of any sustained in-mine flows which are greater than those encountered under normal mining conditions. Such monitoring plan shall include, but not be limited to, documentation of all encountered sustained water sources, chemical analysis of abnormally high flows encountered, and the monitoring of surface sources within the Lease area included within the cumulative hydrologic impact assessment for the mine permit to document the relationships, if any, between underground and surface water. The plan shall be submitted in writing to Lessor prior to its implementation in order for Lessor to verify its compliance with this requirement. Lessor shall not require any monitoring or defined analysis work which imposes water quality testing requirements in excess of those contained in Lessee's approved mining permit.

c. In the event any surface water resource (i.e., reservoir, creek, spring, etc.), including but not limited to Electric Lake, or state-appropriated water is affected by contamination, diminution, or interruption resulting from Lessee's underground Coal mining operations, Lessee shall promptly replace such water in accordance with a replacement plan which shall be submitted in writing to Lessor. Replacement, in the event of contamination, may include, but shall not be limited to, remediation. Lessee shall not implement a replacement plan that affects water or water rights owned by Lessor until Lessor has received a copy of the plan. A water replacement plan shall be submitted to Lessor within thirty (30) days of the first indication that a surface water resource or other state-appropriated water has been affected by Lessee's underground Coal mining operations. Implementation of the plan shall occur no later than thirty (30) days following submission of the plan to Lessor. Potential methods of replacement might

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include pumping of mine water to the surface, replacement water from other sources, purchase of other shares and/or water rights, payment of damages, and other feasible alternatives.

d. Lessee shall indemnify Lessor as hereinafter provided in Section 12 with respect to all claims and demands related to or arising out of the impact of underground Coal mining operations on water resources and state-appropriated water, expressly including any damages suffered by Lessor with regards to Electric Lake.

11. Bond. Prior to the commencement of any activity in, on or under the Leased Premises, other than casual use, Lessee shall deliver to Lessor a performance bond in a form, and with a surety acceptable to Lessor, and for the use and benefit of the Lessor in the amount of Two Hundred Fifty Thousand Dollars ($250,000.00), acknowledging that (i) a bond in the amount of $250,000 was previously provided by Lessee to Lessor under a coal lease that expired in 2009, (ii) that such bond is still in the possession of Lessor, and (iii) that such bond shall satisfy Lessee's obligations under this Section 11. The bond shall ensure payment of rentals and royalties and ensure compliance with all other terms and conditions of this Lease and applicable laws and regulations. Upon termination of this Lease, the bond may be terminated upon Lessee's receipt of Lessor's written permission, which permission shall be given upon Lessee's demonstration to Lessor that Lessee is in full compliance with the terms and conditions of this Lease.

12. Indemnification. Lessee will hold harmless and fully indemnify Lessor against all claims or demands of any kind or nature made upon Lessor or against Lessor's interest in the Leased Premises for, or on account of, any debt or expense contracted or incurred by Lessee in conducting its activities, as well as against any and all acts, transactions and omissions of Lessee, its employees, agents, contractors, subcontractors, lessees, partners or coventurers, licensees and suppliers in conducting such activities, and Lessee will defend and save Lessor harmless and fully indemnify Lessor as to liability or asserted liability, for, or on account of, injury to, or death of, any person or damage to any property sustained during the Term, alleged to have resulted from and/or resulting from any such act or omission of Lessee, its employees, agents, contractors, subcontractors, lessees, partners, or coventurers, licensees and suppliers, or any unsafe condition of the Leased Premises created by Lessee or Lessee's operations. In addition, Lessee will waive, hold harmless and fully indemnify Lessor against any and all penalties or charges imposed upon Lessor by federal, state, or local authorities on account of Lessee's failure to comply with all laws, rules, regulations or orders of such authorities.

Further, Lessee agrees to hold Lessor harmless from all claims of environmental damages and demands arising directly out of Lessee's operations on or affecting the Leased Premises asserted by third parties, including, but not limited to, claims by individuals or groups, whether public or private, by federal, state, or local agencies and/or by any other party bringing said action against Lessor, unless Lessor, or any person or instrumentality acting in Lessor's behalf shall have been a contributing cause to the event giving rise to such claim or demand. Lessor agrees to cooperate with Lessee in the conduct of any suits arising from claims and demands under this subsection.

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13. Surface Ownership. Lessor does not claim ownership of the surface estate with respect to the entirety of the Leased Premises. Lessee shall be responsible to determine the ownership of the surface and obtain any and all such additional lease(s) or lease rights as may be necessary to conduct Lessee's operations on the Leased Premises. It is understood that this Lease is subject to surface patents, deeds, and purchase contracts and Lessee shall assume responsibility for, and indemnify and hold harmless Lessor against, all claims arising from damages to the surface caused by Lessee's operations.

14. Mitigation of Impacts. Lessee shall mitigate any impacts to the surface caused by Lessee's activities on the surface of the Leased Premises (i.e., prospecting, exploring, drilling, etc.) and Lessee's underground Coal mining operation, (including, but not limited to, mining induced subsidence), consistent with Lessee's approved mining permit and Lessee's surface use agreements. Mitigation measures and reclamation activities shall adhere to policies and practices that are no less stringent than those imposed by the U.S. Forest Service with respect to Forest Service lands in the General Mining Area.

15. Seismicity. Due to the proximity of Electric Lake and its associated dam, Lessor must maintain the ability to respond to the impacts of mining related seismicity on the water storage facilities. The Parties both acknowledge that the continued existence of the water storage facilities must take priority over the coal mining operations provided for in this Lease. Lessee and Lessor shall cooperate in the exchange of information and in the assessment and evaluation of impacts to the water storage facilities in any way related to mining activities.

To provide information to the Parties regarding possible impacts of mining on the water storage facilities, Lessee shall, at its sole cost and expense, institute a seismic monitoring program ("***Seismic Plan***") prior to undertaking any underground mining activity on the Leased Premises. The Seismic Plan will include, at a minimum, engaging an independent consultant with mining expertise ("***Consultant***") reasonably acceptable to both Parties, installing a seismic recording device at the dam and monitoring and interpreting pertinent information from other available seismic recording stations. Lessee will obtain Lessor's permission prior to entry upon the lands of Lessor, other than the Leased Premises, and Lessee shall be solely responsible for its actions in carrying out the Seismic Plan. Lessee shall provide regular reports to Lessor summarizing the information collected from the Seismic Plan and the parties shall, at the request of either Party, consult from time to time regarding the information collected.

16. Lessor Termination. As part of the consideration for the issuance of this Lease, if, at any time during the Term, Lessor reasonably believes, based upon credible evidence produced by the Seismic Plan or otherwise, that the continued conduct of mining operations under the Lease currently impacts, or may reasonably result in an impact to, (i) the integrity of the dam at Electric Lake or (ii) the ability of the water storage facilities at Electric Lake to continue to store water at the present capacity, Lessor may, by written notice to Lessee and at Lessors' sole discretion, order the immediate cessation of mining activities. In such event, the Parties and the Consultant shall hold a joint meeting within ten (10) days after the notice to cease mining to

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review the evidence relied upon by Lessor. At the meeting the Lessor shall determine whether mining operations can be revised to protect adequately the water storage facilities. Thereafter Lessor may at its election give Lessee written notice to terminate the Lease, provided, however, that prior to termination of the Lease, and while no operations are being conducted on the Lease, Lessee shall have the right, at its sole cost and expense, to engage other experts to review the evidence to determine what actions are appropriate to protect the water storage facilities. Lessee shall make its presentation of the findings and conclusions to Lessor within ninety (90) days from the date of the joint meeting. Within ten (10) days after Lessee's presentation, Lessor shall notify Lessee in writing of its decision to preserve the Lease subject to additional operating restrictions or to terminate all or a portion of the Lease. In the event of such cessation and/or termination, Lessee shall have no recourse against Lessor whether for monetary damages or otherwise.

17. Default. If Lessee fails to comply with the provisions of this Lease and if Lessee does not initiate and diligently pursue steps to correct the default within thirty (30) days after written notice has been given to it by Lessor specifying with particularity the nature of the default, then upon the expiration of the thirty (30) day period, all rights, liabilities and obligations of Lessee under this Lease shall terminate, except that Lessee shall have a reasonable time in which to remove all of Lessee's machinery, equipment and other property from any part of the Leased Premises. Any default claims with respect to the payment of money may be cured by the deposit in escrow of the amount in controversy (not including claimed consequential, special, exemplary, or punitive damages) and giving of notice of the deposit to Lessor, the amount to remain in escrow until the controversy is resolved by decision of a court or arbitrators or otherwise. If Lessee, by notice to Lessor disputes the existence of a default, then this Lease shall not terminate unless Lessee does not initiate and diligently pursue steps to correct the default within thirty (30) days after the existence of the default has been determined by decision of a court or arbitrators or otherwise. The doing of any acts by Lessee reasonably sufficient to cure all or any of the alleged breaches or defaults shall not be deemed an admission or presumption that Lessee has failed to perform any or all of its obligations hereunder.

18. Surrender. Lessee shall have the unrestricted right and option to terminate this Lease as to the entirety of the Leased Premises, or any portion or parcel thereof, at any time or times and for any purpose upon giving written notice of such release and termination to Lessor and recording such notice in the office of the Recorder of Emery County, Utah. In the event of such release and termination by Lessee, this Lease shall cease immediately as to all lands described in the notice of release and termination. All obligations of the Lessee that have accrued under this Lease as of the date of termination shall survive and be the continuing obligation of Lessee until otherwise satisfied.

At the termination of this Lease, either at the end of the Term or prior thereto by termination, cancellation or surrender, Lessee shall have a reasonable time in which to remove all of Lessee's machinery, equipment and other property from any part of the Leased Premises. Prior to abandonment and/or the sealing off of a mined area, Lessee may, with Lessor's prior written consent, which shall not be unreasonably withheld, elect to abandon machinery or

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equipment in place within the Leased Premises if such abandonment does not (i) violate any applicable federal or state statute, regulation or approved mining plan relating to the Leased Premises or (ii) result in any additional liability to Lessor. Any on-lease disposal of non-coal waste must comply with the laws and regulations governing such disposal.

19. Depository Bank, Change of Ownership. All payments under this Lease may be paid or tendered directly to Lessor's credit as follows:

PACIFICORP
JPMorgan
1 Chase Manhattan Plaza, Floor 07
New York, NY 10005-1401
ABA 021000021
Checking Account 5531896

which bank, and its successors, are hereby made agents of Lessor to receive all payments herein provided for. Lessor may amend the bank account instructions in writing signed by the Treasurer and Assistant Treasurer of Lessor and delivered to the Lessee. If such bank (or any successor bank) should fail, liquidate or be succeeded by another bank, or for any reason fail to accept a payment, Lessee shall not be held in default for failure to make or tender same until thirty (30) days after Lessor shall deliver to Lessee a proper instrument naming another bank or depository as agent to receive such payments or tenders.

All payments or tenders must be made by wire transfer. Payments shall be deemed proper payment or tender as herein provided upon receipt by Lessor in its account with the depository bank.

No change or division in ownership of the Leased Premises or royalties, however accomplished, shall operate to enlarge the obligations or diminish the rights of Lessee. No such change or division in the ownership of the Leased Premises or royalties shall be deemed notice to or binding upon Lessee for any purpose, despite actual or constructive notice by Lessee, until forty-five (45) days after the person acquiring any interest has delivered to Lessee the original instrument or instruments, or certified or true copies thereof, evidencing such change, transfer or division of ownership; provided that Lessee may at its election, recognize any such change or division prior to the expiration of said forty-five (45) day period of time and make payment to the new owners.

20. Lesser Interest. If Lessor owns less interest in the Coal in the Leased Premises than the entire and undivided fee simple estate therein, then whether or not such interest is referred to or described herein, production royalties, rentals and other payments herein provided for shall be paid to Lessor only in the proportion which Lessor's interest bears to the whole and undivided fee simple estate in the Coal in the Leased Premises.

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21. Damages. In addition to the obligation to conduct reclamation activities as specified in Section 14, and not in lieu thereof, Lessee agrees to pay to Lessor for each exploratory test hole location on the portion of the Leased Premises as to which Lessor is the owner of the surface estate as full compensation and satisfaction for any damage to crops, grazing pastures, grass or other of Lessor's surface uses that may be affected thereby, the sum of Two Thousand Five Hundred Dollars ($2,500.00).

22. Compliance with Law. Lessee agrees that it will conduct all operations hereunder in a good and workmanlike manner and in full compliance with all applicable local, state and federal laws, rules, regulations and orders, including, but not limited to, those pertaining to mine safety, zoning, environmental protection and land reclamation. Lease stipulations imposed upon Lessee pursuant to federal Coal leases within the General Mining Area shall be deemed applicable to the Leased Premises.

23. Hazardous, Toxic or Harmful Substances. The Lessee shall not keep on or about the Leased Premises, any substances now or hereafter designated as, or containing components now or hereafter designated as, hazardous, toxic, dangerous or harmful (and/or which are subject to regulation as hazardous, toxic, dangerous or harmful) by federal, state or local law, regulation, statute or ordinance (hereinafter collectively referred to as "***Hazardous Substances***") unless such are necessary to carry out the Lessee's permitted uses of the Leased Premises and unless the Lessee fully complies with all federal, state and local laws, regulations, statutes or ordinances now in existence or as subsequently enacted or amended.

Lessee shall notify Lessor promptly (which shall in no event exceed twenty-four (24) hours after Lessee becomes aware) of the following:

a. all spills or releases of any Hazardous Substance in, on or adjacent to the Leased Premises reportable pursuant to applicable state and federal agency as required by applicable law;

b. all material failures to comply with any federal, state or local law, regulation or ordinance as now enacted or as subsequently enacted or amended;

c. all inspections of the Leased Premises by or any correspondence, orders, citations or notifications from any regulatory entity concerning Hazardous Substances affecting the Leased Premises excluding notices, reports or permits issued by regulatory entity in the normal course of business and not otherwise relating to an enforcement action; and

d. all regulatory orders or fines or all response or interim cleanup actions taken by or proposed to be taken by any government entity or private party and all correspondence, pleadings and/or reports received by or required of the Lessee or issued or written by the Lessee or on the Lessee's behalf with respect to the use, presence, transportation or generation of Hazardous Substances in, on, about or adjacent to the Leased Premises.

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Further, Lessee shall be fully and completely liable to the Lessor and shall indemnify, defend and save harmless the Lessor, and its shareholders, affiliates, directors, officers and employees and agents with respect to any and all claims, damages, costs, fees (including attorneys' fees and costs), penalties (civil and criminal) and cleanup costs assessed against or imposed as a result of Lessee's use, disposal, transportation, generation and/or sale of Hazardous Substances or that of Lessee's employees, agents, assigns, sublessees, contractors, subcontractors, licensees or invitees and for any breach of this Section 23.

24. Liability Insurance. Without limiting any liabilities or any other obligations of the Lessee on and after the date of this Lease, Lessee shall have and maintain Public Liability and Property Damage Insurance with companies which are rated by Best Insurance Rating at A or above and with at least the following liability limits:

a. Commercial General Liability (occurrence form), covering bodily injury and property damage liability, including contractual, XCU, products and completed operations with minimum limits of $5,000,000 per occurrence, $5,000,000 Aggregate Products - Completed Operations and $5,000,000 General Aggregate.

b. Comprehensive Automobile Liability covering owned, hired and non-owned vehicles with minimum limits of $1,000,000 per person and $2,000,000 per accident for bodily injury and $500,000 property damage or combined single limit of at least $2,000,000;

c. Workers' Compensation or Industrial Accident insurance as required by law, including Employer's or Stop-gap Liability with a minimum limit of $500,000 per accident.

All such insurance policies shall be the primary insurance for Lessee and shall name Lessor and its affiliates, directors, officers, employees, and agents as additional insureds. Upon execution of this Lease, Lessee shall provide certificates evidencing the insurance described above and bearing endorsements requiring ten (10) days written notice to Lessor before change or cancellation.

Lessee acknowledges that it has the authority and hereby waives subrogation rights of its property insurance company for insured losses for which Lessee is liable under the terms of this Lease.

25. Taxes. The Lessee shall pay all validly assessed and levied property taxes on its improvements and property and shall pay all of the taxes, if any, validly assessed and levied against its right in the Coal covered by this Lease and its rights, if any, in the surface over the Leased Premises. Lessor shall pay all validly assessed and levied taxes on its interests in the Leased Premises including, but not limited to, those interests subject to central assessment by the State of Utah. In the event a federal, state, county or municipal or other governmental agency levies a license, severance, sales, use, production or other tax on the Coal hereunder, or on

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Lessee's rights to operate or produce or sell such Coal, then and in that event the Lessee shall pay that portion of such tax attributable to its rights in the Coal.

26. Breach of Obligations. Lessee shall be under no obligation, express or implied, to explore, develop, mine or rework the Leased Premises, for Coal or any other mineral or substance which may be covered hereby, it being expressly agreed that the good faith judgment of the Lessee in carrying out the purpose of this Lease shall be conclusive.

In addition to Lessor's rights to terminate this Lease as set forth in Sections 16 and 17, in the event Lessor considers that Lessee has not complied with any express condition, obligation or covenant hereunder, Lessor shall notify Lessee in writing, noting specifically in what respects Lessee has breached or defaulted upon this Lease. Lessee shall then have thirty (30) days after receipt of such notice within which to cure or commence to cure all or any part of the breaches or defaults alleged by Lessor. The service of such notice shall be a condition precedent to the bringing of any action by Lessor on this Lease for such default, and no such action shall be brought with respect to such default until the lapse of thirty (30) days after service of such notice. The doing of any acts by Lessee reasonably sufficient to cure all or any of the alleged breaches or defaults shall not be deemed an admission or presumption that Lessee has failed to perform any or all of its obligations hereunder.

27. Force Majeure. When exploration, testing, mining, or other operations hereunder are delayed or interrupted by lack of water, labor or material, or by fire, storm, flood, war, rebellion, insurrection, riot, labor disputes or failure of carriers to transport or furnish facilities for transportation, or as a result of some order, requisition or necessity of any governmental authority or due to some zoning, environmental protection, or land reclamation requirement, or as a result of any cause whatsoever beyond the control and not a result of any negligence of the Lessee, the time and result of such delay or interruption shall not be counted against Lessee or cause a termination of this Lease; provided, however, the obligation to make rental and royalty payments shall not be suspended but instead shall be due and owing during such period and shall be paid as provided for above. Lessee shall provide Lessor with written notice within ten (10) days after both the occurrence and the cessation of any condition constituting such above described force majeure hereunder.

28. Miscellaneous

a. Assignment/Subletting. This Lease shall inure to the benefit of and bind the Parties and their respective permitted successors and assigns, provided, however that this Lease may not be assigned or otherwise transferred, directly or indirectly, by either Party without the written consent of the other Party (which consent shall not be unreasonably conditioned, withheld or delayed). A Party's consent to the proposed assignment and determination of the proposed assignee's ability to perform shall be based upon all facts material to the decision, including, but not limited to, the adequacy of the assignee's financial condition and the assignee's reputation and experience in the industry. If a transfer or assignment by a Party is consented by the other

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Party as provided in this section, the assignee shall assume in writing all of the obligations of the assigning Party under this Lease. Any assignment by a Party without the prior written consent of the other Party shall be void. Notwithstanding the foregoing, consent shall not be required for assignment or transfer by Lessee to an affiliate controlled by Lessee. No subleasing by Lessee is authorized.

b. Title. Lessor makes no representation or warranties as to title to the Coal or the Leased Premises. Lessee may purchase or lease the rights of any party claiming any interest in said Coal and execute such rights as may be obtained thereby, and Lessee shall not suffer any forfeiture nor incur any liability to Lessor by reason thereof. Should Lessee wish to investigate Lessor's title following execution of this Lease, Lessor agrees to cooperate with Lessee as to title matters by making available to Lessee all abstracts, title insurance policies, and other title documents in Lessor's possession.

c. Recording. The Parties agree that they will execute a Memorandum of Underground Coal Lease in a form substantially similar to that attached as Exhibit D and that the executed Memorandum will be placed of record in Emery County, State of Utah. This Lease shall not be recorded.

d. Notices. All notices and other communications relating to this Lease shall be in writing except where another form of notice is expressly authorized by this Lease and shall be effective when received by the authorized representative of the other Party designated below. Notices sent by *fax or email* shall be considered written notices.

To Lessee:
Canyon Fuel Company, LLC
225 North Fifth Street, 9th Floor
Grand Junction, Colorado 81501
Attn: Land Manager
Wkoontz@bowieresources.com

With a copy to:
Canyon Fuel Company, LLC
6100 Dutchmans Lane, 9th Floor
Louisville, Kentucky 40205
Attn: Brian S. Settles, General Counsel
Email: bsettles@bowieresources.com

To Lessor:
PacifiCorp
1407 W. North Temple
Salt Lake City, Utah 84116
Attn: Fuels Department
Email: steve.larsen@pacificorp.com

With a copy to:
Stoel Rives LLP

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201 S. Main Street, Suite 1100
Salt Lake City, UT 84111-4904
Attn: Richard R. Hall
Email: rrhall@stoel.com

Either Party shall have the right to change its address by giving written notice of the change to the other Party.

e. Inspection. Lessor or its duly authorized agents and representatives shall have the right at all reasonable times and at its own risk to enter into and upon the Leased Premises and workings thereon for the purpose of examining and inspecting the same, and ascertaining whether the terms and conditions of this Lease are being carried out and performed by Lessee. Lessor or its duly authorized representative shall at all reasonable times have access to the production records, and other records as set forth in Section 9 above.

f. Interference with Operations. The Parties recognize that this Lease does not cover oil and gas rights, except Coal Seam Gas, and other mineral rights not covered by this Lease underlying the Leased Premises and that Lessor retains the right to grant leases or other conveyances as to such rights. However, Lessor agrees that any leases, grants or conveyances made by it subsequent hereto affecting or pertaining to oil and gas or other minerals not covered by this Lease shall contain appropriate provisions to insure that all operations of Lessee under this Lease may be carried on without undue interference by any such parties or by Lessor. The rights of such subsequent leases, their assignees, and Lessor thereunder shall be junior and subordinate to those of Lessee hereunder in the event of any actual irreconcilable conflict or interference with Lessee's operations.

g. Applicable Law. This Lease and all of its terms and provisions shall be governed by and interpreted according to the laws of the State of Utah, including its equitable doctrines, without regard to its choice of law doctrines.

h. Headings, Word Usage. The numbered section headings are provided for the use and convenience of the Parties and shall not be deemed part of this Lease, nor as having any bearing upon the interpretations given to any provision of this Lease.

i. Nonwaiver. The failure of either Party to require strict performance of any provision of this Lease by the other Party, or the forbearance to exercise any right or remedy under this Lease, shall not be construed as a waiver by the Party of the right to require strict performance of any provision or the relinquishment by the Party of any right or remedy it might have with respect to any subsequent breach of the provision.

j. Remedies Cumulative. Except as otherwise expressly provided herein, each remedy specifically provided for under this Lease shall be taken and construed as cumulative and

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in addition to any other remedy provided for in this Lease or by law or equity, including, but not limited to, actions for specific performance.

k. JURY WAIVER. TO THE FULLEST EXTENT PERMITTED BY LAW, EACH OF THE PARTIES HERETO WAIVES ANY RIGHT IT MAY HAVE TO A TRIAL BY JURY IN RESPECT OF LITIGATION DIRECTLY OR INDIRECTLY ARISING OUT OF, UNDER OR IN CONNECTION WITH THIS LEASE. EACH PARTY FURTHER WAIVES ANY RIGHT TO CONSOLIDATE ANY ACTION IN WHICH A JURY TRIAL HAS BEEN WAIVED WITH ANY OTHER ACTION IN WHICH A JURY TRIAL CANNOT BE OR HAS NOT BEEN WAIVED.

l. Attorneys' Fees. In the event suit or action is instituted to interpret or enforce the terms of this Lease or to rescind this Lease, the prevailing Party shall be entitled to recover from the other Party such sum as the court may adjudge reasonable as attorneys' fees at trial, on any appeal, and on any petition for review, and in any bankruptcy proceedings related to this Lease, in addition to all other sums provided by law.

m. Entire Agreement; Termination of Prior Agreement; Amendments. This Lease (including all Exhibits), contain the final and entire agreement concerning the subject matter between the Parties, and there are no other understandings, representations, or agreements between the Parties, or either of them, with respect to this Lease. This Lease may not be amended except by an instrument in writing signed by a duly-authorized representative of each Party.

n. Severability. If any provision of this Lease is declared invalid or unenforceable, all other provisions of this Lease shall nevertheless remain in full force and effect.

o. Third Parties. Nothing herein expressed or implied is intended or shall be construed to confer upon or give any person or entity other than the Parties hereto and their successors and assigns any right or remedies by reason of this Lease as a third party beneficiary or otherwise.

p. Further Assurances. The Parties agree from time to time to execute such additional documents as are necessary to effect the intent of the Parties as manifested by this Lease.

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IN WITNESS WHEREOF, the Parties have caused this Lease to be executed on the date first written above.

LESSOR:

PACIFICORP
an Oregon corporation

Cindy A. Crane
President/CEO - PacifiCorp dba Rocky Mountain Power

LESSEE:

CANYON FUEL COMPANY, LLC
a Delaware limited liability company

By: Johannes H. Dreyer
Its: CEO

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EXHIBIT A

Legal Description of the Leased Premises

Township 14 South, Range 6 East, SLB&M

Section 3: Lots 1 & 2; S½NE¼; E½SE¼; E½W½SE¼; NW¼NW¼SE¼

(Containing 287.56 acres, more or less.)

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EXHIBIT B

General Depiction of the Leased Premises and Electric Lake
PacifiCorp Fee Coal Lease - Skyline Mine

[attached]

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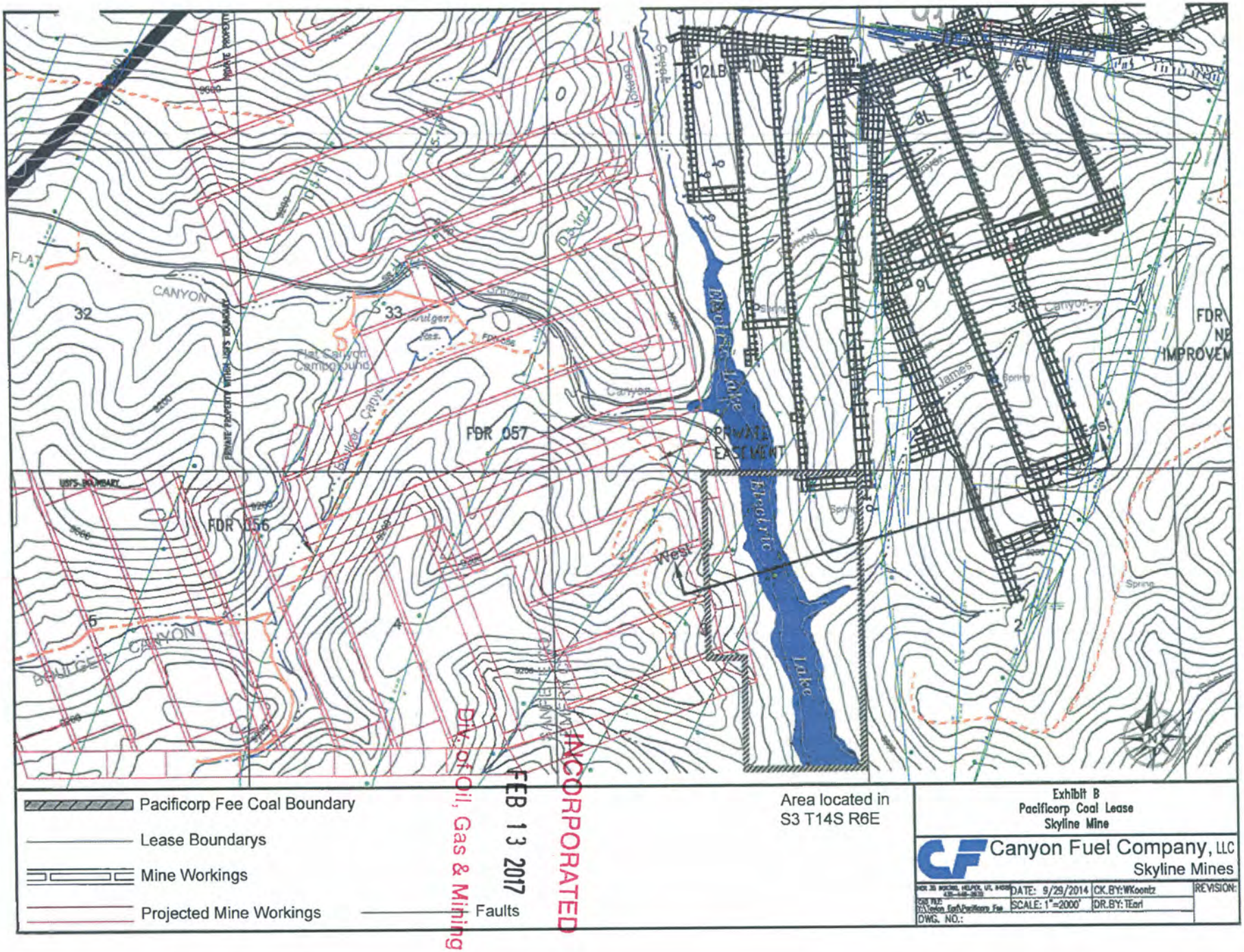
Pacificorp Fee Coal Boundary
Lease Boundarys
Mine Workings
Projected Mine Workings
Faults
Area located in
S3 T14S R6E
Exhibit B
Pacificorp Coal Lease
Skyline Mine
Canyon Fuel Company, LLC
Skyline Mines
DATE: 9/29/2014
SCALE: 1"=2000'
CK.BY:WKoontz
DR.BY:TEarl
REVISION:
DWG. NO.:
RECEIVED
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FDR 057
FDR 056
Electric Lake
Flat Canyon Campground
BOULGER CANYON
FLAT CANYON
PRIVATE EASEMENT
FDR NE IMPROVEM

EXHIBIT C

General Depiction of the Minimum Buffer Zone
and the Connelville Fault
Cross Section of PacifiCorp Coal Fee Coal Lease - Skyline Mine

[attached]

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Exhibit C
Canyon Fuels Company Cross-Section of Pacificorp Fee Coal Lease-Skyline Mine

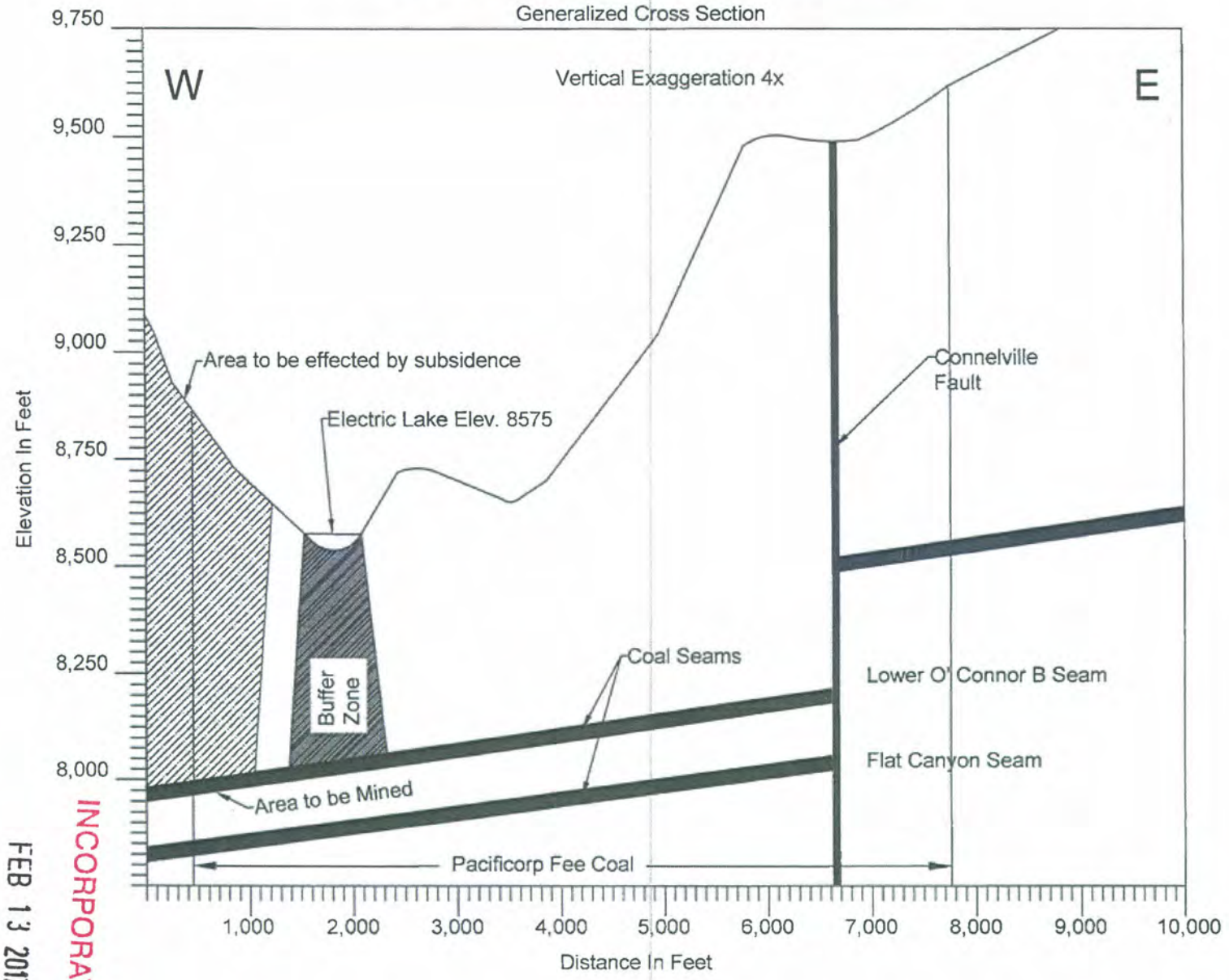

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EXHIBIT D

Memorandum of Underground Coal Lease

[attached]

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RECORDING REQUESTED BY AND
WHEN RECORDED RETURN TO:

Stoel Rives LLP
Attn: Richard R. Hall
201 S. Main St., Suite 1900
Salt Lake City, Utah 83702

(Space Above For Recorder's Use)

MEMORANDUM OF UNDERGROUND COAL LEASE

THIS MEMORANDUM OF UNDERGROUND COAL LEASE (this "***Memorandum***") is made and entered into this 5th day of June, 2015 (the "***Effective Date***") by and between **PACIFICORP**, an Oregon corporation, having a mailing address of 1407 W. North Temple, Salt Lake City, Utah 84116 ("***Lessor***"), and **CANYON FUEL COMPANY, LLC**, a Delaware limited liability company, having a mailing address of 6100 Dutchmans Lane, 9th Floor, Louisville, Kentucky 40205 ("***Lessee***"). Lessor and Lessee may be collectively referred to herein as the "***Parties***" or individually as a "***Party***."

RECITALS

A. WHEREAS, the Lessor and Lessee entered into that certain Underground Coal Lease, of even date herewith (the "***Lease***"), relating to the lease of the coal resources within certain parcels of land located in Emery County, State of Utah, as more particularly described in Exhibit A attached hereto (the "***Leased Premises***"), along with other purposes related to the Lease and the development of the coal resource on the Leased Premises. The Lease is expressly incorporated herein by reference and made a part hereof as though fully set forth herein.

B. WHEREAS, by this Memorandum, the Lessor and Lessee desire to provide public notice of the Lease.

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AGREEMENT

NOW, THEREFORE, in consideration of the foregoing recitals, and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Lessor and Lessee agree as follows:

1. Public Notice. All members of the general public are hereby placed on notice of inquiry as to the specific provisions of the Lease, all of which are incorporated herein by reference with the same force and effect as if herein set forth in full. This Memorandum shall be

recorded in the real estate records of Emery County, State of Utah, in lieu of recording the entire Lease.

2. Lease Term. The Lease will become effective on the Effective Date and shall remain in effect for a term of ten (10) years from the Effective Date hereof (the "***Term***"), unless extended or earlier terminated in accordance with the provisions of the Lease.

3. Conflicts. In the event of any conflict between the terms of this Memorandum and the terms of the Lease, the terms of the Lease shall control.

4. Captions and Capitalized Terms. Caption headings are inserted herein only as a matter of convenience of reference, and in no way serve to define, limit, or describe the scope of intent of, or in any way affect, this Memorandum. Capitalized terms not defined in this Memorandum shall have the meanings ascribed to them in the Lease.

[*Signatures on Following Pages*]

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IN WITNESS WHEREOF, the Parties hereto have executed this Memorandum of Underground Coal Lease as of the date set forth above.

LESSOR:

PACIFICORP
an Oregon corporation

_____

Cindy A. Crane
President/CEO - PacifiCorp dba Rocky Mountain Power

LESSOR ACKNOWLEDGEMENT:

STATE OF UTAH)
ss.
COUNTY OF SALT LAKE)

The foregoing instrument was acknowledged before me this 5th day of June, 2015, by CINDY A. CRANE, the President/CEO of PACIFICORP dba Rocky Mountain Power, an Oregon corporation.

_____

NOTARY PUBLIC
Residing at: _____

My commission expires:

_____

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LESSEE:

CANYON FUEL COMPANY, LLC
a Delaware limited liability company

_____

By: _____
Its: _____

LESSEE ACKNOWLEDGEMENT:

STATE OF)
ss.
COUNTY OF)

The foregoing instrument was acknowledged before me this ____ day of _____, 2015, by _____ the _____ of CANYON FUEL COMPANY, LLC, a Delaware limited liability company.

_____
NOTARY PUBLIC
Residing at: _____

My commission expires:

_____

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EXHIBIT A
to Memorandum of Underground Coal Lease

Legal Description of the Leased Premises

Township 14 South, Range 6 East, SLB&M

Section 3: Lots 1 & 2; S½NE¼;
E½SE¼; E½W½SE¼;
NW¼NW¼SE¼

(Containing 287.66 acres, more or less.)

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ACA

MEMORANDUM OF LEASE

This MEMORANDUM OF LEASE, is made and effective this 22nd day of May, 1998 (the "Effective Date"), by and between, David G. Cunningham and Rene L. Cunningham, whose address is 995 East Hillside Drive, Provo, Utah 84604 ("Lessor") and Canyon Fuel Company, LLC, whose address is 6955 South Union Park Center, Suite 550, Midvale, UT 84047 ("Lessee").

W I T N E S S E T H:

WHEREAS, Lessor and Lessee have entered into a certain Underground Coal Lease of even date herewith (the "Lease"), and desire to provide record notice of the existence of such Lease by the execution and recording of this Memorandum.

NOW THEREFORE, for and in consideration of the agreements contained herein, and the mutual promises and covenants contained in the Lease, the parties agree as follows:

1. Grant of Lease. Lessor does hereby grant, demise, lease and let exclusively unto Lessee all coal situated in, on or under the real estate property located in Emery County, State of Utah, known as:

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Township 14 South, Range 6 East, SLB&M

Section 3: LOTS 3 & 4; S1/2 NW1/4; SW1/4; W1/2 SW1/4 SE1/4; SW1/4 NW1/4 SE1/4

and all unleashed land owned or claimed by Lessor adjacent or contiguous to the land particularly described above, although not included within the boundaries of the land described above (the

E 350102 B 0246 P 690
DATE 30-OCT-1998 11:46AM
FEE: 25.00 CHECK
DIXIE SWASEY, RECORDER
FILED BY DKS
FOR CANYON FUEL COMPANY
EMERY COUNTY CORPORATION

"Leased Premises"). Said Leased Premises comprises approximately 346.68 acres.

2. Rights of Lessee. The Leased Premises are hereby leased exclusively unto Lessee for the purpose of prospecting, exploring, developing, testing, mining and operating for and producing by any underground mining method or methods deemed desirable by Lessee, whether now or hereafter existing or known, all Coal (as hereinafter defined) lying and situated in, on or under the Leased Premises, with the right to store, save, remove, transport, own and market, treat, process or otherwise utilize said Coal, together with all of the mining rights and privileges appurtenant to the said Coal and incident to the ownership thereof, and (by way of enlargement, and not by way of restriction) the following rights and privileges:

   a) The exclusive right and privilege to prospect upon and under the surface overlying the Leased Premises for Coal; to reasonably explore, survey, conduct soil and water sampling and other environmental studies, drill, bore, core and test and analyze by any other reasonable means, provided, however, that such prospecting operations shall not include stripping of the surface or surface mining.

   b) The exclusive right to enter for the purposes of coal exploration, mapping, and environmental monitoring; and the free and uninterrupted right-of-way into, upon, over, across and through the Leased Premises, at such points and in such manner as may be necessary or convenient for the purpose of mining, removing, processing and marketing all of the Coal hereby leased.

   c) The right-of-way, right of entry, access, ingress and egress and right to transport under and through the Leased Premises any Coal now or hereafter owned, leased or otherwise acquired by Lessee and located on lands comprising any portion of the General Mining

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Area. For purposes of the Lease, the term General Mining Area shall cover and include the Leased Premises together with the following lands located in Carbon and Emery County, State of Utah:

Range 6 East, SLB&M

Township 12 South, Sections: All of 35 and portions of 26 and 34

Township 13 South, Sections: All of 2, 3, 10, 11, 14, 15, 20, 21, 22, 23, 26, 27, 28, 29, 32, 33, 34, and 35.

Township 13 South, Sections: Portions of 13, 24, and 25.

Township 14 South, Sections: All of 2, 3, 4 and 5.

d) The right to use so much of the surface as may be necessary or convenient in conjunction with Lessee's operations hereunder, as long as Lessee does not unreasonably interfere with the use of the surface.

e) The right to include the Leased Premises or any portion thereof in any plan of unitization for coal or Federal logical mining unit pursuant to any such unit agreement, and so that operations or mining in any portion of the unit shall be deemed operations or mining on the Leased Premises.

f) The right to subside, collapse, sink, lower, and alter the surface, subsurface, and superadjacent stata as a result of Lessee's permitted operations hereunder without any liability for such removal of coal where Lessee has actually caused such subsidence provided, however, that any subsidence-caused damage to surface structures such as roads or buildings will be repaired at Lessee's expense. In the event that any surface water resource is affected by diminution or interruption resulting from underground coal mining operations, Lessee shall replace such water in accordance with the Lessee's approved Mining and Reclamation Plan.

All of the rights of the Lessee under this Lease shall continue to exist after Merchantable Coal (hereinafter defined) has been mined and removed from the Leased Premises for so long as Lessee is conducting

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mining operations on lands comprising any portion of the General Mining Area.

For the purposes of the Lease, the term "Coal" is used in its commonly accepted meaning and shall include any seam, vein, bed, strata or deposit, from the lowest grade of lignite through the highest grade of anthracite, both inclusive, and all constituent products thereof in whatever physical state or form produced, and all impurities and other minerals of every nature and type of substance associated or commingled therewith, including methane or coal bed methane and other naturally-occurring gases contained therein.

For the purposes of the Lease, the term Merchantable Coal is defined as coal which can be sold at a reasonable profit in markets available to Lessee utilizing modern methods, procedures and accounting principles customarily used by competent operations in the region of the Leased Premises.

3. Term. This Lease shall remain in effect for a term of twenty (20) years from the Effective Date and so long thereafter as Coal is being mined, produced, processed or marketed from the Leased Premises, or so long as the Lease may be held in force and effect by some other provision of the Lease.

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4. Short Form of Lease. This Memorandum is subject to the terms, conditions and restrictions contained in the Lease between Lessor and Lessee of even date herewith. It is understood and agreed between Lessor and Lessee that this Memorandum is a short form only of the Lease, and this Memorandum is executed for the purpose of causing the same to be recorded in the County Clerk's Office, Emery County, as record notice of the existence of the Lease. This Memorandum shall not in any way enlarge upon, restrict or otherwise affect the terms and provisions of the Lease.

IN WITNESS WHEREOF, this Memorandum was executed as of the date first above written.

LESSOR:

David G. Cunningham

Rene L. Cunningham

LESSEE:

CANYON FUEL COMPANY, LLC

By: Mark A. Lucero

Its: VP - FINANCE

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STATE OF Utah)
)
COUNTY OF Utah)

The foregoing Memorandum of Lease was acknowledged before me this 14th day of October, 1998 by David G. Cunningham and Rene L. Cunningham.

NOTARY PUBLIC
LOREEN CASPER
961 South Orem Blvd
Orem, Utah 84058
My Commission Expires 10-1-99
State of Utah

LoReen Casper
Notary Public
My commission expires: 10-1-98

STATE OF Missouri)
)
COUNTY OF St. Louis)

The foregoing Memorandum of Lease was acknowledged before me this 26th day of October by Mark A. Lurkey as Vice President, Finance of Canyon Fuel Company, LLC, a Delaware Limited Liability Company, on behalf of said Company.

Jan L Wooton
Notary Public
My Commission Expires:

JAN L WOOTON
NOTARY PUBLIC STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXP. JAN. 27,2002

INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

EMERY COUNTY
A Great Place to Live and Work

P.O. Box 688
Castle Dale, Utah 84513

NOV - 6'06 PM
UTAH
6744040

CANYON FUEL COMPANY
C/O ARK LAND COMPANY
CITY PLACE ONE , SUITE 300
ST LOUIS MO 63141

INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

E 350160 B 0247 P 42
D 4-NOV-1998 15:23PM
FEE: 25.00 CHECK
DIXIE SWASEY, RECORDER
FILED BY SLB
FOR ARK LAND COMPANY
EMERY COUNTY CORPORATION

SK-015

MEMORANDUM OF LEASE

This MEMORANDUM OF LEASE, is made and effective this 22nd day of May, 1998 (the "Effective Date"), by and between, James O. Tracy, Jr. And Linda D. Tracy, whose address is 3148 North Timpview, Provo, Utah 84604 ("Lessor") and Canyon Fuel Company, LLC, whose address is 6955 South Union Park Center, Suite 550, Midvale, UT 84047 ("Lessee").

W I T N E S S E T H:

WHEREAS, Lessor and Lessee have entered into a certain Underground Coal Lease of even date herewith (the "Lease"), and desire to provide record notice of the existence of such Lease by the execution and recording of this Memorandum.

NOW THEREFORE, for and in consideration of the agreements contained herein, and the mutual promises and covenants contained in the Lease, the parties agree as follows:

1. Grant of Lease. Lessor does hereby grant, demise, lease and let exclusively unto Lessee all coal situated in, on or under the real estate property located in Emery County, State of Utah, known as:

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Township 14 South, Range 6 East, SLB&M

Section 3: LOTS 3 & 4; S1/2 NW1/4; SW1/4; W1/2 SW1/4 SE1/4; SW1/4 NW1/4 SE1/4

and all unleashed land owned or claimed by Lessor adjacent or contiguous to the land particularly described above, although not included within the boundaries of the land described above (the

"Leased Premises"). Said Leased Premises comprises approximately 346.68 acres.

2. Rights of Lessee. The Leased Premises are hereby leased exclusively unto Lessee for the purpose of prospecting, exploring, developing, testing, mining and operating for and producing by any underground mining method or methods deemed desirable by Lessee, whether now or hereafter existing or known, all Coal (as hereinafter defined) lying and situated in, on or under the Leased Premises, with the right to store, save, remove, transport, own and market, treat, process or otherwise utilize said Coal, together with all of the mining rights and privileges appurtenant to the said Coal and incident to the ownership thereof, and (by way of enlargement, and not by way of restriction) the following rights and privileges:

a) The exclusive right and privilege to prospect upon and under the surface overlying the Leased Premises for Coal; to reasonably explore, survey, conduct soil and water sampling and other environmental studies, drill, bore, core and test and analyze by any other reasonable means, provided, however, that such prospecting operations shall not include stripping of the surface or surface mining.

b) The exclusive right to enter for the purposes of coal exploration, mapping, and environmental monitoring; and the free and uninterrupted right-of-way into, upon, over, across and through the Leased Premises, at such points and in such manner as may be necessary or convenient for the purpose of mining, removing, processing and marketing all of the Coal hereby leased.

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c) The right-of-way, right of entry, access, ingress and egress and right to transport under and through the Leased Premises any Coal now or hereafter owned, leased or otherwise acquired by Lessee and located on lands comprising any portion of the General Mining

Area. For purposes of the Lease, the term General Mining Area shall cover and include the Leased Premises together with the following lands located in Carbon and Emery County, State of Utah:

Range 6 East, SLB&M

Township 12 South, Sections: All of 35 and portions of 26 and 34

Township 13 South, Sections: All of 2, 3, 10, 11, 14, 15, 20, 21, 22, 23, 26, 27, 28, 29, 32, 33, 34, and 35.

Township 13 South, Sections: Portions of 13, 24, and 25.

Township 14 South, Sections: All of 2, 3, 4 and 5.

d) The right to use so much of the surface as may be necessary or convenient in conjunction with Lessee's operations hereunder, as long as Lessee does not unreasonably interfere with the use of the surface.

e) The right to include the Leased Premises or any portion thereof in any plan of unitization for coal or Federal logical mining unit pursuant to any such unit agreement, and so that operations or mining in any portion of the unit shall be deemed operations or mining on the Leased Premises.

f) The right to subside, collapse, sink, lower, and alter the surface, subsurface, and superadjacent stata as a result of Lessee's permitted operations hereunder without any liability for such removal of coal where Lessee has actually caused such subsidence provided, however, that any subsidence-caused damage to surface structures such as roads or buildings will be repaired at Lessee's expense. In the event that any surface water resource is affected by diminution or interruption resulting from underground coal mining operations, Lessee shall replace such water in accordance with the Lessee's approved Mining and Reclamation Plan.

All of the rights of the Lessee under this Lease shall continue to exist after Merchantable Coal (hereinafter defined) has been mined and removed from the Leased Premises for so long as Lessee is conducting

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mining operations on lands comprising any portion of the General Mining Area.

For the purposes of the Lease, the term "Coal" is used in its commonly accepted meaning and shall include any seam, vein, bed, strata or deposit, from the lowest grade of lignite through the highest grade of anthracite, both inclusive, and all constituent products thereof in whatever physical state or form produced, and all impurities and other minerals of every nature and type of substance associated or commingled therewith, including methane or coal bed methane and other naturally-occurring gases contained therein.

For the purposes of the Lease, the term Merchantable Coal is defined as coal which can be sold at a reasonable profit in markets available to Lessee utilizing modern methods, procedures and accounting principles customarily used by competent operations in the region of the Leased Premises.

3. Term. This Lease shall remain in effect for a term of twenty (20) years from the Effective Date and so long thereafter as Coal is being mined, produced, processed or marketed from the Leased Premises, or so long as the Lease may be held in force and effect by some other provision of the Lease.

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STATE OF Utah)
)
COUNTY OF Utah)

The foregoing Memorandum of Lease was acknowledged before me this 22nd day of October, 1998 by James O. Tracy, Jr. and Linda D. Tracy.

Linda K. Eggett
Notary Public
My commission expires: June 29, 2001

STATE OF Missouri)
)
COUNTY OF St Louis)

The foregoing Memorandum of Lease was acknowledged before me this 29th day of October by Mark A. Luzecky as Vice-President Finance of Canyon Fuel Company, LLC, a Delaware Limited Liability Company, on behalf of said Company.

Notary Public
My Commission Expires:

JAN L. WOOTON
NOTARY PUBLIC STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXP. JAN. 27,2002

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FEB 13 2017
Div. of Oil, Gas & Mining

Canyon Fuel
Company, LLC
A Subsidiary of Bowie Resource Holdings, LLC

Skyline Mine
Corey Heaps, General Manager
HC35, Box 380
Helper, Utah 84526
(435) 448-2619
Fax (435) 448-2632

*Via Certified Mail

April 17, 2017

Mr. Rick Torgerson, Region 4 Director
Utah Department of Transportation
210 West 800 South
Richfield, Utah 84701

RE: State of Utah Highway SR-264; Subsidence Impact Agreement

To Whom It May Concern:

Canyon Fuel Company, LLC (CFC) Skyline Mines is notifying you of the mine's plan to expand mining into Sections 21, 28, and 33 in Township 13 South, Range 6 East, SLB&M, and Sections 4 and 5 in Township 14 South, Range 6 East, SLB&M. CFC recently acquired this coal lease in this area, and plans to undermine portions of SR-264 in these areas; specifically in areas north of Boulger Reservoir between mile markers approximately 4.5 to 6 (see attached map). Since SR-264 traverses areas which may be affected by subsidence from mining operations, this letter is intended to identify both the obligations and rights of CFC with respect to subsidence from mining operations, and the effects, if any on SR-264.

If accepted and agreed to by the Utah Department of Transportation (UDOT), UDOT has no objection to and will allow CFC's mining operations being conducted, as proposed by CFC, within the area of influence of SR-264. In consideration for such authorization, CFC agrees to repair promptly all damage, such as surface impacts, to SR-264 due to subsidence caused by CFC as we have done previously on other sections of the road.

If UDOT agrees to the provisions as noted, please sign both copies of this letter agreement and return one copy to Canyon Fuel Company, LLC.

If you have any questions regarding this letter or would like to discuss future mining plans for the above referenced sections, please call Gregg Galecki at (435) 448-2636 or me at (435) 448-2662.

Sincerely,

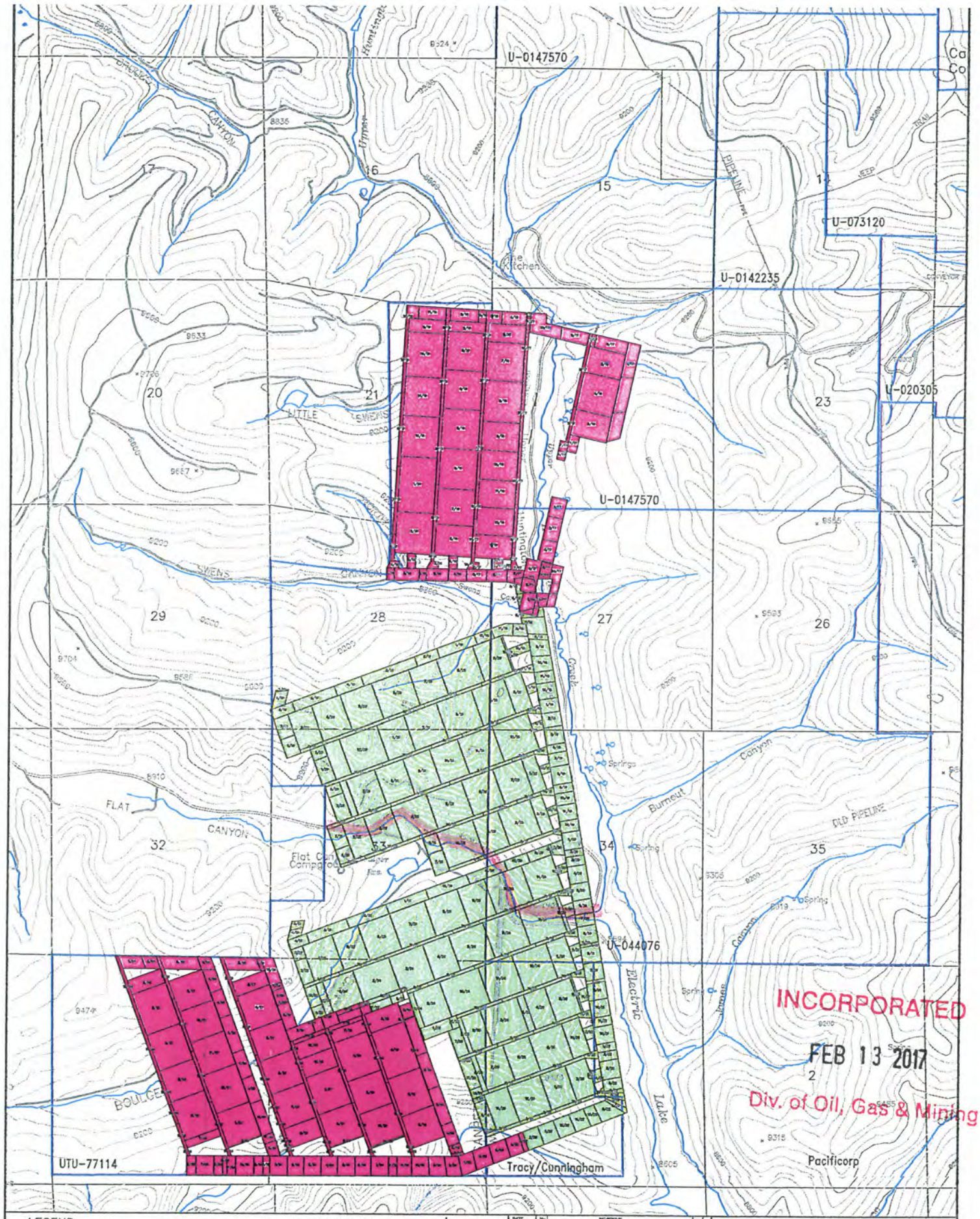
Corey Heaps

Corey Heaps
Mine Manager, Skyline Mine
Canyon Fuel Company, LLC

INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

Agreed and accepted this _____day of _____, 2017.

_____
Rick Torgerson
Director, Region 4
Utah Department of Transportation



LEGEND

- LOB SEAM
- LOA/FLAT CANYON SEAM
- PREVIOUSLY MINED AREA

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUICHAPOINT, SKYLINE, UTAH AND FARNHAM LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ESCALE CANYON ROAD LOCATIONS FROM DIGITAL RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH - 886147

DATE	No.	REVISIONS

SKYLINE MINE
MINE 4
COAL SEAM PLAN

Canyon Fuel Company, LLC
Skyline Mines

SCALE: 1"=1000'	DATE: 04/30/16	CK.BY: GGalecki	REVISION:
DWG. NO.: 3.3-4		DR.BY: BBailey	0
SM3.3-4 Rev 0.dwg			4-30-2016

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Canyon Fuel
Company, LLC
A Subsidiary of Bowie Resource Holdings, LLC

Skyline Mine
Corey Heaps, General Manager
HC35, Box 380
Helper, Utah 84526
(435) 448-2619
Fax (435) 448-2632

*Via Certified Mail

April 17, 2017

Mr. & Mrs. David G. Cunningham
995 East Hillside Drive
Provo, Utah 84604

RE: Canyon Fuel Company, LLC, Skyline Mines; New Federal Lease UTU-77114 commonly referred to as the "Flat Canyon Lease"

Dear Mrs. & Mrs. Tracy:

As required by State mining regulations (R645-301-525.700), Canyon Fuel Company, LLC (CFC) Skyline Mines is notifying you of the mine's plan to expand mining into Sections 21, 28, and 33 in Township 13 South, Range 6 East, SLB&M, and Sections 4 and 5 in Township 14 South, Range 6 East, SLB&M. CFC recently acquired this coal lease in this area, Federal Lease UTU-77114, commonly referred to as the "Flat Lease" and plans to mine portions of this lease underlying National Forest lands in these areas. Mining is planned to be initiated in Federal Lease UTU-77114 in 2017 and continue through approximately 2029. No subsidence or surface disturbance will occur as the result of developing the mains in any of the areas listed. Minor surface subsidence may occur in areas where longwall mining will be conducted, but no surface or ground water flows will be interrupted or diminished as a result of this mining activity. The area to be mined includes your property located in the Upper Huntington drainage west of Electric Lake and currently under lease with Canyon Fuel Company. Electric Lake will not be undermined using longwall mining techniques. Attached is a copy of the Skyline Mine general mine plan indicating approximately when your property will be mined.

If you have any questions regarding this letter or would like to discuss future mining plans for the above referenced sections, please call Gregg Galecki at (435) 448-2636 or me at (435) 448-2662.

Sincerely,

Corey Heaps

Corey Heaps
Mine Manager, Skyline Mine
Canyon Fuel Company, LLC.

xc:Suzanne Steab, Utah Division of Oil, Gas & Mining

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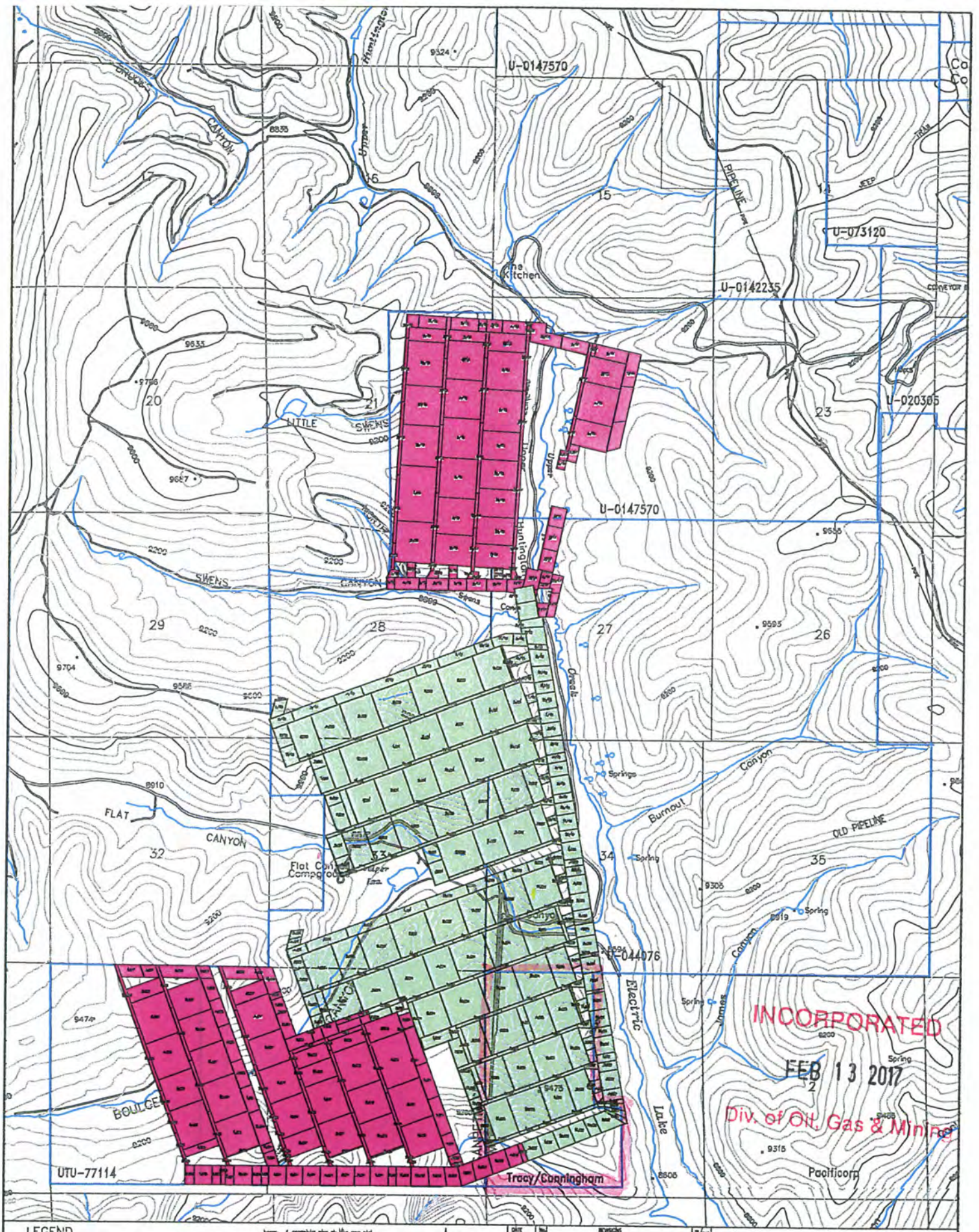
FEB 13 2017
Div. of Oil, Gas & Mining



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LEGEND

- LOB SEAM
- LOA/FLAT CANYON SEAM
- PREVIOUSLY MINED AREA

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

CONTOUR INTERVAL: 80 Feet

DATE	No.	REVISIONS	BY

SKYLINE MINE
MINE 4
COAL SEAM PLAN

Canyon Fuel Company, LLC
Skyline Mines

SCALE: 1" = 1000'	DATE: 04/30/16	CK.BY: GGalecki	REVISION: 0
DWG. NO.: 3.3-4		DR.BY: BBailey	4-30-2016

Canyon Fuel
Company, LLC
A Subsidiary of Bowie Resource Holdings, LLC

Skyline Mine
Corey Heaps, General Manager
HC35, Box 380
Helper, Utah 84526
(435) 448-2619
Fax (435) 448-2632

*Via Certified Mail

April 17, 2017

Mr. & Mrs. James O. Tracy
3148 North Timpview Dr.
Provo, Utah 84604

RE: Canyon Fuel Company, LLC, Skyline Mines; New Federal Lease UTU-77114 commonly referred to as the "Flat Canyon Lease"

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If you have any questions regarding this letter or would like to discuss future mining plans for the above referenced sections, please call Gregg Galecki at (435) 448-2636 or me at (435) 448-2662.

Sincerely,

Corey Heaps

Corey Heaps
Mine Manager, Skyline Mine
Canyon Fuel Company, LLC.

xc: Suzanne Steab, Utah Division of Oil, Gas & Mining

INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

Canyon Fuel Company, LLC
A Subsidiary of Bowie Resource Holdings, LLC

Skyline Mine
Corey Heaps, General Manager
HC35, Box 380
Helper, Utah 84526
(435) 448-2619
Fax (435) 448-2632

*Via Certified Mail

April 17, 2017

Price River Water Improvement District
265 S. Fairgrounds Rd.
Price, Utah 84501

RE: Canyon Fuel Company, LLC, Skyline Mines; New Federal Lease UTU-77114 commonly referred to as the "Flat Canyon Lease"

To Whom It May Concern:

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If you have any questions regarding this letter or would like to discuss future mining plans for the above referenced sections, please call Gregg Galecki at (435) 448-2636 or me at (435) 448-2662.

Sincerely,

Corey Heaps

Corey Heaps
Mine Manager, Skyline Mine
Canyon Fuel Company, LLC.

xc:Suzanne Steab, Utah Division of Oil, Gas & Mining

INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

Canyon Fuel
Company, LLC
A Subsidiary of Bowie Resource Holdings, LLC

Skyline Mine
Corey Heaps, General Manager
HC35, Box 380
Helper, Utah 84526
(435) 448-2619
Fax (435) 448-2632

*Via Certified Mail

April 17, 2017

Manti-LaSal National Forest
c/o Darren Olsen
599 West Price River Road
Price, Utah 84501

RE: Canyon Fuel Company, LLC, Skyline Mines; New Federal Lease UTU-77114 commonly referred to as the "Flat Canyon Lease"

To Whom It May Concern:

As required by State mining regulations (R645-301-525.700), Canyon Fuel Company, LLC (CFC) Skyline Mines is notifying you of the mine's plan to expand mining into Sections 21, 28, and 33 in Township 13 South, Range 6 East, SLB&M, and Sections 4 and 5 in Township 14 South, Range 6 East, SLB&M. CFC recently acquired this coal lease in this area, Federal Lease UTU-77114, commonly referred to as the "Flat Lease" and plans to mine portions of this lease underlying National Forest lands in these areas. Mining is planned to be initiated in Federal Lease UTU-77114 in 2017 and continue through approximately 2029. No subsidence or surface disturbance will occur as the result of developing the mains in any of the areas listed. Minor surface subsidence may occur in areas where longwall mining will be conducted, but no surface or ground water flows will be interrupted or diminished as a result of this mining activity. Copies of the mine plan modification may be examined at the Skyline Mine or at the Utah Division of Oil, Gas & Mining offices in Salt Lake City, Utah.

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Sincerely,

Corey Heaps

Corey Heaps
Mine Manager, Skyline Mine
Canyon Fuel Company, LLC.

xc:Suzanne Steab, Utah Division of Oil, Gas & Mining

INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

Canyon Fuel Company, LLC
A Subsidiary of Bowie Resource Holdings, LLC

Skyline Mine
Corey Heaps, General Manager
HC35, Box 380
Helper, Utah 84526
(435) 448-2619
Fax (435) 448-2632

*Via Certified Mail

April 17, 2017

Emery Water Conservancy
50 S. 100 E.
Castle Dale, Utah 84513

RE: Canyon Fuel Company, LLC, Skyline Mines; New Federal Lease UTU-77114 commonly referred to as the "Flat Canyon Lease"

To Whom It May Concern:

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Sincerely,

Corey Heaps

Corey Heaps
Mine Manager, Skyline Mine
Canyon Fuel Company, LLC.

xc:Suzanne Steab, Utah Division of Oil, Gas & Mining

INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

Append A3

STANDARD LABORATORIES, INC.

04/05/00

CUSTOMER: CANYON FUEL COMPANY

JOB NO.: 200000285006
LOCATION: CASPER, WY

SAMPLE ID: 89-101 CORE DH 99-33-1, LOB, COMP #1 (COAL) 1798.45-1810.90'OVAL:

TRACE ELEMENT, DRY BASIS			RESULT
ANTIMONY	Sb	PPM	0.25
ARSENIC	As	PPM	0.5
BARIUM	Ba	PPM	49
BERYLLIUM	Be	PPM	0.3
BROMINE	Br	PPM	14.3
CADMIUM	Cd	PPM	0.06
CHLORINE	Cl	PPM	300
CHROMIUM	Cr	PPM	3
COBALT	Co	PPM	0.7
COPPER	Cu	PPM	6
FLUORINE	F	PPM	79.9
LEAD	Pb	PPM	1
LITHIUM	Li	PPM	2.5
MANGANESE	Mn	PPM	8
MERCURY	Hg	PPM	0.00
MOLYBDENUM	Mo	PPM	0.3
NICKEL	Ni	PPM	2
SELENIUM	Se	PPM	0.9
SILVER	Ag	PPM	0.08
STRONTIUM	Sr	PPM	36
TIN	Sn	PPM	<0.2
VANADIUM	V	PPM	5
ZINC	Zn	PPM	12
ZIRCONIUM	Zr	PPM	4.9

RECEIVED
MAY 09 2017
DIV. OF OIL, GAS & MINING

INCORPORATED

FEB 13 2017
Div. of Oil, Gas & Mining

STANDARD LABORATORIES, INC.

Apr. 5. 2000 8:35AM 3072340013 No.6915 P. 2/2

04/05/00

CUSTOMER: CANYON FUEL COMPANY

89-94 CORE DH 99-33-1, LOB, ROOF ROCK (SS) 1797.95-1798.45'

JOB NO.: 200000285001
LOCATION: CASPER, WY
APPROVAL:

PROXIMATE ANALYSIS (%)

	AS RECD	DRY	EQM
MOISTURE	3.88		
ASH	63.60	66.17	
SULFUR	0.50	0.52	
BTU/#	38	3942	
		11654	

ULTIMATE ANALYSIS (%)

	AS RECD	DRY	EQM

MINERAL ANALYSIS OF ASH (%)

PHOSPHORUS PENTOXIDE	0.20
SILICON DIOXIDE	74.83
FERRIC OXIDE	1.85
ALUMINUM OXIDE	11.31
TITANIUM DIOXIDE	0.48
MANGANESE DIOXIDE	0.02
CALCIUM OXIDE	4.24
MAGNESIUM OXIDE	3.01
POTASSIUM OXIDE	2.26
SODIUM OXIDE	0.08
SULFUR TRIOXIDE	0.55
BARIUM OXIDE	0.05
STRONTIUM	0.00
UNDETERMINED	1.12

FORMS OF SULFUR (%)

	AS RECD	DRY
SULFATE	0.01	0.01
PYRITIC	0.35	0.36
ORGANIC	0.14	0.15

FUSION TEMPERATURE OF ASH (F)

	OXIDIZING	REDUCING

ADDITIONAL DATA

AIR DRY LOSS	
LBS H20/MM BTU	
LBS ASH/MM BTU	167.86
LBS SULFUR/MM BTU	1.32
BASE/ACID RATIO	0.13
T250	2900+ DEG F
% ALKALI AS Na2O	1.04
SPECIFIC GRAVITY	1.96
FREE SWELLING INDEX	

GRINDABILITY (HGI)

AT % MOISTURE

WATER SOLUBLE ALKALIES (%)

	AS RECD	DRY

Div. of Oil, Gas & Mining
FEB 13 2017
INCORPORATED

STANDARD LABORATORIES, INC.

04/05/00

CUSTOMER: CANYON FUEL COMPANY

89-98 CORE DH 99-33-1, LOB, FLOOR ROCK (SS) 1810.90-1811.40'

JOB NO.: 200000285005
LOCATION: CASPER, WY
APPROVAL:

PROXIMATE ANALYSIS (%)

	AS RECD	DRY	EQM
MOISTURE	1.18		
ASH	91.76	92.85	
SULFUR	0.03	0.03	
BTU/#	524	530	
		7420	

ULTIMATE ANALYSIS (%)

	AS RECD	DRY	EQM

MINERAL ANALYSIS OF ASH (%)

PHOSPHORUS PENTOXIDE	0.00
SILICON DIOXIDE	88.33
FERRIC OXIDE	0.54
ALUMINUM OXIDE	8.61
TITANIUM DIOXIDE	0.48
MANGANESE DIOXIDE	0.00
CALCIUM OXIDE	0.09
MAGNESIUM OXIDE	0.43
POTASSIUM OXIDE	1.75
SODIUM OXIDE	0.00
SULFUR TRIOXIDE	0.05
BARIUM OXIDE	0.03
STRONTIUM	0.00
UNDETERMINED	-0.31

FORMS OF SULFUR (%)

	AS RECD	DRY
SULFATE	0.01	0.01
PYRITIC	0.01	0.01
ORGANIC	0.01	0.01

FUSION TEMPERATURE OF ASH (F)

OXIDIZING	REDUCING

ADDITIONAL DATA

AIR DRY LOSS		
LBS H20/MM BTU		
LBS ASH/MM BTU	751.89	
LBS SULFUR/MM BTU	0.57	
BASE/ACID RATIO	0.03	
T250	2900+	DEG F
% ALKALI AS Na2O	1.07	
SPECIFIC GRAVITY	2.32	
FREE SWELLING INDEX		

GRINDABILITY (HGI)

AT % MOISTURE

WATER SOLUBLE ALKALIES (%)

AS RECD	DRY

No.6915 P. 6/21
Apr. 5. 2000 8:35AM 3072340013
Div. of Oil, Gas & Mining
FEB 13 2017
INCORPORATED

INCORPORATED

FEB 13 2017

Div. of Oil, Gas & Mining

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 708-953-9300 FAX: 708-953-9306

SINCE 1908

Member of the SGS Group (Société Générale de Surveillance)

PLEASE ADDRESS ALL CORRESPONDENCE TO:
4665 PARIS, B-200, DENVER, CO 80239
TEL: (303) 373-4772
FAX: (303) 373-4791

January 4, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE ID:33-11831

Kind of sample reported to us: ROOF ROCK

Sample taken at: XXXXX

Sample taken by: CTE SKYLINE

Date sampled: ------

Date received: December 14, 1995

Analysis Report No. 72-325409

FORMS OF SULFUR

	As Received	Dry Basis
% Pyritic	0.02	0.02
% Sulfate	<0.01	<0.01
% Organic(diff)	0.01	0.01
% Sulfur	0.04	0.04

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Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Denver Laboratory

COMMERCIAL TESTING & ENGINEERING CO.

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TEL: (303) 373-4772
FAX: (303) 373-4791

January 4, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE ID:33-11831

Kind of sample ROOF ROCK

Sample taken by CTE SKYLINE

Date received December 14, 1995

Analysis report no. 72-325409

PARAMETER	RESULTS
Acid Base Account	80.6 T/1000 T
Acid Potential	0.6 T/1000 T
Neutralization Potential	81.2 T/1000 T

Results: Results are reported as indicated.

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Esequiel Barro

Manager, Denver Laboratory

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TEL: (801) 637-7925, EXT. 2044
FAX: (801) 637-7929

November 2, 1995

UTAH FUEL COMPANY
P O BOX 719
HELPER UT 84526

Sample identification by
Utah Fuel Company

CUSTOMER: SKYLINE MINE
LOWER BENCH
FLOOR ROCK
SEAM: LOA
FOOTAGE: 2042.25 - 2042.75
SAMPLE NET: 5 LBS.

95-21-1

Kind of sample reported to us	FLOOR ROCK
Sample taken at	Skyline Mine
Sample taken by	Utah Fuel Company
Date sampled	------
Date received	October 31, 1995

Analysis report no. 33-11834

PROXIMATE ANALYSIS

	As Received	Dry Basis
% Moisture	4.01	xxxxx
%Ash	86.90	90.53
% Volatile	9.08	9.46
% Fixed Carbon	0.01	0.01
	100.00	100.00
Btu/lb	xxxxx	xxxxx
% Sulfur	xxxxxx	xxxxxx

% Moisture, Ash-free Volatile = 99.89
% Dry, Mineral matter free Volatile = xxxxxx
% Dry, Mineral matter free Fixed Carbon = xxxxxx
Moisture, Ash-free Btu = xxxxx
Moisture, Mineral matter free Btu * = xxxxx
Pounds of SO_2 per 10^6 Btu @ 100% = xxxxxx
(Based on as rec'd moisture)*
% Air Dry Loss = 3.18
Pound of Sulfur per 10^6 Btu = xxxxxx
% Residual moisture = 0.86

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Manager, Skyline Laboratory

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January 4, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE ID:33-11834

Kind of sample reported to us: FLOOR ROCK

Sample taken at: XXXXX

Sample taken by: CTE SKYLINE

Date sampled: ------

Date received: December 14, 1995

Analysis Report No. 72-325408

FORMS OF SULFUR

	As Received	Dry Basis
% Pyritic	1.18	1.20
% Sulfate	<0.01	<0.01
% Organic(diff)	0.40	0.40
% Sulfur	1.59	1.61

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January 4, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE ID:33-11834

Kind of sample FLOOR ROCK

Sample taken by CTE SKYLINE

Date received December 14, 1995

Analysis report no. 72-325408

PARAMETER	RESULTS
Acid Base Account	-1.5 T/1000 T
Acid Potential	37.5 T/1000 T
Neutralization Potential	36.0 T/1000 T

Results: Results are reported as indicated.

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February 12, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE #: 33-12156
CORE DRILL HOLE 95-28-01
ROOF ROCK
BEGINNING FOOTAGE: 1210.95
ENDING FOOTAGE: 1211.45

Kind of sample reported to us: ROOF ROCK

Sample taken at: XXXXX

Sample taken by: CTE SKYLINE

Date sampled: ------

Date received: February 1, 1996

Analysis report no. 72-328481

	FORMS OF SULFUR As Received	Dry Basis
% Pyritic Sulfur	0.84	0.85
% Sulfate Sulfur	< 0.01	< 0.01
% Organic Sulfur(diff)	0.16	0.16
% Total Sulfur	1.01	1.02

APPARENT SPECIFIC GRAVITY = 2.21

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February 6, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE #: 33-12156
CORE DRILL HOLE 95-28-01
ROOF ROCK
BEGINNING FOOTAGE: 1210.95
ENDING FOOTAGE: 1211.45

Kind of sample ROOF ROCK

Sample taken by CTE SKYLINE

Date received February 1, 1996

Analysis report no. 72-328481

PARAMETER	RESULTS
Acid Base Account	129.7 T/1000 T
Acid Potential	31.6 T/1000 T
Neutralization Potential	161.3 T/1000 T

Results: Results are reported as indicated.

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E Siegmund Jaros

Manager, Denver Laboratory

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February 12, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE #: 33-12158
CORE DRILL HOLE 95-28-01
LOWER COAL
BEGINNING FOOTAGE: 1215.58
ENDING FOOTAGE: 1219.70

Kind of sample reported to us: COAL

Sample taken at: XXXXX

Sample taken by: CTE SKYLINE

Date sampled: ------

Date received: February 1, 1996

Analysis report no. 72-328483

	FORMS OF SULFUR	
	As Received	Dry Basis
% Pyritic Sulfur	0.05	0.05
% Sulfate Sulfur	< 0.01	< 0.01
% Organic Sulfur(diff)	0.39	0.40
% Total Sulfur	0.45	0.46

APPARENT SPECIFIC GRAVITY = 1.28

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March 6, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE #: 33-12160
CORE DRILL HOLE 95-28-01
COMP #1
BEGINNING FOOTAGE: 1211.45
ENDING FOOTAGE: 1219.70

Kind of sample COAL

Sample taken by CTE SKYLINE

Date received February 1, 1996

Analysis report no. 72-328485

TRACE ELEMENTS IN COAL (Dry Coal Basis)

Antimony	<1	ug/g	Manganese	12	ug/g
Arsenic	2	ug/g	Mercury	0.16	ug/g
Barium	15	ug/g	Molybdenum	<2	ug/g
Beryllium	0.3	ug/g	Nickel	3	ug/g
Cadmium	<0.2	ug/g	Selenium	1	ug/g
Chromium	6	ug/g	Silver	<0.2	ug/g
Cobalt	<1	ug/g	Strontium	43	ug/g
Copper	5	ug/g	Tin	<1	ug/g
Lead	2	ug/g	Vanadium	7	ug/g
Lithium	2	ug/g	Zinc	7	ug/g
			Zirconium	7	ug/g

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Byron C. Cat

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February 6, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE #: 33-12159
CORE DRILL HOLE 95-28-01
FLOOR ROCK
BEGINNING FOOTAGE: 1219.70
ENDING FOOTAGE: 1220.20

Kind of sample FLOOR ROCK

Sample taken by CTE SKYLINE

Date received February 1, 1996

Analysis report no. 72-328484

PARAMETER	RESULTS
Acid Base Account	115.6 T/1000 T
Acid Potential	0.3 T/1000 T
Neutralization Potential	115.9 T/1000 T

Results: Results are reported as indicated.

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March 7, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE #: 33-12154
CORE DRILL HOLE 95-28-01
COMP #1
BEGINNING FOOTAGE: 1341.58
ENDING FOOTAGE: 1348.00

Kind of sample COAL

Sample taken by CTE SKYLINE

Date received January 25, 1996

Analysis report no. 72-327704

TRACE ELEMENTS IN COAL (Dry Coal Basis)

Antimony	<1	ug/g	Manganese	15	ug/g
Arsenic	5	ug/g	Mercury	0.12	ug/g
Barium	75	ug/g	Molybdenum	<4	ug/g
Beryllium	0.8	ug/g	Nickel	3	ug/g
Cadmium	<0.4	ug/g	Selenium	2	ug/g
Chromium	14	ug/g	Silver	<0.4	ug/g
Cobalt	3	ug/g	Strontium	72	ug/g
Copper	8	ug/g	Tin	<1	ug/g
Lead	17	ug/g	Vanadium	19	ug/g
Lithium	13	ug/g	Zinc	18	ug/g
			Zirconium	20	ug/g

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Byron C. Cate

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FAX: (303) 373-4791

February 12, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE #: 33-12153
CORE DRILL HOLE 95-28-01
FLOOR ROCK
BEGINNING FOOTAGE: 1348.00
ENDING FOOTAGE: 1348.50

Kind of sample reported to us: FLOOR ROCK

Sample taken at: XXXXX

Sample taken by: CTE SKYLINE

Date sampled: ------

Date received: February 1, 1996

Analysis report no. 72-328477

	FORMS OF SULFUR	
	As Received	Dry Basis
% Pyritic Sulfur	0.03	0.03
% Sulfate Sulfur	< 0.01	< 0.01
% Organic Sulfur(diff)	0.01	0.01
% Total Sulfur	0.05	0.05

APPARENT SPECIFIC GRAVITY = 2.53

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February 6, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE #: 33-12153
CORE DRILL HOLE 95-28-01
FLOOR ROCK
BEGINNING FOOTAGE: 1348.00
ENDING FOOTAGE: 1348.50

Kind of sample FLOOR ROCK

Sample taken by CTE SKYLINE

Date received February 1, 1996

Analysis report no. 72-328477

PARAMETER	RESULTS
Acid Base Account	21.5 T/1000 T
Acid Potential	1.6 T/1000 T
Neutralization Potential	23.1 T/1000 T

Results: Results are reported as indicated.

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April 29, 1999

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE NO: 33-15747
SAMPLE ID: ROOF ROCK

98-3-2C

Kind of sample ROCK

Sample taken by CTE SKYLINE

Date received April 9, 1999

Analysis report no. 72-402729

	FORMS OF SULFUR	
	As Received	Dry Basis
% Pyritic Sulfur	0.13	0.13
% Sulfate Sulfur	< 0.01	< 0.01
% Organic Sulfur(diff)	0.41	0.41
% Total Sulfur	0.55	0.55

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Denver Laboratory

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FAX: (303) 373-4791

April 29, 1999

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE NO: 33-15747
SAMPLE ID: ROOF ROCK

Kind of sample ROCK

Sample taken by CTE SKYLINE

Date received April 9, 1999

Analysis report no. 72-402729

PARAMETER	RESULTS	UNITS
Acid Base Account	2.6	T/1000 T
Acid Potential	17.2	T/1000 T
Neutralization Potential	19.8	T/1000 T

Results: Results are reported on an as received basis.

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FAX: (303) 373-4781

April 29, 1999

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE #: 33-15756
CORE COMPOSITE 4
CORE HOLE: 98-3-2C
LOB SEAM

Kind of sample COAL

Sample taken by CTE SKYLINE

Date received April 9, 1999

Analysis report no. 72-402736

TRACE ELEMENTS IN COAL (Dry Coal Basis)

Antimony	<1 ug/g	Manganese	12 ug/g
Arsenic	<1 ug/g	Mercury	0.07 ug/g
Barium	89 ug/g	Molybdenum	5 ug/g
Beryllium	<0.2 ug/g	Nickel	<1 ug/g
Cadmium	<0.2 ug/g	Selenium	<1 ug/g
Chromium	3 ug/g	Silver	<0.2 ug/g
Cobalt	1 ug/g	Strontium	64 ug/g
Copper	3 ug/g	Tin	<1 ug/g
Lead	2 ug/g	Vanadium	4 ug/g
Lithium	1 ug/g	Zinc	3 ug/g
		Zirconium	4 ug/g

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April 23, 1999

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE NO: 33-15752
SAMPLE ID: FLOOR COAL

Kind of sample COAL

Sample taken by CTE SKYLINE

Date received April 9, 1999

Analysis report no. 72-402734

FORMS OF SULFUR	As Received	Dry Basis
% Pyritic Sulfur	0.07	0.07
% Sulfate Sulfur	< 0.01	< 0.01
% Organic Sulfur(diff)	0.22	0.23
% Total Sulfur	0.30	0.31

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Byron C. Cat

Denver Laboratory

MEMBER ACIL

Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench A
Product Description:	Coal	Footage Begin:	2065.1
		Footage End:	2066.15
		Thickness:	1.05
		Seam:	LOA
		Lithology:	Rock
		Sample Wt.:	6.40 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531337-001

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	3.17		
Ash %	ASTM D7582	85.60	88.40	
Sulfur %	ASTM D4239 (A)	1.40	1.44	
Gross Calorific Value Btu/lb	ASTM D5865	515	532	4582
Sulfur, Pyritic %	ASTM D2492	1.26	1.30	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.13	0.13	

Tests	Result	Unit	Method
Apparent Specific Gravity	2.55	---	Modified D167

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Coco van den Bergh
Branch Manager

SGS North America Inc. | Minerals Services Division
2035 North Airport Road Huntington UT 84528 **t** (435) 653-2311 **f** (435)-653-2436 www.sgs.com/minerals

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SGS

Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench A
Product Description:	Coal	Footage Begin:	2065.1
		Footage End:	2066.15
		Thickness:	1.05
		Seam:	LOA
		Lithology:	Rock
		Sample Wt.:	6.40 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531337-001

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	69.83	%	ASTM D6349
Aluminum Oxide, Al2O3	16.14	%	ASTM D6349
Titanium Dioxide, TiO2	0.67	%	ASTM D6349
Iron Oxide, Fe2O3	3.42	%	ASTM D6349
Calcium Oxide, CaO	3.31	%	ASTM D6349
Magnesium Oxide, MgO	2.12	%	ASTM D6349
Potassium Oxide, K2O	2.98	%	ASTM D6349
Sodium Oxide, Na2O	0.17	%	ASTM D6349
Sulfur Trioxide, SO3	0.97	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.32	%	ASTM D6349
Strontium Oxide, SrO	0.01	%	ASTM D6349
Barium Oxide, BaO	0.04	%	ASTM D6349
Manganese Oxide, MnO2	0.02	%	ASTM D6349
Silica Value	88.75	---	
Base Acid Ratio	0.14	---	
T250 Temperature	>2900	°F	
Fouling Index	0.17	---	
Alkalies as Na2O, As-Received	1.82	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	1.03	---	
Silica/Alumina Ratio	4.33	---	

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Div. of Oil, Gas & Mining

Coco van den Bergh
Branch Manager

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HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench B
Product Description:	Coal	Footage Begin:	2066.15
		Footage End:	2069.5
		Thickness:	3.35
		Seam:	LOA
		Lithology:	Coal
		Sample Wt.:	15.92 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531337-002

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	4.89		
Ash %	ASTM D7582	42.12	44.29	
Sulfur %	ASTM D4239 (A)	1.39	1.46	
Gross Calorific Value Btu/lb	ASTM D5865	7170	7539	13533
Sulfur, Pyritic %	ASTM D2492	0.85	0.89	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.53	0.56	

Tests	Result	Unit	Method
Apparent Specific Gravity	1.66	---	Modified D167

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HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench B
Product Description:	Coal	Footage Begin:	2066.15
		Footage End:	2069.5
		Thickness:	3.35
		Seam:	LOA
		Lithology:	Coal
		Sample Wt.:	15.92 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531337-002

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	68.69	%	ASTM D6349
Aluminum Oxide, Al2O3	18.69	%	ASTM D6349
Titanium Dioxide, TiO2	0.77	%	ASTM D6349
Iron Oxide, Fe2O3	4.69	%	ASTM D6349
Calcium Oxide, CaO	1.42	%	ASTM D6349
Magnesium Oxide, MgO	1.43	%	ASTM D6349
Potassium Oxide, K2O	2.72	%	ASTM D6349
Sodium Oxide, Na2O	0.33	%	ASTM D6349
Sulfur Trioxide, SO3	0.96	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.23	%	ASTM D6349
Strontium Oxide, SrO	0.02	%	ASTM D6349
Barium Oxide, BaO	0.04	%	ASTM D6349
Manganese Oxide, MnO2	0.01	%	ASTM D6349
Silica Value	90.11	---	
Base Acid Ratio	0.12	---	
T250 Temperature	>2900	°F	
Fouling Index	0.04	---	
Slagging Index	0.18	---	
Alkalies as Na2O, As-Received	0.89	%	
Type of Ash	BITUMINOUS	---	
Iron/Calcium Ratio	3.30	---	
Silica/Alumina Ratio	3.68	---	

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ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench C
Product Description:	Coal	Footage Begin:	2069.5
		Footage End:	2074.43
		Thickness:	4.93
		Seam:	LOA
		Lithology:	Coal
		Sample Wt.:	19.38 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531337-003

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	6.21		
Ash %	ASTM D7582	7.94	8.46	
Sulfur %	ASTM D4239 (A)	0.83	0.88	
Gross Calorific Value Btu/lb	ASTM D5865	12313	13128	14341
Sulfur, Pyritic %	ASTM D2492	0.31	0.33	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.51	0.54	

Tests	Result	Unit	Method
Apparent Specific Gravity	1.32	---	Modified D167

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ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench C
Product Description:	Coal	Footage Begin:	2069.5
		Footage End:	2074.43
		Thickness:	4.93
		Seam:	LOA
		Lithology:	Coal
		Sample Wt.:	19.38 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531337-003

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	44.79	%	ASTM D6349
Aluminum Oxide, Al2O3	16.93	%	ASTM D6349
Titanium Dioxide, TiO2	0.69	%	ASTM D6349
Iron Oxide, Fe2O3	8.42	%	ASTM D6349
Calcium Oxide, CaO	12.72	%	ASTM D6349
Magnesium Oxide, MgO	2.87	%	ASTM D6349
Potassium Oxide, K2O	0.24	%	ASTM D6349
Sodium Oxide, Na2O	1.13	%	ASTM D6349
Sulfur Trioxide, SO3	11.49	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.42	%	ASTM D6349
Strontium Oxide, SrO	0.10	%	ASTM D6349
Barium Oxide, BaO	0.18	%	ASTM D6349
Manganese Oxide, MnO2	0.02	%	ASTM D6349
Silica Value	65.10	---	
Base Acid Ratio	0.41	---	
T250 Temperature	2403	°F	
Fouling Index	1.13	---	
Alkalies as Na2O, As-Received	0.10	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.66	---	
Silica/Alumina Ratio	2.65	---	

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Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench D
Product Description:	Coal	Footage Begin:	2074.43
		Footage End:	2077.35
		Thickness:	2.92
		Seam:	LOA
		Lithology:	Coal
		Sample Wt.:	10.86 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531337-004

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	5.84		
Ash %	ASTM D7582	6.47	6.87	
Sulfur %	ASTM D4239 (A)	0.58	0.61	
Gross Calorific Value Btu/lb	ASTM D5865	12639	13423	14413
Sulfur, Pyritic %	ASTM D2492	0.08	0.08	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.49	0.52	

Tests	Result	Unit	Method
Apparent Specific Gravity	1.32	---	Modified D167

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Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench D
Product Description:	Coal	Footage Begin:	2074.43
		Footage End:	2077.35
		Thickness:	2.92
		Seam:	LOA
		Lithology:	Coal
		Sample Wt.:	10.86 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531337-004

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	56.76	%	ASTM D6349
Aluminum Oxide, Al2O3	10.71	%	ASTM D6349
Titanium Dioxide, TiO2	0.71	%	ASTM D6349
Iron Oxide, Fe2O3	5.04	%	ASTM D6349
Calcium Oxide, CaO	11.94	%	ASTM D6349
Magnesium Oxide, MgO	2.50	%	ASTM D6349
Potassium Oxide, K2O	0.29	%	ASTM D6349
Sodium Oxide, Na2O	0.91	%	ASTM D6349
Sulfur Trioxide, SO3	10.54	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.27	%	ASTM D6349
Strontium Oxide, SrO	0.09	%	ASTM D6349
Barium Oxide, BaO	0.22	%	ASTM D6349
Manganese Oxide, MnO2	0.02	%	ASTM D6349
Silica Value	74.45	---	
Base Acid Ratio	0.30	---	
T250 Temperature	2555	°F	
Fouling Index	0.91	---	
Alkalies as Na2O, As-Received	0.07	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.42	---	
Silica/Alumina Ratio	5.30	---	

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Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench E
Product Description:	Coal	Footage Begin:	2077.35
		Footage End:	2078.5
		Thickness:	1.15
		Seam:	LOA
		Lithology:	Rock
		Sample Wt.:	8.28 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531337-005

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	2.36	
Ash %	ASTM D7582	90.57	92.76
Sulfur %	ASTM D4239 (A)	<0.05	<0.05
Gross Calorific Value Btu/lb	ASTM D5865	<300	
Sulfur, Pyritic %	ASTM D2492	0.05	0.05
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01
Sulfur, Organic (by diff) %	ASTM D2492	<0.01	0.01

Tests	Result	Unit	Method
Apparent Specific Gravity	2.53	---	Modified D167

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Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench E
Product Description:	Coal	Footage Begin:	2077.35
		Footage End:	2078.5
		Thickness:	1.15
		Seam:	LOA
		Lithology:	Rock
		Sample Wt.:	8.28 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531337-005

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	80.40	%	ASTM D6349
Aluminum Oxide, Al2O3	10.00	%	ASTM D6349
Titanium Dioxide, TiO2	0.47	%	ASTM D6349
Iron Oxide, Fe2O3	1.15	%	ASTM D6349
Calcium Oxide, CaO	4.04	%	ASTM D6349
Magnesium Oxide, MgO	0.99	%	ASTM D6349
Potassium Oxide, K2O	2.14	%	ASTM D6349
Sodium Oxide, Na2O	0.13	%	ASTM D6349
Sulfur Trioxide, SO3	0.44	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.18	%	ASTM D6349
Strontium Oxide, SrO	0.01	%	ASTM D6349
Barium Oxide, BaO	0.03	%	ASTM D6349
Manganese Oxide, MnO2	0.02	%	ASTM D6349
Silica Value	92.86	---	
Base Acid Ratio	0.09	---	
T250 Temperature	>2900	°F	
Fouling Index	0.13	---	
Alkalies as Na2O, As-Received	1.39	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.28	---	
Silica/Alumina Ratio	8.04	---	

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HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	2066.15
		Footage End:	2077.35
		Thickness:	11.2
		Seam:	LOA
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver; insufficient sample for HGI

SGS Minerals Sample ID: 782-1531337-006

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	5.54		
Ash %	ASTM D7582	17.92	18.97	
Volatile Matter %	ASTM D7582	38.73	41.00	
Fixed Carbon %	ASTM D3172 (by diff)	37.81	40.03	
Sulfur %	ASTM D4239 (A)	0.93	0.99	
Gross Calorific Value Btu/lb	ASTM D5865	10868	11506	14199
Carbon %	ASTM D5373	60.50	64.05	
Hydrogen %	ASTM D5373	4.63	4.90	
Nitrogen %	ASTM D5373	1.25	1.32	
Oxygen %	ASTM D3176 (by diff)	9.23	9.77	
Chlorine, Cl µg/g	ASTM D6721		180	
Water Soluble Alkalies - K %	ASTMC114MSW7610	0.007	0.007	
Water Soluble Alkalies - Na %	ASTMC114MSW7770	0.014	0.015	

Tests	Result	Unit	Method
Equilibrium Moisture	4.80	%	ASTM D1412
Apparent Specific Gravity	1.42	---	Modified D167
FREE SWELLING INDEX			
Free Swelling Index	2.0	---	ASTM D720
FUSION TEMPERATURE OF ASH, REDUCING			
Initial Deformation	2232	°F	ASTM D1857
Softening	2287	°F	ASTM D1857
Hemispherical	2309	°F	ASTM D1857
Fluid	2486	°F	ASTM D1857

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HCR 35 BOX 380
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HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	2066.15
		Footage End:	2077.35
		Thickness:	11.2
		Seam:	LOA
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver; insufficient sample for HGI

SGS Minerals Sample ID: 782-1531337-006

Tests	Result	Unit	Method
FUSION TEMPERATURE OF ASH, OXIDIZING			
Initial Deformation	2250	°F	ASTM D1857
Softening	2296	°F	ASTM D1857
Hemispherical	2356	°F	ASTM D1857
Fluid	2493	°F	ASTM D1857

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Div. of Oil, Gas & Mining

Coco van den Bergh
Branch Manager

SGS North America Inc. | Minerals Services Division
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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	2066.15
		Footage End:	2077.35
		Thickness:	11.2
		Seam:	LOA
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver; insufficient sample for HGI

SGS Minerals Sample ID: 782-1531337-006

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	62.16	%	ASTM D6349
Aluminum Oxide, Al2O3	17.89	%	ASTM D6349
Titanium Dioxide, TiO2	0.76	%	ASTM D6349
Iron Oxide, Fe2O3	5.30	%	ASTM D6349
Calcium Oxide, CaO	4.51	%	ASTM D6349
Magnesium Oxide, MgO	1.81	%	ASTM D6349
Potassium Oxide, K2O	2.05	%	ASTM D6349
Sodium Oxide, Na2O	0.57	%	ASTM D6349
Sulfur Trioxide, SO3	4.55	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.26	%	ASTM D6349
Strontium Oxide, SrO	0.04	%	ASTM D6349
Barium Oxide, BaO	0.09	%	ASTM D6349
Manganese Oxide, MnO2	0.01	%	ASTM D6349
Silica Value	84.25	---	
Base Acid Ratio	0.18	---	
T250 Temperature	>2900	°F	
Fouling Index	0.57	---	
Slagging Index	>100.00	---	
Alkalies as Na2O, As-Received	0.34	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	1.18	---	
Silica/Alumina Ratio	3.47	---	

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	2066.15
		Footage End:	2077.35
		Thickness:	11.2
		Seam:	LOA
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver; insufficient sample for HGI

SGS Minerals Sample ID: 782-1531337-006

Tests	Result	Unit	Method
TRACE ELEMENTS - DRY BASIS			
Antimony, Sb	<3	µg/g	ASTM D6357 (Mod)
Molybdenum, Mo	<3	µg/g	ASTM D6357 (Mod)
Arsenic, As	2.0	µg/g	ASTM D6357 (Mod)
Beryllium, Be	0.9	µg/g	ASTM D6357 (Mod)
Cadmium, Cd	<0.5	µg/g	ASTM D6357 (Mod)
Chromium, Cr	27	µg/g	ASTM D6357 (Mod)
Cobalt, Co	3	µg/g	ASTM D6357 (Mod)
Copper, Cu	13	µg/g	ASTM D6357 (Mod)
Fluoride, Fl	140	µg/g	ASTM D3761
Lead, Pb	5	µg/g	ASTM D6357 (Mod)
Mercury, Hg	0.12	µg/g	ASTM D6722
Nickel, Ni	13	µg/g	ASTM D6357 (Mod)
Vanadium, V	23	µg/g	ASTM D6357 (Mod)
Zinc, Zn	26	µg/g	ASTM D6357 (Mod)
TRACE ELEMENTS BY GFAA			
Selenium, Se	1	µg/g	ASTM D3684 (Mod)
TRACE ELEMENTS BY ICP			
Boron, B	48	µg/g	ASTM D3684 (Mod)

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench A
Product Description:	Coal	Footage Begin:	1950.4
		Footage End:	1951.4
		Thickness:	1.0
		Seam:	LOB
		Lithology:	Rock
		Sample Wt.:	6.68 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-001

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	3.64		
Ash %	ASTM D7582	80.03	83.05	
Sulfur %	ASTM D4239 (A)	0.16	0.16	
Gross Calorific Value Btu/lb	ASTM D5865	1437	1492	8800
Sulfur, Pyritic %	ASTM D2492	0.10	0.10	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.05	0.05	

Tests	Result	Unit	Method
Apparent Specific Gravity	2.28	---	Modified D167

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench A
Product Description:	Coal	Footage Begin:	1950.4
		Footage End:	1951.4
		Thickness:	1.0
		Seam:	LOB
		Lithology:	Rock
		Sample Wt.:	6.68 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-001

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	72.55	%	ASTM D6349
Aluminum Oxide, Al2O3	16.30	%	ASTM D6349
Titanium Dioxide, TiO2	0.74	%	ASTM D6349
Iron Oxide, Fe2O3	2.41	%	ASTM D6349
Calcium Oxide, CaO	1.63	%	ASTM D6349
Magnesium Oxide, MgO	2.12	%	ASTM D6349
Potassium Oxide, K2O	3.27	%	ASTM D6349
Sodium Oxide, Na2O	0.19	%	ASTM D6349
Sulfur Trioxide, SO3	0.43	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.27	%	ASTM D6349
Strontium Oxide, SrO	0.01	%	ASTM D6349
Barium Oxide, BaO	0.05	%	ASTM D6349
Manganese Oxide, MnO2	0.03	%	ASTM D6349
Silica Value	92.17	---	
Base Acid Ratio	0.11	---	
T250 Temperature	>2900	°F	
Fouling Index	0.19	---	
Alkalies as Na2O, As-Received	1.87	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	1.48	---	
Silica/Alumina Ratio	4.45	---	

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench B
Product Description:	Coal	Footage Begin:	1951.4
		Footage End:	1954.6
		Thickness:	3.2
		Seam:	LOB
		Lithology:	Coal
		Sample Wt.:	12.18 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-002

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	6.54		
Ash %	ASTM D7582	7.72	8.26	
Sulfur %	ASTM D4239 (A)	0.49	0.53	
Gross Calorific Value Btu/lb	ASTM D5865	12294	13154	14338
Sulfur, Pyritic %	ASTM D2492	0.05	0.05	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.43	0.47	

Tests	Result	Unit	Method
Apparent Specific Gravity	1.32	---	Modified D167

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Analysis Report

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CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench B
Product Description:	Coal	Footage Begin:	1951.4
		Footage End:	1954.6
		Thickness:	3.2
		Seam:	LOB
		Lithology:	Coal
		Sample Wt.:	12.18 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-002

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	68.35	%	ASTM D6349
Aluminum Oxide, Al2O3	12.21	%	ASTM D6349
Titanium Dioxide, TiO2	0.78	%	ASTM D6349
Iron Oxide, Fe2O3	4.47	%	ASTM D6349
Calcium Oxide, CaO	5.11	%	ASTM D6349
Magnesium Oxide, MgO	1.17	%	ASTM D6349
Potassium Oxide, K2O	0.69	%	ASTM D6349
Sodium Oxide, Na2O	1.75	%	ASTM D6349
Sulfur Trioxide, SO3	5.24	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.17	%	ASTM D6349
Strontium Oxide, SrO	0.03	%	ASTM D6349
Barium Oxide, BaO	0.02	%	ASTM D6349
Manganese Oxide, MnO2	0.01	%	ASTM D6349
Silica Value	86.41	---	
Base Acid Ratio	0.16	---	
T250 Temperature	>2900	°F	
Fouling Index	1.75	---	
Alkalies as Na2O, As-Received	0.17	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.87	---	
Silica/Alumina Ratio	5.60	---	

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench C
Product Description:	Coal	Footage Begin:	1954.6
		Footage End:	1957.8
		Thickness:	3.2
		Seam:	LOB
		Lithology:	Coal
		Sample Wt.:	13.06 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 732-1531336-003

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	6.06		
Ash %	ASTM D7582	9.56	10.18	
Sulfur %	ASTM D4239 (A)	0.34	0.37	
Gross Calorific Value Btu/lb	ASTM D5865	12186	12971	14442
Sulfur, Pyritic %	ASTM D2492	0.04	0.04	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.30	0.32	

Tests	Result	Unit	Method
Apparent Specific Gravity	1.37	---	Modified D167

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench C
Product Description:	Coal	Footage Begin:	1954.6
		Footage End:	1957.8
		Thickness:	3.2
		Seam:	LOB
		Lithology:	Coal
		Sample Wt.:	13.06 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-003

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	68.02	%	ASTM D6349
Aluminum Oxide, Al2O3	11.36	%	ASTM D6349
Titanium Dioxide, TiO2	0.63	%	ASTM D6349
Iron Oxide, Fe2O3	4.12	%	ASTM D6349
Calcium Oxide, CaO	6.79	%	ASTM D6349
Magnesium Oxide, MgO	1.50	%	ASTM D6349
Potassium Oxide, K2O	0.36	%	ASTM D6349
Sodium Oxide, Na2O	1.68	%	ASTM D6349
Sulfur Trioxide, SO3	5.19	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.25	%	ASTM D6349
Strontium Oxide, SrO	0.05	%	ASTM D6349
Barium Oxide, BaO	0.04	%	ASTM D6349
Manganese Oxide, MnO2	0.01	%	ASTM D6349
Silica Value	84.57	---	
Base Acid Ratio	0.18	---	
T250 Temperature	>2900	°F	
Fouling Index	1.68	---	
Alkalies as Na2O, As-Received	0.18	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.61	---	
Silica/Alumina Ratio	5.99	---	

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Analysis Report

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CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench D
Product Description:	Coal	Footage Begin:	1957.8
		Footage End:	1961.0
		Thickness:	3.2
		Seam:	LOB
		Lithology:	Coal
		Sample Wt.:	12.58 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-004

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	6.74		
Ash %	ASTM D7582	5.47	5.87	
Sulfur %	ASTM D4239 (A)	0.43	0.46	
Gross Calorific Value Btu/lb	ASTM D5865	12585	13495	14337
Sulfur, Pyritic %	ASTM D2492	0.05	0.05	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.37	0.40	

Tests	Result	Unit	Method
Apparent Specific Gravity	1.32	---	Modified D167

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HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench D
Product Description:	Coal	Footage Begin:	1957.8
		Footage End:	1961.0
		Thickness:	3.2
		Seam:	LOB
		Lithology:	Coal
		Sample Wt.:	12.58 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-004

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	45.91	%	ASTM D6349
Aluminum Oxide, Al2O3	9.55	%	ASTM D6349
Titanium Dioxide, TiO2	0.59	%	ASTM D6349
Iron Oxide, Fe2O3	7.95	%	ASTM D6349
Calcium Oxide, CaO	16.29	%	ASTM D6349
Magnesium Oxide, MgO	3.71	%	ASTM D6349
Potassium Oxide, K2O	0.34	%	ASTM D6349
Sodium Oxide, Na2O	3.25	%	ASTM D6349
Sulfur Trioxide, SO3	12.08	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.09	%	ASTM D6349
Strontium Oxide, SrO	0.08	%	ASTM D6349
Barium Oxide, BaO	0.14	%	ASTM D6349
Manganese Oxide, MnO2	0.02	%	ASTM D6349
Silica Value	62.16	---	
Base Acid Ratio	0.56	---	
T250 Temperature	2267	°F	
Fouling Index	3.25	---	
Alkalies as Na2O, As-Received	0.19	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.49	---	
Silica/Alumina Ratio	4.81	---	

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Div. of Oil, Gas & Mining

Coco van den Bergh
Branch Manager

SGS North America Inc. | Minerals Services Division
2035 North Airport Road Huntington UT 84528 **t** (435) 653-2311 **f** (435)-653-2436 www.sgs.com/minerals

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench E
Product Description:	Coal	Footage Begin:	1961.0
		Footage End:	1962.1
		Thickness:	1.1
		Seam:	LOB
		Lithology:	Rock
		Sample Wt.:	8.18 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-005

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	3.78	
Ash %	ASTM D7582	93.44	97.11
Sulfur %	ASTM D4239 (A)	0.22	0.23
Gross Calorific Value Btu/lb	ASTM D5865	<300	
Sulfur, Pyritic %	ASTM D2492	0.22	0.23
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01
Sulfur, Organic (by diff) %	ASTM D2492	<0.01	0.01

Tests	Result	Unit	Method
Apparent Specific Gravity	2.42	---	Modified D167

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench E
Product Description:	Coal	Footage Begin:	1961.0
		Footage End:	1962.1
		Thickness:	1.1
		Seam:	LOB
		Lithology:	Rock
		Sample Wt.:	8.18 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-005

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	82.83	%	ASTM D6349
Aluminum Oxide, Al2O3	6.67	%	ASTM D6349
Titanium Dioxide, TiO2	0.47	%	ASTM D6349
Iron Oxide, Fe2O3	0.70	%	ASTM D6349
Calcium Oxide, CaO	0.12	%	ASTM D6349
Magnesium Oxide, MgO	0.30	%	ASTM D6349
Potassium Oxide, K2O	1.75	%	ASTM D6349
Sodium Oxide, Na2O	0.10	%	ASTM D6349
Sulfur Trioxide, SO3	6.94	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.08	%	ASTM D6349
Strontium Oxide, SrO	0.01	%	ASTM D6349
Barium Oxide, BaO	0.03	%	ASTM D6349
Manganese Oxide, MnO2	<0.01	%	ASTM D6349
Silica Value	98.67	---	
Base Acid Ratio	0.03	---	
T250 Temperature	>2900	°F	
Fouling Index	<0.01	---	
Slagging Index	<0.01	---	
Alkalies as Na2O, As-Received	1.17	%	
Type of Ash	BITUMINOUS	---	
Iron/Calcium Ratio	5.83	---	
Silica/Alumina Ratio	12.42	---	

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	1951.4
		Footage End:	1961
		Thickness:	9.6
		Seam:	LOB
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-006

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	6.30		
Ash %	ASTM D7582	7.66	8.18	
Volatile Matter %	ASTM D7582	42.15	44.98	
Fixed Carbon %	ASTM D3172 (by diff)	43.89	46.84	
Sulfur %	ASTM D4239 (A)	0.42	0.45	
Gross Calorific Value Btu/lb	ASTM D5865	12410	13244	14424
Carbon %	ASTM D5373	68.58	73.19	
Hydrogen %	ASTM D5373	5.06	5.40	
Nitrogen %	ASTM D5373	1.37	1.46	
Oxygen %	ASTM D3176 (by diff)	10.61	11.32	
Chlorine, Cl µg/g	ASTM D6721		94	
Water Soluble Alkalies - K %	ASTMC114MSW7610	<0.001	0.001	
Water Soluble Alkalies - Na %	ASTMC114MSW7770	0.010	0.011	

Tests	Result	Unit	Method
Equilibrium Moisture	5.50	%	ASTM D1412
Apparent Specific Gravity	1.33	---	Modified D167
FREE SWELLING INDEX			
Free Swelling Index	1.5	---	ASTM D720
HARDGROVE GRINDABILITY			
Hardgrove Grindability Index	52	---	ASTM D409
Hardgrove Grindability Moisture	3.08	%	ASTM D409

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	1951.4
		Footage End:	1961
		Thickness:	9.6
		Seam:	LOB
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-006

Tests	Result	Unit	Method
FUSION TEMPERATURE OF ASH, REDUCING			
Initial Deformation	2170	°F	ASTM D1857
Softening	2217	°F	ASTM D1857
Hemispherical	2261	°F	ASTM D1857
Fluid	2426	°F	ASTM D1857
FUSION TEMPERATURE OF ASH, OXIDIZING			
Initial Deformation	2222	°F	ASTM D1857
Softening	2253	°F	ASTM D1857
Hemispherical	2293	°F	ASTM D1857
Fluid	2587	°F	ASTM D1857

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Analysis Report

January 28, 2016

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HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	1951.4
		Footage End:	1961
		Thickness:	9.6
		Seam:	LOB
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-006

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	63.33	%	ASTM D6349
Aluminum Oxide, Al2O3	10.96	%	ASTM D6349
Titanium Dioxide, TiO2	0.64	%	ASTM D6349
Iron Oxide, Fe2O3	4.88	%	ASTM D6349
Calcium Oxide, CaO	8.62	%	ASTM D6349
Magnesium Oxide, MgO	1.82	%	ASTM D6349
Potassium Oxide, K2O	0.46	%	ASTM D6349
Sodium Oxide, Na2O	1.99	%	ASTM D6349
Sulfur Trioxide, SO3	7.01	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.18	%	ASTM D6349
Strontium Oxide, SrO	0.05	%	ASTM D6349
Barium Oxide, BaO	0.05	%	ASTM D6349
Manganese Oxide, MnO2	0.01	%	ASTM D6349
Silica Value	80.52	---	
Base Acid Ratio	0.24	---	
T250 Temperature	2703	°F	
Fouling Index	1.99	---	
Slagging Index	>100.00	---	
Alkalies as Na2O, As-Received	0.18	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.57	---	
Silica/Alumina Ratio	5.78	---	

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Analysis Report

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HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	1951.4
		Footage End:	1961
		Thickness:	9.6
		Seam:	LOB
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531336-006

Tests	Result	Unit	Method
TRACE ELEMENTS - DRY BASIS			
Antimony, Sb	<1	µg/g	ASTM D6357 (Mod)
Molybdenum, Mo	<1	µg/g	ASTM D6357 (Mod)
Arsenic, As	<1	µg/g	ASTM D6357 (Mod)
Beryllium, Be	0.5	µg/g	ASTM D6357 (Mod)
Cadmium, Cd	<0.2	µg/g	ASTM D6357 (Mod)
Chromium, Cr	9	µg/g	ASTM D6357 (Mod)
Cobalt, Co	1	µg/g	ASTM D6357 (Mod)
Copper, Cu	7	µg/g	ASTM D6357 (Mod)
Fluoride, Fl	34	µg/g	ASTM D3761
Lead, Pb	<2	µg/g	ASTM D6357 (Mod)
Mercury, Hg	<0.02	µg/g	ASTM D6722
Nickel, Ni	6	µg/g	ASTM D6357 (Mod)
Vanadium, V	6	µg/g	ASTM D6357 (Mod)
Zinc, Zn	3	µg/g	ASTM D6357 (Mod)
TRACE ELEMENTS BY GFAA			
Selenium, Se	0.9	µg/g	ASTM D3684 (Mod)
TRACE ELEMENTS BY ICP			
Boron, B	76	µg/g	ASTM D3684 (Mod)

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench A
Product Description:	Coal	Footage Begin:	1873.35
		Footage End:	1874.4
		Thickness:	1.05
		Seam:	UO
		Lithology:	Rock
		Sample Wt.:	7.26 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-001

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	2.12	
Ash %	ASTM D7582	89.89	91.84
Sulfur %	ASTM D4239 (A)	<0.05	<0.05
Gross Calorific Value Btu/lb	ASTM D5865	<300	
Sulfur, Pyritic %	ASTM D2492	0.04	0.04
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01
Sulfur, Organic (by diff) %	ASTM D2492	<0.01	<0.01

Tests	Result	Unit	Method
Apparent Specific Gravity	2.66	---	Modified D167

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench A
Product Description:	Coal	Footage Begin:	1873.35
		Footage End:	1874.4
		Thickness:	1.05
		Seam:	UO
		Lithology:	Rock
		Sample Wt.:	7.26 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-001

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	77.17	%	ASTM D6349
Aluminum Oxide, Al2O3	13.19	%	ASTM D6349
Titanium Dioxide, TiO2	0.72	%	ASTM D6349
Iron Oxide, Fe2O3	1.61	%	ASTM D6349
Calcium Oxide, CaO	2.10	%	ASTM D6349
Magnesium Oxide, MgO	1.77	%	ASTM D6349
Potassium Oxide, K2O	2.67	%	ASTM D6349
Sodium Oxide, Na2O	0.14	%	ASTM D6349
Sulfur Trioxide, SO3	0.27	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.29	%	ASTM D6349
Strontium Oxide, SrO	0.01	%	ASTM D6349
Barium Oxide, BaO	0.04	%	ASTM D6349
Manganese Oxide, MnO2	0.02	%	ASTM D6349
Silica Value	93.37	---	
Base Acid Ratio	0.09	---	
T250 Temperature	>2900	°F	
Fouling Index	0.14	---	
Alkalies as Na2O, As-Received	1.71	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.77	---	
Silica/Alumina Ratio	5.85	---	

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HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench B
Product Description:	Coal	Footage Begin:	1874.4
		Footage End:	1877.1
		Thickness:	2.7
		Seam:	UO
		Lithology:	Coal
		Sample Wt.:	10.66 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-002

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	6.66		
Ash %	ASTM D7582	7.58	8.12	
Sulfur %	ASTM D4239 (A)	0.57	0.61	
Gross Calorific Value Btu/lb	ASTM D5865	12419	13306	14482
Sulfur, Pyritic %	ASTM D2492	0.09	0.10	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.47	0.50	

Tests	Result	Unit	Method
Apparent Specific Gravity	1.33	---	Modified D167

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ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench B
Product Description:	Coal	Footage Begin:	1874.4
		Footage End:	1877.1
		Thickness:	2.7
		Seam:	UO
		Lithology:	Coal
		Sample Wt.:	10.66 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-002

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	64.89	%	ASTM D6349
Aluminum Oxide, Al2O3	15.51	%	ASTM D6349
Titanium Dioxide, TiO2	0.93	%	ASTM D6349
Iron Oxide, Fe2O3	5.04	%	ASTM D6349
Calcium Oxide, CaO	4.04	%	ASTM D6349
Magnesium Oxide, MgO	1.07	%	ASTM D6349
Potassium Oxide, K2O	0.56	%	ASTM D6349
Sodium Oxide, Na2O	3.06	%	ASTM D6349
Sulfur Trioxide, SO3	4.26	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.51	%	ASTM D6349
Strontium Oxide, SrO	0.08	%	ASTM D6349
Barium Oxide, BaO	0.04	%	ASTM D6349
Manganese Oxide, MnO2	0.01	%	ASTM D6349
Silica Value	86.47	---	
Base Acid Ratio	0.17	---	
T250 Temperature	>2900	°F	
Fouling Index	3.06	---	
Alkalies as Na2O, As-Received	0.26	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	1.25	---	
Silica/Alumina Ratio	4.18	---	

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Div. of Oil, Gas & Mining

Coco van den Bergh
Branch Manager

SGS North America Inc. | Minerals Services Division
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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench C
Product Description:	Coal	Footage Begin:	1877.1
		Footage End:	1879.8
		Thickness:	2.7
		Seam:	UO
		Lithology:	Coal
		Sample Wt.:	10.42 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-003

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	6.88		
Ash %	ASTM D7582	13.78	14.80	
Sulfur %	ASTM D4239 (A)	0.44	0.48	
Gross Calorific Value Btu/lb	ASTM D5865	11318	12154	14266
Sulfur, Pyritic %	ASTM D2492	0.05	0.05	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.39	0.42	

Tests	Result	Unit	Method
Apparent Specific Gravity	1.39	---	Modified D167

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench C
Product Description:	Coal	Footage Begin:	1877.1
		Footage End:	1879.8
		Thickness:	2.7
		Seam:	UO
		Lithology:	Coal
		Sample Wt.:	10.42 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-003

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	65.55	%	ASTM D6349
Aluminum Oxide, Al2O3	15.31	%	ASTM D6349
Titanium Dioxide, TiO2	0.97	%	ASTM D6349
Iron Oxide, Fe2O3	4.70	%	ASTM D6349
Calcium Oxide, CaO	4.37	%	ASTM D6349
Magnesium Oxide, MgO	1.60	%	ASTM D6349
Potassium Oxide, K2O	1.97	%	ASTM D6349
Sodium Oxide, Na2O	1.18	%	ASTM D6349
Sulfur Trioxide, SO3	4.16	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.10	%	ASTM D6349
Strontium Oxide, SrO	0.03	%	ASTM D6349
Barium Oxide, BaO	0.04	%	ASTM D6349
Manganese Oxide, MnO2	0.02	%	ASTM D6349
Silica Value	86.00	---	
Base Acid Ratio	0.17	---	
T250 Temperature	>2900	°F	
Fouling Index	1.18	---	
Alkalies as Na2O, As-Received	0.34	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	1.08	---	
Silica/Alumina Ratio	4.28	---	

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench D
Product Description:	Coal	Footage Begin:	1879.8
		Footage End:	1880.9
		Thickness:	1.1
		Seam:	UO
		Lithology:	Rock
		Sample Wt.:	7.5

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-004

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	2.72		
Ash %	ASTM D7582	89.66	92.16	
Sulfur %	ASTM D4239 (A)	<0.05	<0.05	
Gross Calorific Value Btu/lb	ASTM D5865	<300	<300	3260
Sulfur, Pyritic %	ASTM D2492	0.03	0.03	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	<0.01	<0.01	

Tests	Result	Unit	Method
Apparent Specific Gravity	2.46	---	Modified D167

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Analysis Report

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CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench D
Product Description:	Coal	Footage Begin:	1879.8
		Footage End:	1880.9
		Thickness:	1.1
		Seam:	UO
		Lithology:	Rock
		Sample Wt.:	7.5

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-004

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	73.45	%	ASTM D6349
Aluminum Oxide, Al2O3	17.08	%	ASTM D6349
Titanium Dioxide, TiO2	0.75	%	ASTM D6349
Iron Oxide, Fe2O3	2.52	%	ASTM D6349
Calcium Oxide, CaO	0.57	%	ASTM D6349
Magnesium Oxide, MgO	1.76	%	ASTM D6349
Potassium Oxide, K2O	3.24	%	ASTM D6349
Sodium Oxide, Na2O	0.16	%	ASTM D6349
Sulfur Trioxide, SO3	0.16	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.24	%	ASTM D6349
Strontium Oxide, SrO	0.01	%	ASTM D6349
Barium Oxide, BaO	0.04	%	ASTM D6349
Manganese Oxide, MnO2	0.02	%	ASTM D6349
Silica Value	93.81	---	
Base Acid Ratio	0.09	---	
T250 Temperature	>2900	°F	
Fouling Index	0.01	---	
Slagging Index	<0.01	---	
Alkalies as Na2O, As-Received	2.06	%	
Type of Ash	BITUMINOUS	---	
Iron/Calcium Ratio	4.42	---	
Silica/Alumina Ratio	4.30	---	

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	1874.4
		Footage End:	1879.8
		Thickness:	5.4
		Seam:	UO
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-005

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	6.69		
Ash %	ASTM D7582	10.67	11.43	
Volatile Matter %	ASTM D7582	41.13	44.08	
Fixed Carbon %	ASTM D3172 (by diff)	41.51	44.49	
Sulfur %	ASTM D4239 (A)	0.49	0.53	
Gross Calorific Value Btu/lb	ASTM D5865	11893	12745	14390
Carbon %	ASTM D5373	65.90	70.63	
Hydrogen %	ASTM D5373	4.97	5.32	
Nitrogen %	ASTM D5373	1.34	1.44	
Oxygen %	ASTM D3176 (by diff)	9.94	10.65	
Chlorine, Cl µg/g	ASTM D6721		52	
Water Soluble Alkalies - K %	ASTMC114MSW7610	0.003	0.003	
Water Soluble Alkalies - Na %	ASTMC114MSW7770	0.013	0.014	

Tests	Result	Unit	Method
Equilibrium Moisture	6.10	%	ASTM D1412
Apparent Specific Gravity	1.35	---	Modified D167
FREE SWELLING INDEX			
Free Swelling Index	1.5	---	ASTM D720
HARDGROVE GRINDABILITY			
Hardgrove Grindability Index	53	---	ASTM D409
Hardgrove Grindability Moisture	2.86	%	ASTM D409

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HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	1874.4
		Footage End:	1879.8
		Thickness:	5.4
		Seam:	UO
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-005

Tests	Result	Unit	Method
FUSION TEMPERATURE OF ASH, REDUCING			
Initial Deformation	2257	°F	ASTM D1857
Softening	2281	°F	ASTM D1857
Hemispherical	2306	°F	ASTM D1857
Fluid	2434	°F	ASTM D1857
FUSION TEMPERATURE OF ASH, OXIDIZING			
Initial Deformation	2316	°F	ASTM D1857
Softening	2346	°F	ASTM D1857
Hemispherical	2380	°F	ASTM D1857
Fluid	2500	°F	ASTM D1857

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HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	1874.4
		Footage End:	1879.8
		Thickness:	5.4
		Seam:	UO
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-005

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	65.52	%	ASTM D6349
Aluminum Oxide, Al2O3	15.51	%	ASTM D6349
Titanium Dioxide, TiO2	0.94	%	ASTM D6349
Iron Oxide, Fe2O3	4.72	%	ASTM D6349
Calcium Oxide, CaO	4.16	%	ASTM D6349
Magnesium Oxide, MgO	1.37	%	ASTM D6349
Potassium Oxide, K2O	1.50	%	ASTM D6349
Sodium Oxide, Na2O	1.86	%	ASTM D6349
Sulfur Trioxide, SO3	4.06	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.25	%	ASTM D6349
Strontium Oxide, SrO	0.05	%	ASTM D6349
Barium Oxide, BaO	0.04	%	ASTM D6349
Manganese Oxide, MnO2	0.02	%	ASTM D6349
Silica Value	86.47	---	
Base Acid Ratio	0.17	---	
T250 Temperature	>2900	°F	
Fouling Index	1.86	---	
Slagging Index	>100.00	---	
Alkalies as Na2O, As-Received	0.30	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	1.13	---	
Silica/Alumina Ratio	4.22	---	

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ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	1874.4
		Footage End:	1879.8
		Thickness:	5.4
		Seam:	UO
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531335-005

Tests	Result	Unit	Method
TRACE ELEMENTS - DRY BASIS			
Antimony, Sb	<2	µg/g	ASTM D6357 (Mod)
Molybdenum, Mo	<2	µg/g	ASTM D6357 (Mod)
Arsenic, As	<1	µg/g	ASTM D6357 (Mod)
Beryllium, Be	1.2	µg/g	ASTM D6357 (Mod)
Cadmium, Cd	<0.3	µg/g	ASTM D6357 (Mod)
Chromium, Cr	15	µg/g	ASTM D6357 (Mod)
Cobalt, Co	1	µg/g	ASTM D6357 (Mod)
Copper, Cu	8	µg/g	ASTM D6357 (Mod)
Fluoride, Fl	70	µg/g	ASTM D3761
Lead, Pb	3	µg/g	ASTM D6357 (Mod)
Mercury, Hg	<0.02	µg/g	ASTM D6722
Nickel, Ni	6	µg/g	ASTM D6357 (Mod)
Vanadium, V	12	µg/g	ASTM D6357 (Mod)
Zinc, Zn	5	µg/g	ASTM D6357 (Mod)
TRACE ELEMENTS BY GFAA			
Selenium, Se	1	µg/g	ASTM D3684 (Mod)
TRACE ELEMENTS BY ICP			
Boron, B	110	µg/g	ASTM D3684 (Mod)

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HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench A
Product Description:	Coal	Footage Begin:	2103.5
		Footage End:	2104.55
		Thickness:	1.05
		Seam:	FC
		Lithology:	Rock
		Sample Wt.:	7.64 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-001

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	2.22	
Ash %	ASTM D7582	89.33	91.36
Sulfur %	ASTM D4239 (A)	0.13	0.13
Gross Calorific Value Btu/lb	ASTM D5865	<300	
Sulfur, Pyritic %	ASTM D2492	0.13	0.13
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01
Sulfur, Organic (by diff) %	ASTM D2492	0.01	0.01

Tests	Result	Unit	Method
Apparent Specific Gravity	2.53	---	Modified D167

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HCR 35 BOX 380
ACCOUNTS PAYABLE
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Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench A
Product Description:	Coal	Footage Begin:	2103.5
		Footage End:	2104.55
		Thickness:	1.05
		Seam:	FC
		Lithology:	Rock
		Sample Wt.:	7.64 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-001

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	80.81	%	ASTM D6349
Aluminum Oxide, Al2O3	7.45	%	ASTM D6349
Titanium Dioxide, TiO2	0.44	%	ASTM D6349
Iron Oxide, Fe2O3	1.12	%	ASTM D6349
Calcium Oxide, CaO	6.39	%	ASTM D6349
Magnesium Oxide, MgO	1.21	%	ASTM D6349
Potassium Oxide, K2O	1.80	%	ASTM D6349
Sodium Oxide, Na2O	0.06	%	ASTM D6349
Sulfur Trioxide, SO3	0.44	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.21	%	ASTM D6349
Strontium Oxide, SrO	0.01	%	ASTM D6349
Barium Oxide, BaO	0.03	%	ASTM D6349
Manganese Oxide, MnO2	0.03	%	ASTM D6349
Silica Value	90.26	---	
Base Acid Ratio	0.12	---	
T250 Temperature	>2900	°F	
Fouling Index	0.06	---	
Alkalies as Na2O, As-Received	1.11	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.18	---	
Silica/Alumina Ratio	10.85	---	

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2035 North Airport Road Huntington UT 84528 **t** (435) 653-2311 **f** (435)-653-2436 www.sgs.com/minerals

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench B
Product Description:	Coal	Footage Begin:	2104.55
		Footage End:	2106.05
		Thickness:	1.5
		Seam:	FC
		Lithology:	Coal
		Sample Wt.:	8.10 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-002

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	4.23		
Ash %	ASTM D7582	65.94	68.85	
Sulfur %	ASTM D4239 (A)	0.34	0.35	
Gross Calorific Value Btu/lb	ASTM D5865	3584	3742	12013
Sulfur, Pyritic %	ASTM D2492	0.13	0.14	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.19	0.20	

Tests	Result	Unit	Method
Apparent Specific Gravity	1.99	---	Modified D167

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench B
Product Description:	Coal	Footage Begin:	2104.55
		Footage End:	2106.05
		Thickness:	1.5
		Seam:	FC
		Lithology:	Coal
		Sample Wt.:	8.10 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-002

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	68.99	%	ASTM D6349
Aluminum Oxide, Al2O3	20.73	%	ASTM D6349
Titanium Dioxide, TiO2	0.94	%	ASTM D6349
Iron Oxide, Fe2O3	2.62	%	ASTM D6349
Calcium Oxide, CaO	0.41	%	ASTM D6349
Magnesium Oxide, MgO	1.70	%	ASTM D6349
Potassium Oxide, K2O	4.08	%	ASTM D6349
Sodium Oxide, Na2O	0.17	%	ASTM D6349
Sulfur Trioxide, SO3	0.11	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.15	%	ASTM D6349
Strontium Oxide, SrO	0.02	%	ASTM D6349
Barium Oxide, BaO	0.06	%	ASTM D6349
Manganese Oxide, MnO2	0.02	%	ASTM D6349
Silica Value	93.58	---	
Base Acid Ratio	0.10	---	
T250 Temperature	>2900	°F	
Fouling Index	0.02	---	
Slagging Index	0.03	---	
Alkalies as Na2O, As-Received	1.88	%	
Type of Ash	BITUMINOUS	---	
Iron/Calcium Ratio	6.39	---	
Silica/Alumina Ratio	3.33	---	

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Analysis Report

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CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench C
Product Description:	Coal	Footage Begin:	2106.05
		Footage End:	2109.0
		Thickness:	2.95
		Seam:	FC
		Lithology:	Coal
		Sample Wt.:	11.76 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-003

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	6.28		
Ash %	ASTM D7582	5.64	6.02	
Sulfur %	ASTM D4239 (A)	0.52	0.56	
Gross Calorific Value Btu/lb	ASTM D5865	12476	13311	14164
Sulfur, Pyritic %	ASTM D2492	0.07	0.07	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.45	0.48	

Tests	Result	Unit	Method
Apparent Specific Gravity	1.31	---	Modified D167

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench C
Product Description:	Coal	Footage Begin:	2106.05
		Footage End:	2109.0
		Thickness:	2.95
		Seam:	FC
		Lithology:	Coal
		Sample Wt.:	11.76 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-003

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	55.24	%	ASTM D6349
Aluminum Oxide, Al2O3	20.18	%	ASTM D6349
Titanium Dioxide, TiO2	0.77	%	ASTM D6349
Iron Oxide, Fe2O3	4.19	%	ASTM D6349
Calcium Oxide, CaO	7.92	%	ASTM D6349
Magnesium Oxide, MgO	1.29	%	ASTM D6349
Potassium Oxide, K2O	0.58	%	ASTM D6349
Sodium Oxide, Na2O	1.79	%	ASTM D6349
Sulfur Trioxide, SO3	7.65	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.25	%	ASTM D6349
Strontium Oxide, SrO	0.09	%	ASTM D6349
Barium Oxide, BaO	0.04	%	ASTM D6349
Manganese Oxide, MnO2	0.01	%	ASTM D6349
Silica Value	80.48	---	
Base Acid Ratio	0.21	---	
T250 Temperature	2746	°F	
Fouling Index	1.79	---	
Alkalies as Na2O, As-Received	0.12	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.53	---	
Silica/Alumina Ratio	2.74	---	

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Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench D
Product Description:	Coal	Footage Begin:	2109.0
		Footage End:	2112.1
		Thickness:	3.1
		Seam:	FC
		Lithology:	Coal
		Sample Wt.:	11.78 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-004

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	6.76		
Ash %	ASTM D7582	6.91	7.41	
Sulfur %	ASTM D4239 (A)	0.53	0.57	
Gross Calorific Value Btu/lb	ASTM D5865	12475	13379	14450
Sulfur, Pyritic %	ASTM D2492	0.08	0.09	
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01	
Sulfur, Organic (by diff) %	ASTM D2492	0.44	0.47	

Tests	Result	Unit	Method
Apparent Specific Gravity	1.31	---	Modified D167

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Analysis Report

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HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench D
Product Description:	Coal	Footage Begin:	2109.0
		Footage End:	2112.1
		Thickness:	3.1
		Seam:	FC
		Lithology:	Coal
		Sample Wt.:	11.78 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-004

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	64.37	%	ASTM D6349
Aluminum Oxide, Al2O3	9.54	%	ASTM D6349
Titanium Dioxide, TiO2	0.70	%	ASTM D6349
Iron Oxide, Fe2O3	4.20	%	ASTM D6349
Calcium Oxide, CaO	9.55	%	ASTM D6349
Magnesium Oxide, MgO	1.39	%	ASTM D6349
Potassium Oxide, K2O	0.77	%	ASTM D6349
Sodium Oxide, Na2O	1.17	%	ASTM D6349
Sulfur Trioxide, SO3	8.09	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.09	%	ASTM D6349
Strontium Oxide, SrO	0.07	%	ASTM D6349
Barium Oxide, BaO	0.05	%	ASTM D6349
Manganese Oxide, MnO2	0.01	%	ASTM D6349
Silica Value	80.96	---	
Base Acid Ratio	0.23	---	
T250 Temperature	2736	°F	
Fouling Index	1.17	---	
Alkalies as Na2O, As-Received	0.12	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.44	---	
Silica/Alumina Ratio	6.75	---	

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Analysis Report

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ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench E
Product Description:	Coal	Footage Begin:	2112.1
		Footage End:	2113.2
		Thickness:	1.1
		Seam:	FC
		Lithology:	Rock
		Sample Wt.:	8.48 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-005

	Method	As Received	Dry
Moisture, Total %	ASTM D3302	1.76	
Ash %	ASTM D7582	94.92	96.62
Sulfur %	ASTM D4239 (A)	<0.05	
Gross Calorific Value Btu/lb	ASTM D5865	<300	
Sulfur, Pyritic %	ASTM D2492	<0.01	0.01
Sulfur, Sulfate %	ASTM D2492	<0.01	0.01
Sulfur, Organic (by diff) %	ASTM D2492	0.01	0.01

Tests	Result	Unit	Method
Apparent Specific Gravity	2.53	---	Modified D167

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HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Bench E
Product Description:	Coal	Footage Begin:	2112.1
		Footage End:	2113.2
		Thickness:	1.1
		Seam:	FC
		Lithology:	Rock
		Sample Wt.:	8.48 lb: 1 Bag

Comments: Sulfur Forms ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-005

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	85.65	%	ASTM D6349
Aluminum Oxide, Al2O3	9.54	%	ASTM D6349
Titanium Dioxide, TiO2	0.59	%	ASTM D6349
Iron Oxide, Fe2O3	0.55	%	ASTM D6349
Calcium Oxide, CaO	0.38	%	ASTM D6349
Magnesium Oxide, MgO	0.45	%	ASTM D6349
Potassium Oxide, K2O	2.50	%	ASTM D6349
Sodium Oxide, Na2O	0.08	%	ASTM D6349
Sulfur Trioxide, SO3	0.02	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.19	%	ASTM D6349
Strontium Oxide, SrO	0.01	%	ASTM D6349
Barium Oxide, BaO	0.04	%	ASTM D6349
Manganese Oxide, MnO2	<0.01	%	ASTM D6349
Silica Value	98.41	---	
Base Acid Ratio	0.04	---	
T250 Temperature	>2900	°F	
Fouling Index	0.08	---	
Alkalies as Na2O, As-Received	1.64	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	1.45	---	
Silica/Alumina Ratio	8.98	---	

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HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	2104.5
		Footage End:	2112.1
		Thickness:	7.55
		Seam:	FC
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-006

	Method	As Received	Dry	DAF
Moisture, Total %	ASTM D3302	5.89		
Ash %	ASTM D7582	17.29	18.37	
Volatile Matter %	ASTM D7582	36.38	38.66	
Fixed Carbon %	ASTM D3172 (by diff)	40.44	42.97	
Sulfur %	ASTM D4239 (A)	0.50	0.53	
Gross Calorific Value Btu/lb	ASTM D5865	10916	11598	14209
Carbon %	ASTM D5373	60.59	64.38	
Hydrogen %	ASTM D5373	4.42	4.70	
Nitrogen %	ASTM D5373	1.19	1.27	
Oxygen %	ASTM D3176 (by diff)	10.12	10.75	
Chlorine, Cl µg/g	ASTM D6721		120	
Water Soluble Alkalies - K %	ASTMC114MSW7610	0.007	0.007	
Water Soluble Alkalies - Na %	ASTMC114MSW7770	0.009	0.010	

Tests	Result	Unit	Method
Equilibrium Moisture	5.40	%	ASTM D1412
Apparent Specific Gravity	1.43	---	Modified D167
FREE SWELLING INDEX			
Free Swelling Index	2.0	---	ASTM D720
HARDGROVE GRINDABILITY			
Hardgrove Grindability Index	49	---	ASTM D409
Hardgrove Grindability Moisture	2.88	%	ASTM D409

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Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	2104.5
		Footage End:	2112.1
		Thickness:	7.55
		Seam:	FC
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-006

Tests	Result	Unit	Method
FUSION TEMPERATURE OF ASH, REDUCING			
Initial Deformation	2355	°F	ASTM D1857
Softening	2436	°F	ASTM D1857
Hemispherical	2499	°F	ASTM D1857
Fluid	2620	°F	ASTM D1857
FUSION TEMPERATURE OF ASH, OXIDIZING			
Initial Deformation	2443	°F	ASTM D1857
Softening	2507	°F	ASTM D1857
Hemispherical	2560	°F	ASTM D1857
Fluid	2650	°F	ASTM D1857

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HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	2104.5
		Footage End:	2112.1
		Thickness:	7.55
		Seam:	FC
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-006

Tests	Result	Unit	Method
ANALYSIS OF ASH			
Silicon Dioxide, SiO2	63.33	%	ASTM D6349
Aluminum Oxide, Al2O3	10.96	%	ASTM D6349
Titanium Dioxide, TiO2	0.64	%	ASTM D6349
Iron Oxide, Fe2O3	4.88	%	ASTM D6349
Calcium Oxide, CaO	8.62	%	ASTM D6349
Magnesium Oxide, MgO	1.82	%	ASTM D6349
Potassium Oxide, K2O	0.46	%	ASTM D6349
Sodium Oxide, Na2O	1.99	%	ASTM D6349
Sulfur Trioxide, SO3	7.01	%	ASTM D5016
Phosphorus Pentoxide, P2O5	0.18	%	ASTM D6349
Strontium Oxide, SrO	0.05	%	ASTM D6349
Barium Oxide, BaO	0.05	%	ASTM D6349
Manganese Oxide, MnO2	0.01	%	ASTM D6349
Silica Value	80.52	---	
Base Acid Ratio	0.24	---	
T250 Temperature	2703	°F	
Fouling Index	1.99	---	
Slagging Index	>100.00	---	
Alkalies as Na2O, As-Received	0.40	%	
Type of Ash	LIGNITIC	---	
Iron/Calcium Ratio	0.57	---	
Silica/Alumina Ratio	5.78	---	

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Coco van den Bergh
Branch Manager

SGS North America Inc. | Minerals Services Division
2035 North Airport Road Huntington UT 84528 t (435) 653-2311 f (435)-653-2436 www.sgs.com/minerals

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SGS

Analysis Report

January 28, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	Bowie Resources	Mine:	SKYLINE
Date Sampled:	N/A	Core:	15-21-2
Date Received:	Nov 12, 2015	Sample ID:	Comp
Product Description:	Coal	Footage Begin:	2104.5
		Footage End:	2112.1
		Thickness:	7.55
		Seam:	FC
		Lithology:	Coal

Comments: EQ, T. E., FSI, WSA, ran at SGS-Denver

SGS Minerals Sample ID: 782-1531338-006

Tests	Result	Unit	Method
TRACE ELEMENTS - DRY BASIS			
Antimony, Sb	<2	µg/g	ASTM D6357 (Mod)
Molybdenum, Mo	<2	µg/g	ASTM D6357 (Mod)
Arsenic, As	1.0	µg/g	ASTM D6357 (Mod)
Beryllium, Be	0.9	µg/g	ASTM D6357 (Mod)
Cadmium, Cd	<0.4	µg/g	ASTM D6357 (Mod)
Chromium, Cr	25	µg/g	ASTM D6357 (Mod)
Cobalt, Co	3	µg/g	ASTM D6357 (Mod)
Copper, Cu	10	µg/g	ASTM D6357 (Mod)
Fluoride, Fl	140	µg/g	ASTM D3761
Lead, Pb	5	µg/g	ASTM D6357 (Mod)
Mercury, Hg	<0.02	µg/g	ASTM D6722
Nickel, Ni	9	µg/g	ASTM D6357 (Mod)
Vanadium, V	22	µg/g	ASTM D6357 (Mod)
Zinc, Zn	18	µg/g	ASTM D6357 (Mod)
TRACE ELEMENTS BY GFAA			
Selenium, Se	1	µg/g	ASTM D3684 (Mod)
TRACE ELEMENTS BY ICP			
Boron, B	72	µg/g	ASTM D3684 (Mod)

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CUTTINGS X
CORE
OUTCROP

Skyline Mine
Canyon Fuel Co

PROJECT 2015 Exp DATE 10-29-15 HOLE NO. 15-21-2
LOGGED BY J. Rogers Run Interval 0-400
Length Cored Length Recovered % Recovery
Observations
Depth Adjustment

LOCATION
T 13S R 6E Sec 21
N 4,391,926.2 (NAD83)
E 477,271.3
Elev 9186'

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip / Description / Graph	THICKNESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY / MUD / SILT / VERY FINE / FINE / MEDIUM / COARSE / VERY COARSE	Srt: POOR / MOD / WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
				FT.				Alluvium: glacial till consisting of ground wash, terminal moraine + end moraine. grvl (grnul + pebl snd vc-vf, slt, + cly. gy-ochr-tan, ang-sb ang. grvl composed of f-vf ss. p srtd.
				0				
				20				
				40				
				60				
				80				SS: ltgy-gy, vfgr-slty, occ f-m gr, rd-sbrd, cly, mod srt semi cons, clr qtz
				100				SH: dkgy, plty-sbplty, carb, slty ip, clymtrx, mod sft-mod hd
				120				SS: ltgy, qtz, vf-fgr, slty ip, cons, tt, mod hd,
				140				SH: dkgy-gy, sbplty-plty, carb clymtrx, slty ip, mod sft-mod hd SS: ltgy aa 30%
				160				SH: aa 45% + SLTST: aa 55%
				180				SH: aa
				200				SS: ltgy, qtz, vf-fgr, slty ip, sbrd-rd, cln, w srt,
				220				aa
				240				aa
				260				SS: aa SH: aa wi 1-2%, yel-ochr slst,
				280				aa
				300				SS: aa wi 1% uphole slst
				320				SS: ltgy, vfgr-slty, cons
				340				SS: aa
				360				SS: aa
				380				SS: aa 20% SLTST SH: gy-dkgy 80%
				400				

Sample Box #1

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CUTTINGS X
CORE
OUTCROP

Skyline Mine
Canyon Fuel Co

LOCATION
T 13S R 6E Sec 21
N
E
Elev

PROJECT 2015 Exp DATE 10-29-15 HOLE NO. 15-21-2
LOGGED BY J Rogers Run Interval 400 - 800
Length Cored Length Recovered % Recovery
Observations
Depth Adjustment

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip / Description / Graph	THICKNESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY, MUD, SILT, VERY FINE, FINE, MEDIUM, COARSE, VERY COARSE	Srt: POOR, MOD, WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
				FT. 400				SLTST: ltgy, shly, calc,
				420				SH: dkgy, plty, carb, sl calc, carb frag, mod sft-mod hd. SS: ltgy, gtz, vf gr, slty ip, calc, mod hd,
				440				SS: aa
				460				aa
				480				aa
				500				SH: dkgy-blk, plty, carb, cly mtrx, mod hd-mod sft, hole sluff
				520				aa. pyr
				540				aa sl calc
				560				aa hole sluff (till)
				580				SLTST: gy-dkgy, plty, sdy vf gr ip, calc, mod sft.
				600				SH: aa
				620				SH: aa
				640				SH: aa
				660				SH: aa
				680				SLTST: ltgy-dkgy, carb, calc, cly mtrx, mod sft-mod hd
				700				SLTST: aa
				720				aa
				740				aa
				760				SH: dkgy-gy, slty-vfgr ss ip, calc, carb, cly mtrx, mod sft-mod hd.
				780				
				800				

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CUTTINGS X
CORE
OUTCROP

Skyline Mine
Canyon Fuel Co

LOCATION
T 13S R 6E Sec 21
N
E
Elev

PROJECT 2015 Exp DATE 10-29-15 HOLE NO. 15-21-2
LOGGED BY JRogers Run Interval 800-1200
Length Cored Length Recovered % Recovery
Observations
Depth Adjustment

SAMPLE No.	Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY	MUD	SILT	VERY FINE	FINE	MEDIUM	COARSE	VERY COARSE	Srt: POOR	MOD	WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
							FT.													
							800													SH: cont blsh gy, plty, carb, sl-mod calc, clymtrx, slty ip
							820													
							840													
							860													
							880													
							900													SS: ltgy - blsh dkgy, qtz, vf-slty calc, carb, slty ip, mod sft-mod hd.
							920													
							940													
							960													
							980													
							1000													
							1020													
							1040													
							1060													SH: blsh dkgy, carb, plty, calc clymtrx w/ slty.
							1080													
							1100													
							1120													v carb
							1140													v carb
							1160													SH: aa
							1180													
							1200													

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CUTTINGS X
CORE
OUTCROP

Skyline Mine
Canyon Fuel Co

PROJECT 2015 Exp DATE 10-29-15 HOLE NO. 15-21-2

LOGGED BY J Rogers Run Interval 1200 - 1600

Length Cored Length Recovered % Recovery

Observations

Depth Adjustment

LOCATION
T 13S R 6E Sec 21
N
E
Elev

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY, MUD, SILT, VERY FINE, FINE, MEDIUM, COARSE, VERY COARSE	Srt: POOR, MOD, WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						FT.				
						1200				SLTST: gy-dkgy, carb, slcalc, cly mtrx, shly, modsft-modhd
						1220				SS: ltgy, gtz, vf-slty, wsrt, calc, stp, mod cmt, cons, mod hd. SH: dkgy, plty, carb, slcalc cly mtrx modsft-mod hd
						1240				
						1260				aa
						1280				slty
						1300				aa
						1320				
						1340				
						1360				
						1380				slty
						1400				slty
						1420				
						1440				SS: ltgy-gy, vf-slty, calc W srt, mod cmt, mod hd
						1460				
						1480				
						1500				SH: dkgy, plty, carb, shly, cly mtrx, mod sft
						1520				aa
						1540				SS: ltgy, vf-slty, wsrt, stp, mod cmt, calc, mod hd
						1560				shly
						1580				
						1600				

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CUTTINGS X
CORE
OUTCROP

Skyline Mine
Canyon Fuel Co

LOCATION
T 13S R 6E Sec 21
N
E
Elev

PROJECT 2015 Exp DATE 10-29-15 HOLE NO. 15-21-2
LOGGED BY J Rogers Run Interval 1600-1842
Length Cored Length Recovered % Recovery
Observations
Depth Adjustment

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip / Description / Graph	THICKNESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY / MUD / SILT / VERY FINE / FINE / MEDIUM / COARSE / VERY COARSE	Srt: POOR / MOD / WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
				FT. 1600				50% SS 50% SLTS LT-MED GRY, VFG,
				1620				AS ABV.
				1640				60% SLTS 35% SS: VFG DRK-LT GRY, 5% CMS TRC COAL
				1660				80% SLTS 20% SS: VFG DRK GRY W/ LT GRY TRC CMS & COAL
				1680				AS ABV.
				1700				AS ABV
				1720				60% SLTS 35% MS 5% SS VFG, DRK-MED GRY,
				1740				AS ABV W/ SOME CMS
				1760				50% SLTS 40% MS 10% SS VFG, DRK GRY
				1780				70% MS 30% SLTS TRC SS DRK GRY
				1800				70% MS 25% SLTS 5% COAL GRY - BLUE GRY
				1820				65% SLTS 20% MS 15% COAL DRK GRY & BLK
				1840				
				1842'				SWITCH TO 3"X5" (PQ) CORE @ 1842'

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CUTTINGS / CORE / OUTCROP

Skyline Mine
Canyon Fuel Co

LOCATION
T 13S R 6E Sec 21
N 4,391,902.2 (NAD83)
E 477,271.3
Elev 9186'

PROJECT 2015 Exp DATE 10-30-15 HOLE NO. 15-21-2
LOGGED BY J Rogers Run # 1 Interval 1842-1862
Length Cored 20 Length Recovered 19.6 % Recovery
Observations
Depth Adjustment

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY / MUD / SILT / VERY FINE / FINE / MEDIUM / COARSE / VERY COARSE	Srt: POOR / MOD / WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						FT.				Driller took upper 0.7'
						1842				MS: gy gnsh - dkgy, cly, carb slty, thnly lam, vfis, vfri, mod sft - sft.
		15	Slk R DI For			43				
			FIS							
		60	For, DI			44				
						45				
		90	BP							
		90	BP			46				
			BP							
			BP			47				cont sharp
										SS: ltgy, vfgr - slty, calc, roots - spar, mod cmt, w srt, mod hd
						48				
						49				grd cont
		90	BP							CMS: blk, carb, [illegible] spar, vfis, vfri, mod sft - sft
		90	FIS			50				
			BP							
						51				
		90				52				
										cont sharp, uneven
		90	BP			53				SLTST: Hgy grdng - SS: Hgy vfgr, calc, roots, plant frag
						54				
										root spar
						55				
			BP							vthnly lam
		85 90	BP			56				
						57				cont sharp, even,
			FIS							CMS: blk, carb, sl calc - non calc, thnly lam, vfis, vfri
						58				
										grdng SLTST:
		85				59				
		40								cont, ang, shrp, uneven
			FIS			60				MS: dkgy - gnshgy, carb, vsl calc, cly mtrx, vfis, fri
						61				
										Lost Core
						1862				

DISCARDED CORE

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CUTTINGS
CORE X
OUTCROP

Skyline Mine
Canyon Fuel Co

LOCATION
T 13S R 6E Sec 21
N
E
Elev

PROJECT 2015 Exp DATE 10-30-15 HOLE NO. 15-21-2
LOGGED BY J Rogers Run # 2 Interval 1862-1882
Length Cored 20 Length Recovered 20.2 % Recovery 100%
Observations 11:00pm - 1:00pm Down To replace wire rope
Depth Adjustment

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICK NESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY / MUD / SILT / VERY FINE / FINE / MEDIUM / COARSE / VERY COARSE	Srt: POOR / MOD / WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						FT.				
		90	BP			1862				MS: cont aa
		80				63				grd cont, uneven
		90	BP			64				SLTST: ltgy,
		90	o, E, S							SH: gnsh gy, cly mtrx, occ
		40				65				silty lp, vsl calc, carb plant
		80								frags, fri, wk, sft
CORE DISCARDED → 1866.6'						66				
						67				
BOX 1		90	BP			68				
		90								
		90				69				grd - SLTST:
										thnly lam
						70				vf gr wi slt
1871.3'		90				71				
BOX 2		90	o, UE, r,			72				grd - vf gr SS: ltgy, silty
		85								calc, mod hd
1871335						73				Low ang Thn lam
										cly incr
						74				MS: gy, grdng - CMS: blk
		90	BP							sharp, even,
		0	CIT			75	P			Coal (1874.4 - 1879.9')
		90	BP				R			blk, mod dul - mod brt, res,
		0	CIT			76	R			Wcltd @ top, bony @ base
						77				
						78				
						79				
		90	BP							bony, sooty,
			BP			80				
			FIS							ms: gnsh gy, cly mtrx, slty,
		90	BP							fri
1880.9'			O, E, S,			81				
BOX 3		90	BP							
						1882				

1874.4 – 1876.4
1876.4 – 1878.4
1878.4 – 1879.9
LAB SAMPLES

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CUTTINGS
CORE
OUTCROP

Skyline Mine
Canyon Fuel Co

LOCATION
T 13S R 6E Sec 21
N
E
Elev

PROJECT 2015 Exp DATE 10-30-15 HOLE NO. 15-21-2
LOGGED BY J Rogers Run #3 Interval 1882-1902
Length Cored 20 Length Recovered 20 % Recovery 100%
Observations
Depth Adjustment

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICK NESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY MUD SILT VERY FINE FINE MEDIUM COARSE VERY COARSE	Srt: POOR MOD WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						FT.				
		90	BP			1882				MS: aa cont
		90	BP							
BOX 3		0	C, uE,		1.1	83				SS: ltgy, vfgr, slty ip loc, calc, low ang thnly lam, cln, wsrt, wcmt, mod Hd
1885.0'		90	BP			84				
						85				
					2.5	86				INCORPORATED
						87				FEB 13 2017
		90	BP							
		0	C, E,		0.7	88				Div. of Oil, Gas & Mining
						89				root
		90	BP 0, E, FIS							MS+ blk - gnsh gy, cly mtrx v thn lam, vfis, vfri, wk mod hd, grsy
		90	BP 0, E			90				
			FIS			91				
						92				carb frags
						93				carb frags
		90	BP 0, E,		1.5	94				grdng slty SS; SS: ltgy, vfgr-slty, calc
		90	BP, 0, E		1.4	95				CMS: dkgy-blk, carb, coal frag + lam, vfis, vfri, v thnly lam
		90	BP, 0, E			96				
						97				SS: ltgy, vfgr-slty, calc thnly lam loc, wsrt, wcmt mod hd
					1.6	98				
		50	D, uE, R Rub DI							ang cont, sharp, uE
						99				
		50	DI DE R		0.9	1900				SLTST: ltgy, calc, lmy, mod hd-hd, sug, xln vf-slty
		90	BP		0.8					
		90	DI uE R DES			1901				
		90	DI DES			1902	EOR			

CORE DISCARDED

CUTTINGS
CORE X
OUTCROP

Skyline Mine
Canyon Fuel Co

LOCATION
T 13S R 6E Sec 21
N
E
Elev

PROJECT 2015 EXP SKYLINE DATE 10-30-15 HOLE NO. 15-21-2
LOGGED BY B. LINDSAY Run #4 Interval 1902-1922
Length Cored 20 Length Recovered 19.9 % Recovery
Observations
Depth Adjustment

CORE DISCARDED

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE FT.	LITH Graph	Grain Size: CLAY, MUD, SILT, VERY FINE, FINE, MEDIUM, COARSE, VERY COARSE	Srt: POOR, MOD, WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						1902'	TOP OF RUN 4			
			RUBBLE		0.54					1902.0'-1908.7' SLTS W/ ZONES OF MS: DRK-LT GRY, V WEAK-
		60°	0, DI, IRR		0.58	1903				
		90	0, PL, SM		0.78	1904				... COAL LENSE
			EDGES SLICKS							
			EDGES SCOURED		0.45	1905				
		30°	0, PL, SLK-DEP							
		60°-90°	0, DI - WEAK ROCK		0.42	1906				
		15°	0, PL							
			0, IRR,		0.47	1907				
					0.96	1908				... 0.2' THK MS M WEAK
						1909				1908.7'-1910' SS W/ SILTY LAMS & SLTS & MS ZONES: LT GRY W/ DRK GRY, VFG, SILTY LAMS W/ SOFT SED DEF
		85°	0, BP, WAVY		1.37	1910				... 1910.6'-1911.2' MS GRADING TO CMS W/ COAL STRINGERS
			WEAK ROCK			1911				... 1911.2'-1912.5' SLTS
					0.96	1912				COAL LENSE
			0, DI, IRR		0.84	1913				
		25°	0, BP, RGH		2.35	1914				... ROUND PYRITE BLEBS
						1915				DRK IRR LAMS
		60°	0, DI, RGH		1.38	1916				... 1916.8'- 1920.1 ALT SLTS, SS, & MS
		75°	0, BP, IRR RGH		0.4	1917				
		45° 0°-90°	0, PL, SLK-DEP 0, IRR		0.95	1918				
			0, IRR		0.44	1919				... 1919.3' CO STRINGERS
			RUBBLE		0.52					
		~90	0, DI		1.98	1920				SS AS ABV
						1921				BIOTURBS
		~90	0, DI							
						1922'	END OF RUN 4			

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CUTTINGS / CORE / OUTCROP

Skyline Mine
Canyon Fuel Co

PROJECT SKYLINE 2015 EXP DATE 10/30/15 HOLE NO. 15-21-2

LOGGED BY B. LINDSAY Run # 5 Interval 1922' TO 1942'

Length Cored 20.0' Length Recovered 20.0' % Recovery

Observations

Depth Adjustment

LOCATION T 13S R 6E Sec 21 N E Elev

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE FT.	LITH Graph	Grain Size: CLAY MUD SILT VERY FINE FINE MEDIUM COARSE VERY COARSE	Srt: POOR MOD WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						1922'	TOP OF RUN 5			
CORE DISCARDED		60°	SLUFF O, BP, R&H, IRR		0.37					1922.0' – 1923.9' SS W/ SLTS LAMS; LT GRY W/ MED GRY & BRN LAMS
		90°	O, BP, IRR		0.94	1923				
		~90	O, IRR, RUB			1924				SHARP CONTACT 1923.9' – 1935.6' ALT SS & SLTS: LT GRY W/ SOME MED GRY, VFG, SOME FAINT LAMS W/ SOFT SED DEF, SOME THIN MS ZONES HARD – MED WEAK,
		90° CP	RUB		0.58	1925				
1927.0		~90	O, BP, DI, IRR		1.02	1926				
		85°	O, DI			1927				... 0.2' THK MS MED GRY
BOX 4		85°	DI O, WAVEY		1.40	1928				
					1.95	1929				
		70°	O, BP, IRR			1930				
		15-20°	O, PL, CURVED, R&I		0.51					
1931.9'		90°	DI		0.55	1931				... LEAF FOSSILS
BOX 5		80°	O, BP, IRR		0.64	1932				
		75°	C, WAVEY-FI-CA O, IRR, R&H C, PLAT-CA O, BP, RUB		0.7	1933				
					0.57	1934				
			O, BP O, DI, IRR EDGES SCOURED		0.77	1935				1935.6' – 1937.3' MS: MED-DRK GRY & BRN, M WEAK – WEAK
					0.74	1936				
						1937				... GRADES ↓ CARBY V THIN CD STRINGERS SHARP CONTACT
BOX 6		90°	O, BP, WAVEY M SCM		1.31	1938				1937.3' – 1941.8' SS: LT GRY VFG, HARD, FAINT LAMS
		0°	O, PL, M R&H O, IRR, R&H C, PL, FI-CA		0.76	1939				
					1.57	1940				
1941.6 BOX 7		~90	O, BP, CURVED RUB		0.71	1941				... 1941.1 0.4' THK SILTY ZONE BRN & GRY 1941.8' – 1942' MS DRK GRY, COAL STRINGERS, M WEAK
						1942	END OF RUN			

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PROJECT SKYLINE 2015 EXP DATE 10/30/15 HOLE NO. 15-21-2
LOGGED BY B. LINDSAY Run # 6 Interval 1942' TO 1962'
Length Cored 20.0' Length Recovered 20.1' % Recovery
Observations
Depth Adjustment

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE FT.	LITH Graph	Grain Size: CLAY, MUD, SILT, VERY FINE, FINE, MEDIUM, COARSE, VERY COARSE	Srt: POOR, MOD, WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						1942'	TOP OF RUN 6			1942'-1942.6' MS: DRK GRY, M WEAK, SOME THIN COAL STRINGERS
BOX 7		90°	O, BP, CURVED-IRR		1.5'	1943'				1942.6'-1944.8' SLTS: LT GRY-DRK GRY GRADES ↓ DARKER & FINER, M STRONG-WEAK
			O, DI, RGH RUB			1944'				
1946.4'					2.3'	1945'				SHARP CONTACT
						1946'				1944.8'-1948.0' SS: LT GRY, VFG, HARD, SOME CARB TRASH
		90°	O, DI, RGH			1947'				SOFT SED DEF
BOX 8		90°	O, IRR		1.0'	1948'				SHARP CONTACT
			O, CURVED, RGH							1948.0'-1950.5' SLTS: MED GRY, MED WEAK CONTAINS CARB TRASH
			O, IRR, PLATEY ?		0.9'	1949'				
1950.4'		90°	O, IRR		0.4'	1950'				GRADED CONTACT
			O, DI, PLATEY WEAK ROCK							1950.5'-1951.4' MS: MED-DRK GRY & BRN, MED WEAK-WEAK, GRADES ↓ TO CMS ~ 1950.8' RESIN @ BOTTOM
1951.4'	1950.4	90°	O, DI, BP		0.8'	1951'				← GRADED CONTACT, 1951.4'-1961.0' COAL: BLK, BRT, SOME RESIN
		25°	O, PL RUBBLE							
		10°	C, PL			1952'				
		45°	O, PL, M RGH			1953'				
		90°	O, IRR		1.0'					
1954.6'		0°	O, PL & STEPPED			1954'				
		5°	O, PL, ENE/CLEAN			1955'				
		90°	O, IRR							
		5°	O, PL			1956'				
			O, IRR, RUB		1.1'					
1957.8'						1957'				
		10°	O, PL, M RGH EN			1958'				... LITTLE PYRITE ON THE CLEAT
						1959'				
					2.5'	1960'				
		10-0°	O, PL & IRR			1961'				
1961.0'		80° BP	DI? LITTLE PYRITE ON FRACS		1.0'					WAVEY, SHARP CONTACT 1961.0'-1962' SS: LT GRY, VFG, M HARD. VERT. COALY STRINGER W/ PYRITE
1962.1'						1962'	END OF RUN 6			

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PROJECT 2015 Exp DATE 10-30-15 HOLE NO. 15-21-2
LOGGED BY J Rogers Run #7 Interval 1962-1982
Length Cored 20 Length Recovered 20 % Recovery 100%
Observations
Depth Adjustment

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SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY, MUD, SILT, VERY FINE, FINE, MEDIUM, COARSE, VERY COARSE	Srt: POOR, MOD, WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
1962'						FT. 1962				SS: ltgy, vf gr - slty, mod srt, calc, mod hd
BOX 9		90	BP, C, E,			63				thn - thnly lam, low ang x lam, cren
		90	BP C, UE,			64				
		90	DI			65				hztl lam
1966.9'			BP, P, C, UE,			66				coal spar
		70	DI			67				MS: dk gnsh gy - blk, carb, vfis, vfri
BOX 10		60	DI, BP C, UE, NP			68				SS: aa ltgy, vf gr, hztl lam
		90	BP			69				
		90	BP			70				MS: dk gy - blk, cly, slt, vfis vfri, SS: aa
1971.7'						71				
		90	BP			72				CMS: dk gy - blk, vthnly lam vfis, vfri, cly mtrx, FRAG vcarb @ base
		90	BP			73				
		90				74				
CORE DISCARDED		90	BP			75				SS: ltgy,
		@ 60	C, UE, NP			76				coal spar, root thnly lam, Hztl, mod hd
						77				coal lath
			Rub			78				MS: ltgnsh gy, cly mtrx, shly vfis, vfri, grsy, incr slt
		0	DI, C, UE, NP Rub			79				SLTST: ltgy, sdy ip vf gr,
		90				80				sd incr SS: ltgy, vf - slty, calc, w srt, w cmt, mod hd.
		90	DI			81				
		90	Rub			82				

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PROJECT 2015 Exp DATE 10-31-15 HOLE NO. 15-21-2
LOGGED BY J Rogers Run Interval 1982-2042
Length Cored Length Recovered % Recovery
Observations Ream f/1842-1982 Rotary f/1982-2042
Depth Adjustment Resume coring @ 2042'

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY	MUD	SILT	VERY FINE	FINE	MEDIUM	COARSE	VERY COARSE	Srt: POOR	MOD	WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						FT.													ROTARY DRILL W/ 6¼" BIT FROM 1982'-2042'
						1982													SH: dk gy, plt, carb, wi SS: int bdng, vfgr-slty
						1992													
						2002													
						2012													
						2022													SS: Hgy, vfgr-slty, WSrt, calc, mod cmt, mod hd
						2032													
						2042													@ 2042' SWITCH BACK TO 3" x 5" PQ CORE

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PROJECT 2015 Exp DATE 10-31-15 HOLE NO. 15-21-2
LOGGED BY J Rogers Run #8 Interval 2042-2062
Length Cored 20 Length Recovered 20 % Recovery 100
Observations
Depth Adjustment

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY, MUD, SILT, VERY FINE, FINE, MEDIUM, COARSE, VERY COARSE	Srt: POOR, MOD, WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						FT.	TOP OF RUN 8			
2042.0		55°	O, BP, PL, RLH		1.2'	2042				2042' - 2044' SS: LT GRY, VFG, WAVEY LAMS, CO STRINGERS, HARD,
		90°	O, BP, IRR							
BOX 11		85°	O, DI, WAVEY		0.4	2043				2044' - 2052' ALT SLTS & MS: DRK BRN - BLK & LT - MED GRY, M HARD & WEAK, COALY STRINGERS, ZONES OF CMS, WAVEY LAMS,
		90°	O, BP, IRR		0.35	2044				
		90°	O, PLATEY, BP		0.5	2045				SOFT SED DEF
2046.9		80-90°	O, IRR, BP			2046				... SANDY ZONE VFG
		50°	O, IRR, DI STEPPED		0.4	2047				... 2046.6 - 2047.7' CMS W/ CO STRINGERS, WEAK
BOX 12		60-90°	O, BP, IRR		0.95	2048				... SANDY ZONE VFG
			O, DI, IRR		0.45 0.58 0.43 0.37	2049				2049.4' - 2050.7' CMS W/ CO STRINGERS, WEAK
2051.75			B, DI, PL, RLH		0.76 1.20	2050				
						2051				
						2052				2052.0' - 2062' SS W/ SLTS LAMS & ZONES: LT GRY, VFG,
BOX 13		90°	O, BP, RLH		1.07	2053				HARD - M WEAK, SOFT SED DEF IN SLTS ZONES, BIOTURBS,
		85°				2054				
		75°			0.87	2055				
		90°	O, BP, WAVEY		0.17 0.2 0.12	2056				
2056.6'		75°				2057				... 2057.2' LESS SILTY ZONES BELOW FEW THIN LAMS, MOSTLY CLEAN
		5°	CEO, PL, RLH PYRITE ON FRAC		0.10					
BOX 14		15°	D, CURVED, RLH		0.71	2058				
			O, PL, RLH		0.36	2059				... FEW MUD POCKETS
		15°	O, PL-IRR, RLH		1.63	2060				
		80°	O, PL, BP, RLH		0.54	2061				
2061.5		90-70°	O, BP, M SM		0.38					... SILTY ZONE W/ RIP UP CLASTS ABOVE.
BOX 15						2062	END OF RUN 8			

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PROJECT SKYLINE 2015 EXP DATE 10/31/15 HOLE NO. 15-21-2
LOGGED BY B. LINDSAY Run #9 Interval 2062'-2082'
Length Cored 20.0' Length Recovered 20' % Recovery 100%
Observations LEA SEAM
Depth Adjustment

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY MUD SILT VERY FINE FINE MEDIUM COARSE VERY COARSE	Srt: POOR MOD WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						FT.	TOP OF RUN 9			
		85°	0, PL, M SM		0.65'	2062'				2062'-2063.1' SS: LT GRY, VFG, MASSIVE & LAMINATED, SOFT SED DEF.
BOX 15		90°	0, IRR			2063'				2063.1'-2063.5' MS: MED GRY, WEAK-MED WEAK
			RUBBLE			2064'				2063.5'-2063.8' SS: AS ABV
										2063.8'-2064.55' MS: DRK GRY WEAK, CO STRINGERS, FEW PYRITE FLECKS, PLATEY
2065.1'					0.94'	2065'				2064.55'-2065.1' SS: AS ABV
BENCH (A)	2065.1'	90°	0, IRR							2065.1'-2066.15' MS: DRK GRY M WEAK-WEAK, THIN CO STRINGERS, PLATEY, GRADES TO CMS @ BOTTOM
2066.15'		90°	RUBBLE 0, BP			2066'				SHARP CONTACT (CONTAINS PYRITE FLECK
		0°	0 FC CLEAT							2066.15'-2077.35' COAL: (1.2'
BENCH (B)		85°	0, BP		1.08'	2067'				BLK, BRT, SOME PYRITE & RESIN & CA IN CLEAT,
		90°	0, BP			2068'				PYRITE ON CLEAT
										RESIN
										2068.25'-2069.5' MS PARTING:
3067.5'		90°			0.70'	2069'				DRK BRN-BLK, CMS IN TOP 0.2' & BOTTOM 0.4' M WEAK-WEAK
BENCH (C)					1.46'	2070'				
		90	0, IRR			2071'				
		5°	0, CLEAT		0.66'					
		60°	0, IRR		1.17'	2072'				
						2073'				LITTLE PYRITE ON CLEAT
		10°	0, CLEAT EN		0.32'					
		75°	0, RLH			2074'				2073.85' 0.04' THK SANDY PARTING
2074.43'			0, IRR							BOTTOM OF MATERIAL IS COAL W/ PYRITE -
BENCH (D)		85°	0, RLH		1.50'	2075'				
						2076'				RESIN
			0, PL & IRR							
2077.35'						2077'				SHARP CONTACT
BENCH (E)		90°	0, BP							2077.35'-2077.75' MS: DRK GRY, THIN COAL STRINGERS, CARBY @ TOP, M WEAK-WEAK
	2078.5'	90°	0, BP		1.33'	2078'				GRADED CONTACT
2078.5'	BOX 15 2079.5'									
		75°				2079'				2077.75'-2080.8' SS: LT GRY W/ SOME MED GRY STRINGERS, VFG, STRONG-M WEAK, SILTY ZONES W/ SOFT SED DEF.
		75°			0.3'					
		80°			0.81'	2080'				2080.8'-2082' SLTS: DRK GRY
	BOX 16					2081'				M STRONG, PLATEY,
			PLATEY							
						2082'	END OF RUN 9			

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PROJECT SKYLINE 2015 EXP DATE 10/31/15 HOLE NO. 15-21-2
LOGGED BY B. LINDSAY Run #10 Interval 2082' TO 2102'
Length Cored 20' Length Recovered 20' % Recovery 100%
Observations
Depth Adjustment

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE FT.	LITH Graph	Grain Size: CLAY / MUD / SILT / VERY FINE / FINE / MEDIUM / COARSE / VERY COARSE	Srt: POOR / MOD / WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						2082'	TOP OF RUN 10			
Box 16		0°	O, IRR			2083'				2082' – 2092.1' ALT SLTS & MS: MED GRY – DRK GRY, M HARD – M WEAK, LAMS & SOFT SED DEF
2084.4		70°–90°	O, BP, IRR		0.75	2084'				..2083–2083.2' MS
						2085'				,,, 2085.0' – 2085.6' MS
Box 17		85°	O, BP		0.6	2086'				
		80°			1.46	2087'				
2089.3		90°			0.85	2088'				
		90°				2089'				...2089.4' – 2090.6' MS
		30°	O, PL & IRR			2090'				,,, SLICKS
Box 18		40°	DEPOSITIONAL SLICKS			2091'				
		10°	O, IRR		1.04	2092'				2092.1' – 2,102' SS; MED – LT GRY, LAMINATED, SILTY ZONES, SOFT SED DEF
		90°	O, IRR			2093'				
2094.0		25°	O, PL, RGH, FI-PYRITE		1.34	2094'				
		10°	C, PL							
		50°	O, BP, WAVEY		0.17	2095'				
		0°	O, IRR		0.68	2096'				
Box 19		90°			0.68					
		40°			0.70	2097'				,,, 0.3' THK MS/SLTS
		50°			1.17	2098'				,,, SILTY
2099.0			O, BP, IRR RUBBLE		0.35	2099'				,,, SILTY
		80°–85°	O, BP, IRR, WAVEY		0.71	2100'				
Box 20						2101'				
		10°	O, C, PL		0.98					
						2102'	END OF RUN 10			

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PROJECT SKYLINE 2015 EXP DATE 10/31/15 HOLE NO. 15-21-2
LOGGED BY B. LINDSAY Run #11 Interval 2102' - 2122'
Length Cored 20' Length Recovered 20' % Recovery 100%
Observations
Depth Adjustment

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE FT.	LITH Graph	Grain Size: CLAY / MUD / SILT / VERY FINE / FINE / MEDIUM / COARSE / VERY COARSE	Srt: POOR / MOD / WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						2102'	TOP OF RUN 11			2102.0' - 2104.4' SS; LT GRY, VFG, LAMS, RIP UP CLASTS, HARD - M HARD
BOX 20		75°	O, BP, PL, RLH		1.07	2103				
2103.5' BENCH (A)		85° 90°	RUBBLE		0.50	2104				2104.4' - 2104.55' MS & CMS; DRK GRY - BLK, M WEAK
2104.55 BENCH (B)		15	O, PL, CLEAT			2105				2104.55' - 2105.15' COAL; BLK, BRT, PYRITE AT TOP
		90	RUBBLE		0.60					2105.15' - 2106.05' MS; DRK GRY TOP 0.2' = CMS W/ COAL STRINGERS, M WEAK,
2106.05 BENCH (C)		90	O, BP, SMTH W/ PYRITE			2106				2106.05' - 2112.1' COAL;
		25°	O, PL, IRR		0.80					BLK, BRT, SOME RESIN & PYRITE
		90°	O, DI, RGH		2.05	2107				... PYRITE
						2108				... RESIN
2109.0 BENCH (D)		70°	O, IRR, DI		0.36	2109				... RESIN
		0	O, PL,		0.40					
		90-70	O, CURVED RGH			2110				
		35°	O, PL,							... PYRITE FLECKS
		0-5°	O, CLT, PL FI- WHITE		0.95	2111				SHARP CONTACT
2112.1' BENCH (E)		15°	O, PL							2112.1' - 2121.55' SS; MED -
		80°	O, BP, WAVEY		0.65	2112				LT GRY, HARD - M HARD, VFG - FG, LAMS
2113.2'	2113.2	90	O, RGH		0.92	2113				
	BOX 21	65°	O, PL, BP, SMTH			2114				
		65°			0.81					
		80°	O, IRR, RGH		0.29	2115				
					1.69	2116				
		60°	O, BP, WAVEY			2117				... MS ZONE
	2118.0'	70	O, DI		0.37					
		60	O, RGH		0.46	2118				... 2118.6' - 218.9' SILTY ZONE
		85	O, DI, RGH		0.48					
	BOX 22	90°	O, BP, RGH		0.57	2119				
		90°			1.21	2120				
		10°	O, PL, SMTH		0.91	2121				2121.55' - 2122' SLTS; DRK GRY M WEAK, SOME CO STRINGERS
		75°	O, BP RUBBLE			2122				

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PROJECT 2015 Exp DATE 10-31-15 HOLE NO. 15-21-2
LOGGED BY J Rogers Run #12 Interval 2122 - 2142
Length Cored 20 Length Recovered 19.8 % Recovery
Observations
Depth Adjustment

SAMPLE No. Box	ROCK STR 1 2 3 4	DISCONTINUITIES Dip	Description	Graph	THICKNESS	DEPTH SCALE	LITH Graph	Grain Size: CLAY / MUD / SILT / VERY FINE / FINE / MEDIUM / COARSE / VERY COARSE	Srt: POOR / MOD / WELL	LITHOLOGIC DESCRIPTION (bedding, contacts, color, grain size, structures, etc.)
						FT.				
BOX 23		90	FIS BP			2122				CMS: gy-blk, clymtrx above + below coaly middle @5-.7 vfis-vfri sharp contact, even
2122.8		90	FIS BP			23				
										SS: ltgy, vfgr, slty, thn-thnly carb lam, low ang-hztl, uneven cren
					2.4	24				
						25				sharp cont, even
		90	Rub DI							CSlt: gy-dk gy, coal (2125.6'-2126.9') 1.3' blk, mod dul-mod brt, p clt,
		50				26				
		40			0.5					
		85	BP							sharp cont, even
					1.3	27				SLTST: ltgy, sdy lp vf gr, calc,
										SS: ltgy, vfgr, slty @ base, grdng-ms
		0	C, F, Calc			28				Pyr
										MS: gy-dk gy-blk, contact grdl, thnly lam, vfis, vfri, wk, mod sft (Rz)
		90	FIS BP Rub		0.5	29				
					0.3					Coal: blk, mod brt, f clt
						30				SS: brnsh gy, vf-f gr, slty, w srt, calc, mod cmt, mod hd,
					1.4					
		30	O, P, E, DI			31				
		40								MASS
						32				
					3.2					
						33				
						34				
										ltgy, vf wi occ f gr, w rd, w srt, calc, mod-p cmt, ht, cons, cln, occ stp, est vis por 12%, frm
						35				
		40	O, UE, R DI		0.6	36				thnly lam
		90	BP							
					3.0	37				
						38				
						39				
		90	BP, DI O, E, Plnr		0.9	40				
						41				
		35	DI, O, UE, R							
		20				2142				End of coring

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Southwest Reserves
NEPA Analysis Area
2011

Northern Goshawk, other Raptors and
General Wildlife Surveys

Prepared for:

Skyline Mine
Greg Galecki
Environmental Engineer
Canyon Fuel Company, LLC

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WESTERN LAND SERVICES, INC

08.10.2011

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1.0 Introduction

The following narrative is submitted pursuant to Federal requirements regulating potential impacts to threatened, endangered, candidate and sensitive species and their associated habitats.

The Southwest Reserves NEPA Project Area (Project Area) is located near Electric Lake at the top of Fairview Canyon. While leasing authority for all Federal coal reserves is given to the BLM under the Mineral Leasing Act of 1920, the surface management agency for this project is the US Forest Service. The Project Area is located on lands administered by the Manti-La Sal National Forest and adjacent privately owned property. This survey was required to meet Special Coal Lease Stipulations #2, #3 and #14, as outlined in the Record of Decision (ROD) (ROD Attachment 1, pp 2-3) which was based on the Final Environmental Impact Statement for the Flat Canyon Coal Lease Tract (UTU-77114).

> Stipulation #2 states; *"If there is reason to believe that Threatened or Endangered (T&E) species of plants or animals, or migratory bird species of high Federal interest occur in the area, the Lessee shall be required to conduct an intensive field inventory of the area to be disturbed and/or impacted..."*.
>
> Stipulation #3 states; *The Lessee shall be required to perform a study to secure adequate baseline data to quantify the existing surface resources on and adjacent to the lease area...The study shall be adequate to locate, quantify, and demonstrate the interrelationship of hydrology, vegetation, and wildlife. Baseline data will be established so that future programs of observation can be incorporated at regular intervals for comparison."*
>
> Stipulation #14 states; *"In order to protect big-game wintering areas, elk calving and deer fawning areas, sage grouse strutting areas, and other key wildlife habitat and/or activities, specific surface uses outside the mine development areas may be curtailed during specified periods of the year."*

The National Environmental Policy Act (NEPA) requires that federal agencies consider the environmental impact of their proposed actions and reasonable alternatives. Under NEPA, through the development of an Environmental Impact Statement (EIS), the Forest Service has considered the environmental consequences of the proposed leasing of Tract (UTU-77114) and determined that the aforementioned stipulations were required to ensure environmental compliance with federal, state and forest laws, regulations, plans and conservation agreements. Coal exploration in the state of Utah requires consideration of wildlife species on the ground surface above associated mining activities. Thus, project implementation requires biological surveys to identify the presence or absence, and habitat suitability of protected status species prior to project activities.

In an effort to achieve environmental compliance as outlined in the ROD, Skyline Mine contracted with Western Land Services (WLS), an environmental consulting firm, to

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conduct raptor inventory surveys (i.e. northern goshawk protocol surveys) and general wildlife surveys in the area to assess species presence/absence and potential habitat.

Pre-field research was completed by WLS wildlife biologists, who utilized GIS data from the Utah Division of Wildlife Resources (UDWR), coordinated with US Forest Service (USFS) Wildlife Biologists, and researched species ecology, life history, known distribution, and habitat requirements.

2.0 Project Description

The Southwest Reserves Project Area is located in Township 13 South, Range 6 East, in Sections 15, 16, 17, 20, 21, 22, 27, 28, 29, 31, 32, 33, 34, and 35; and Township 14 South, Range 6 East, in Sections 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, and 16 (see attached Map). The project lies in Sanpete and Emery Counties. The Project Area was delineated in a GIS by outlining the boundaries defined in the ROD. During the month of July 2011, protocol surveys for northern goshawk, other nesting raptors, and general wildlife inventories were completed. Surveys for nesting raptors were completed simultaneously with the northern goshawk protocol surveys.

3.0 Habitat Overview

Habitat in the inventory analysis area is characterized by aspen, mixed conifer, conifer, and sagebrush communities. Primary plant species include quaking aspen (Populus tremuloides), Douglas-fir (*Pseudotsuga menziesii var. glauca*), sub-alpine fir *(Abies lasiocarpa)*, snowberry *(Symphoricarpos albus)*, antelope bitterbrush *(Purshia tridentate)*, and sagebrush *(Artemisia sp.)* with intermixed native and non-native graminoid species.

4.0 Methodology

Northern Goshawk broadcast acoustical surveys were conducted following U.S. Department of Agriculture (USDA) Forest Service, 2006, Northern Goshawk Inventory and Monitoring Technical Guide pp.3.13-15. Using GIS, survey transects were established 250 meters apart through the survey area; which encompassed the entire Project Area. Broadcast calling stations were then established every 200 meters along each transect. All surveys were completed by qualified wildlife biologists and technicians with a minimum of 2 years experience conducting broadcast acoustical surveys. Upon arrival at each broadcast calling station, the surveyor looked and listened before broadcasting the pre-recorded alarm calls. Utilizing FoxPro game calls, pre-recorded northern goshawk alarm calls were broadcast for approximately 10 seconds followed by 30 seconds of looking and listening. After turning 120 degrees the sequence was then repeated. Once the sequence of 10 seconds of calling and 30 seconds of looking and listening was completed 3 times and no response was elicited the surveyor then repeated the sequence before moving to the next calling station. Surveys were timed in accordance to the survey requirements outlined in the 2006 Goshawk Technical Guide and were based on local knowledge of nesting chronologies in the area. Additionally, surveyors searched for foraging raptors between calling stations when vantage points were available. In an effort not to duplicate inventories, calling stations east of Electric

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Lake and Upper Huntington Creek and specific call stations in T13S R6E Sections 28, 27, 33, and 34 were conducted by USFS Technicians as a part of a separate Forest Service Project.

5.0 Survey Results

In summary, no northern goshawk observations or vocal elicitations were documented during the course of this inventory. Surveyors documented both visual and audible responses to the alarm calls from red-tailed hawks (REHA), and common ravens (CORA). Other species encountered during the inventory include mule deer, rocky mountain elk, black bear, turkey vulture (TUVU), bald eagle (BAEA), blue grouse, dark-eyed junco (slate-colored form), Clark's nutcracker, American robin, black-capped chickadee, mountain chickadee, Lazuli bunting, and Townsend's solitaire.

5.1 Raptor Results

Based on observations made during the course of the inventory four active red-tailed hawk territories were established; near call stations 96, 253, 321, and 383 (see attached map). Due to the aggressive behavior of the individuals only cursory nest searches were conducted in order to reduce potential impacts to the nest sites. In addition one inactive nest was documented near call station 425 and is classified as an historic territory. Table 1 summarizes each raptor detection by call station, species, number of individuals, date, whether the detection was visual or audible, and surveyor notes if available.

Table 1. Data Sheet Summary of Raptor Observations

Call Station	*Species*	*Number*	*Date*	*A/V*	*Notes*
3	REHA	1	7/28/2011	A	
6	REHA	1	7/28/2011	A	
13	UNIDENT	2	7/14/2011	V	Looked like possible SWHA or Dark Morph REHA
21	REHA	1	7/14/2011	V	Not responding to Call
22	REHA	1	7/14/2011	A	Possible Nest close by
37	REHA	1	7/14/2011	V	Perched Across Canyon
48	REHA	1	7/28/2011	V	
49	REHA	1	7/28/2011	A	
50	REHA	1	7/14/2011	V	Perched Across Canyon
62	REHA	1	7/27/2011	V	
81	REHA	1	7/27/2011	V	
93	REHA	1	7/27/2011	A	
*96	REHA	2	7/27/2011	AV	Territory Defense
104	REHA	2	7/27/2011	AV	Territory Defense on BAEA
119	REHA	1	7/26/2011	V	
120	REHA	1	7/13/2011	V	Flew and Perched
141	TUVU	2	7/27/11	V	
190	REHA	1	7/27/2011	AV	

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192	REHA	1	7/27/2011	A	
247	REHA	1	7/9/2011	AV	
249	REHA	1	7/11/2011	A	Not responding to Call
253	SWHA	1	7/11/2011	AV	Viewed from a distance. May be dark morph REHA
*253	REHA	1	7/26/2011	AV	Possible nest in area, alarm calls, circling and landing frequently
298	REHA	4	7/26/2011	AV	Nest Site [Could not called due to] REHA calling and circling
299	REHA	3	7/26/2011	AV	Nest Site [Could not called due to] REHA calling and circling
307	REHA	1	7/27/2011	A	
320	REHA	2	7/26/2011	AV	Nest Site REHA calling and circling
*321	REHA	1	7/26/2011	AV	Nest Site REHA calling and circling
345	REHA	1	7/25/2011	V	Not responding to Call
358	REHA	1	7/25/2011	AV	Possible Nest
*383	REHA	1	7/25/2011	AV	
385	REHA	1	7/25/2011	A	
425	Nest	1	7/12/2011	V	(Inactive) Nest Between waypoints 425 and 424
430	REHA	1	7/25/2011	AV	Soaring
476	UNIDENT	1	7/21/2011	V	Speckled roosting in Pine
479	REHA	1	7/21/2011	A	Not responding to Call
490	REHA	1	7/8/2011	V	
494	REHA	1	7/21/2011	V	
500	REHA	1	7/21/2011	V	Not responding to Call
504	REHA	1	7/21/2011	V	Not responding to Call
513	REHA	1	7/21/2011	V	Not responding to Call
545	REHA	1	7/7/2011	V	
559	REHA	1	7/8/2011	AV	

*Call stations near the REHA territories that were established based on field observations.

Red-tailed hawks were noted throughout the project area; behavioral observations included both foraging and territorial defense. Audible responses by red-tailed hawks varied, as some were elicited from the northern goshawk alarm calls while others were noted by surveyors as not in response to the call. Other stations such as 298 and 299 could not be called due to an adult REHA that followed the surveyors from call station

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321. In general activity levels were higher on the southern half of the project area in comparison to activity on the northern half.

5.2 Big Game Results

The Project Area contains both mule deer fawning and elk calving habitat. To achieve compliance with Stipulation #14 surveyors also documented mule deer and elk observations. Table 2 summarizes big game species encountered during the course of the inventory by call station, species, number of individuals, date, whether the detection was visual or audible, and the surveyor's notes.

Table 2 Data Sheet Summary of Big Game Observations.

Call Station	Species	Number	Date	A/V	Notes
8	MD	1	7/25/2011	V	Doe
20	MD	2	7/28/2011	V	2 Doe
31	MD	3	7/14/2011	V	2 Doe, 1 Fawn
43	MD	2	7/28/2011	V	Doe, 1 Buck-3pt
45	MD	4	7/28/2011	V	3 Doe, 1 Buck-2pt
56	MD	1	7/27/2011	V	
64	MD	2	7/27/2011	V	Doe
65	MD	1	7/27/2011	V	2 pt
72	MD	1	7/27/2011	V	Fawn
79	MD	1	7/27/2011	V	Good Luck
115	MD	1	7/11/2011	V	Doe and Fawn
126	MD	2	7/13/2011	V	2 Doe
135	MD	3	7/27/2011	V	2 Doe, 1 Fawn
142	MD	1	7/26/2011	V	Big Buck 28-30 inch 4 pt
145	MD	1	7/9/2011	V	Doe
154	MD	1	7/9/2011	V	Doe
160	MD	1	7/27/2011	V	Doe
181	MD	1	7/11/2011	V	Doe
188	MD	2	7/26/2011	V	2 Bucks- (2 points)
192	Elk	12	7/13/2011	V	Cows and Calves
210	MD	1	7/13/2011	V	Doe
213	MD	2	7/26/2011	V	2 Bucks
214	MD	1	7/26/2011	V	Doe
238	MD	1	7/27/2011	V	Doe
252	MD	1	7/11/2011	V	Doe
296	MD	1	7/11/2011	V	Doe
319	MD	2	7/9/2011	V	Doe
325	Elk	25	7/12/2011	V	25 Cows and Calves
332	MD	1	7/9/2011	V	Doe
352	MD	1	7/25/2011	V	Doe

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356	MD	1	7/12/2011	V	Fawn
356	MD	1	7/25/2011	V	Doe
384	MD	2	7/25/2011	V	Doe
388	MD	3	7/25/2011	V	3 Doe
414	MD	2	7/25/2011	V	2 Doe
449	MD	1	7/12/2011	V	Doe
452	MD	2	7/26/2011	V	
495	MD	1	7/21/2011	V	1 Buck 26 inch 4pt.
497	MD	3	7/21/2011	V	3 Doe
524	MD	2	7/21/2011	V	2 Doe
526	MD	1	7/21/2011	V	Doe
527	MD	1	7/21/2011	V	Doe
533	MD	1	7/21/2011	V	Doe
538	MD	1	7/21/2011	V	Doe
544	MD	1	7/21/2011	V	Doe
545	MD	3	7/21/2011	V	3 Doe
564	MD	1	7/21/2011	V	Doe
565	MD	2	7/20/2011	V	2 Doe
605	MD	1	7/7/2011	V	Doe
614	MD	1	7/20/2011	V	Doe
616	MD	2	7/20/2011	V	2 Doe
619	MD	1	7/20/2011	V	Small Fawn

MD=Mule Deer

6.0 Conclusions and Recommendations

During the inventory of the Project Area, biologists documented audible responses or visual detections of raptors on 43 occasions, none of which were from northern goshawks. The vegetative communities within the Project Area are classified by the Utah Division of Wildlife Resources as crucial summer mule deer fawning habitat and crucial summer elk calving habitat; during the course of the survey 52 big game observations were documented within the Project Area.

We recommend in subsequent years coordination with the US Forest Service continues to be conducted prior to inventory initiation in order to refine the survey area requirements, ensure nesting data is transferred, and up to date protocols are followed.

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Appendix A

Project Map

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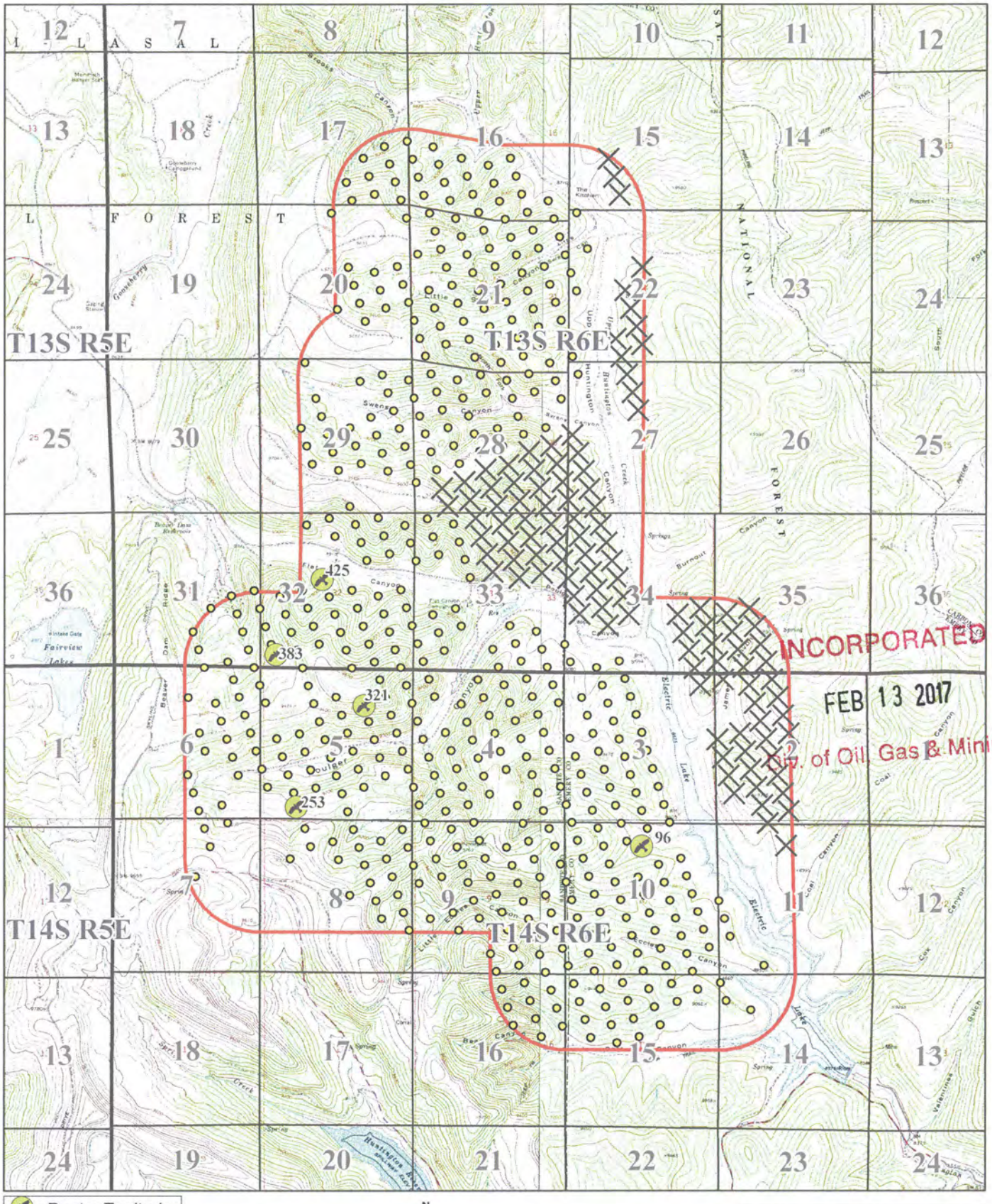

No warranty is made for data usage purposes other than those intended by Western Land Services. Maps are created as part of a GIS that compiles records, information and data from various sources. This data experiences frequent updates and accordingly, WLS shall not be liable for any errors or omissions herein.

Skyline Mine

Southwest Reserve NEPA Project Area

WESTERN LAND SERVICES

Richfield, UT 84701 (435) 896-5501

CONFIDENTIAL

Prepared By:	MGC	Date:	8/10/11

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Appendix B

Data Sheets

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Southwest Reserves
NEPA Analysis Area
2012

Northern Goshawk, other Raptors and
General Wildlife Surveys

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WESTERN LAND SERVICES, INC

08.06.2012

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2.0 Project Description

The Southwest Reserves Project Area is located in Township 13 South, Range 6 East, in Sections 15, 16, 17, 20, 21, 22, 27, 28, 29, 31, 32, 33, 34, and 35; and Township 14 South, Range 6 East, in Sections 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, and 16 (see attached Map). The project lies in Sanpete and Emery Counties. The Project Area was delineated in a GIS by outlining the boundaries defined in the ROD. During the month of July 2012, protocol surveys for northern goshawk, other nesting raptors, and general wildlife inventories were completed. Surveys for other nesting raptor species were completed simultaneously with northern goshawk protocol surveys; a subsequent survey was also completed based on observations made during the 1st calling station survey.

3.0 Habitat Overview

The vegetation across the survey area is very diverse and is somewhat consistent throughout the survey area. Vegetation is dependent on elevation, slope, and available water resources. Riparian areas are dominated by typical high elevation riparian species. The bottoms of some valleys are drier and dominated by mountain big sagebrush and silver sagebrush communities. South and East facing slopes, at higher elevations are dominated by quaking aspen communities. However, there are some areas that are open on South and East facing slopes. These open areas are typically grass and tall forb communities. However, a significant number of the open areas are dominated by false hellebore. The North and West facing slopes are dominated by conifer communities. The tree species within the conifer community are mostly dead or dying, and most areas have an abundance of deadfall due to beetle infestations. Because of the deadfall and dead trees the forbs and grasses within the conifer communities are very diverse and most areas have a solid understory. The tops of the ridges in the survey area vary with some being dominated by shrub communities such as mountain big sagebrush, elderberry or chokecherry while others are dominated by grass and tall forb communities. While some of the ridge tops are dominated by cluster tarweed. For complete list of plant species noted to occur within the project area see attached Appendix A, Plant Species Table.

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4.0 Methodology

Northern Goshawk broadcast acoustical surveys were conducted following U.S. Department of Agriculture (USDA) Forest Service, 2006, Northern Goshawk Inventory and Monitoring Technical Guide pp.3.13-15. Using GIS, survey transects were established 250 meters apart through the survey area; which encompassed the entire Project Area. Broadcast calling stations were then established every 200 meters along each transect. All surveys were completed by qualified wildlife biologists and technicians

with a minimum of 2 years' experience conducting broadcast acoustical surveys. Upon arrival at each broadcast calling station, the surveyor looked and listened before broadcasting the pre-recorded alarm calls. Utilizing FoxPro game calls, pre-recorded northern goshawk alarm calls were broadcast for approximately 10 seconds followed by 30 seconds of looking and listening. After turning 120 degrees the sequence was then repeated. Once the sequence of 10 seconds of calling and 30 seconds of looking and listening was completed 3 times and no response was elicited the surveyor then repeated the sequence before moving to the next calling station. Surveys were timed in accordance to the survey requirements outlined in the 2006 Goshawk Technical Guide and were based on local knowledge of nesting chronologies in the area. Additionally, surveyors searched for foraging raptors between calling stations when vantage points were available. In an effort not to duplicate inventories, calling stations east of Electric Lake and Upper Huntington Creek and other specific call stations in T13S R6E Sections 28, 27, 33, and 34 were conducted by USFS Technicians as a part of a separate Forest Service Project. Therefore, call stations in these areas were not surveyed as a part of these inventories. Seasonal timing of the inventory surveys within the project area was later in the nesting season due to limited access to the area as a result of high elevation snow pack levels and then restricted access in the area due to the Seely wildfire. Consultation with the USFS and UDOGM was conducted concerning survey timing and was within the seasonal guidelines as defined in the 2006 technical guide. Prior to conducting the survey the nest documented during the 2011 survey were monitored to determine nesting status. Of the five nests documented four nest were removed from the database; 2 misclassified (i.e., large mistletoe structures with dish shaped tops), 2 were suspected blown out, and one was occupied by an adult breeding pair of red-tailed hawks. The nest had one nestling perched on the nest. The call stations within 0.5 miles of the nest were not called in order to eliminate any potential for negative effects to the nestling.
Call stations near the campground of Mia Shalom were eliminated after the 2011 survey due to habitat suitability limits, habitat alterations such as logging, and constant high activity levels on the privately owned land. Elimination was only conducted after consultation with the USFS biologists after the 2011survey.

5.0 Survey Results

On July 24, 2012 near call station 32 one unconfirmed observation of a possible northern goshawk was documented. The sighting was brief and the biologist was unable to positively identify species with certainty. The behavioral observation suggested a non-vocal northern goshawk response may have occurred. Therefore, on July 26, 2012 a high intensity nest search was conducted around the call station and surrounding area where the unconfirmed sighting was documented. The nest search included a combination of visual nest searches utilizing ocular equipment and attempts to elicit vocal responses by playing a combination of northern goshawk alarm and wailing calls. During the course of the nest search, no audible or visual responses were documented of northern goshawks and no nest sites were detected.

In summary, as previously stated one unconfirmed northern goshawk observations was documented but no vocal elicitations were documented during the course of this

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inventory. Further investigation in the area resulted in no visual or audible observations of northern goshawk.

Surveyors documented both visual and audible responses to the alarm calls from red-tailed hawks (REHA), and common ravens (CORA). Other species encountered during the inventory include mule deer, rocky mountain elk, black bear, turkey vulture (TUVU), bald eagle (BAEA), dusky blue grouse, dark-eyed junco (slate-colored form), Clark's nutcracker, American robin, black-capped chickadee, mountain chickadee, Lazuli bunting, and Townsend's solitaire.

5.1 Raptor Results

While conducting northern goshawk calling surveys, red-tailed hawks were noted throughout the project area; behavioral observations included both foraging and territorial defense. Audible responses by red-tailed hawks varied, as some were elicited from the northern goshawk alarm calls while others were noted by surveyors as not in response to the call.

Table 1 summarizes each raptor detection by call station, species, number of individuals, date, whether the detection was visual or audible, and surveyor notes if available.

Table 1. Data Sheet Summary of Raptor Observations

Station#	Date	Auditory	Visual	Species	Notes
307	7/16/2012	No	yes	GOEA	2 GOEA observed flying NE of calling station
320	7/17/2012	No	yes	REHA	2 RTHA observed near nest
273	7/17/2012	Yes	yes	REHA	2 REHA observed and heard west of calling station
211	7/17/2012	Yes	no	REHA	REHA heard near calling station
96	7/18/2012	Yes	no	REHA	REHA heard near calling station
200	7/18/2012	No	yes	AMKE	AMKE observed near calling station
149	7/18/2012	No	yes	REHA	REHA observed near calling station
177	7/18/2012	Yes	no	REHA	REHA heard west of calling station
179	7/18/2012	Yes	no	REHA	REHA heard east of calling station
90	7/18/2012	Yes	no	REHA	REHA heard near calling station
119	7/18/2012	Yes	no	REHA	REHA heard north of calling station
77	7/18/2012	Yes	yes	REHA	REHA observed and heard near calling station

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54	7/19/2012	No	yes	REHA	2 REHA observed perched west of calling station
53	7/19/2012	Yes	yes	REHA	2 REHA observed and heard north of calling station
16	7/19/2012	No	yes	REHA	fledgling REHA observed near calling station
463	7/19/2012	No	yes	REHA	Several REHA observed , both adult and juveniles
469	7/19/2012	No	yes	REHA	2 REHA observed near calling station
426	7/19/2012	Yes	no	REHA	
435	7/19/2012	No	yes	Unknown	2 Hawks observed to the east of calling station, unable to identify
33	7/20/2012	Yes	yes	REHA	2 REHA observed and heard SW of calling station
387	7/20/2012	Yes	yes	REHA	1 adult and 1 fledgling REHA observed and heard SW of calling station
298	7/23/2012	Yes	no	REHA	REHA heard east of calling station
330	7/23/2012	Yes	yes	REHA	REHA observed and heard near calling station
273	7/23/2012	No	yes	REHA	REHA Observed to the west of calling station
319	7/23/2012	No	yes	REHA	REHA Observed to the south of calling station
432	7/24/2012	Yes	no	REHA	REHA heard west of calling station
434	7/24/2012	Yes	no	REHA	REHA heard northeast of calling station
479	7/24/2012	No	yes	REHA	REHA Observed to the east of calling station
54	7/24/2012	No	yes	REHA	2 REHA observed north of calling station
53	7/24/2012	No	yes	REHA	2 REHA observed east of calling station
48	7/24/2012	No	yes	NOGO	1 NOGO unconfirmed observation (further survey efforts to locate nest or confirm sighting yielded in no nests found and no sightings)
468	7/24/2012	Yes	no	REHA	REHA heard near calling station

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493	7/24/2012	No	yes	REHA	REHA observed near calling station
32	7/24/2012	No	yes	NOGO	1 NOGO possibly observed (further survey efforts to locate nest or confirm sighting yielded in no nests found and no sightings)
175	7/25/2012	Yes	no	REHA	REHA heard north of calling station
133	7/25/2012	Yes	yes	REHA	REHA observed near calling station
78	7/25/2012	No	yes	REHA& GOEA	REHA&GOEA observed near calling station
135	7/26/2012	No	yes	REHA	REHA observed near calling station
26	7/26/2012	Yes	yes	REHA	REHA observed and heard near calling station
33	7/26/2012	Yes	no	REHA	REHA heard southeast of calling station
21	7/26/2012	No	yes	Unknown Owl	Owl (unidentified species observed near calling station)
4	7/26/2012	No	yes	REHA	2 REHA observed near calling station

As a result of the number of observations of red tailed hawks within the survey area it was determined that subsequent surveys for red-tailed hawk nest sites would be conducted in areas where sightings and/or vocalization were heard. Initially, survey data sheets were reviewed and locations of adult pair or fledgling red-tailed hawk were noted on a map which included the location of calling stations. From that, areas were identified where likely nest sites may occur based on previously documented response data. The areas near the following groups of calling stations were then surveyed on foot and by glassing likely nesting habitat. The areas surveyed were located in and around calling stations; (33, 34) (53, 54) (469) (426) (389, 388,387,403) (307, 320, and 279,264) (177, 179,149) (96, 90, and 77). Surveys were conducted on July 19-22, 2012

In addition to the existing active nest that was first detected in 2011, two new active red-tailed hawk territories were established during these survey efforts; near call stations 33 and 53 (see attached map). A UDOGM Raptor Survey Form was completed for each of the new active territories and is attached as Appendix C. Survey efforts in other identified areas resulted in observing red-tailed hawks on several occasions, but did not result in detecting any new nest sites.

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5.2 Big Game Results

Observations of Big Game, mule deer and rocky mountain elk, were noted during northern goshawk calling surveys. On July 19th approximately 50 cow and calf elk were

observed near calling stations 434, 436 and 455. On July 24th, 12 cow and calf elk were observed near calling station 428. On July 25, 10 cow and calf elk were observed near calling station 179, with an additional 6 elk observed near station 88. On July 23rd approximately 16 mule deer were observed near calling stations 273 and 289.

6.0 Conclusions and Recommendations

During the inventory of the Project Area, biologists documented audible responses or visual detections of raptors on 42 occasions, none of which were from northern goshawks. Three actively occupied red-tailed hawk territories were documented during surveys.

The vegetative communities within the Project Area are classified by the Utah Division of Wildlife Resources as crucial summer mule deer fawning habitat and crucial summer elk calving habitat; during the course of the survey numerous cow-calf and doe-fawn observations were documented within the Project Area. This survey meets the wildlife components of the aforementioned stipulations (e.g. #2, #3, and #14) as documented in the ROD. No T&E species were encountered during the course of this inventory survey.

We recommend in subsequent years coordination with the US Forest Service and Utah Division of Oil, Gas, and Mining continues to be conducted prior to inventory initiation in order to refine the survey area requirements, ensure nesting data is transferred, and up to date protocols are followed.

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Appendix A-Plant Species Table

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Tree Species	
Scientific Name	Common Name
Abies concolor	White fir
Abies lasiocarpa	Subalpine Fir
Picea engelmannii	Engelmann Spruce
Picea pungens	Blue Spruce
Populus tremuloides	Quaking Aspen
Pseudotsuga menziesii	Douglas fir

Shrub Species	
Scientific Name	Common Name
Artemisia cana	Silver Sagebrush
Artemisia tridentata vaseyana	Mountain Big Sagebrush
Potentilla fruticosa	Bush Cinquefoil
Prunus virginiana	Chokecherry
Ribes inerme	Whitestem Gooseberry
Ribes viscosissimum	Sticky Currant
Salix boothii	Booth's Willow
Salix drumondiana	Drummond Willow
Salix exigua	Coyote Willow
Sambucus racemosa	Red Elderberry
Symphoricarpos oreophilus	Mountain Snowberry

Forb Species	
Scientific Name	Common Name
Achelia millefolium	Western Yarrow
Aconitum columbianum	Monkshood
Agoseris glauca	Pale Agoseris
Artemisia ludoviciana	Louisiana Sagebrush
Aquilegia spp.	Columbine
Aster spp.	Aster
Balsamorhiza sagittata	Arrowleaf Balsamroot
Castilleja spp.	Indian Paintbrush
Crisium spp.	Thistle
Claytonia lanceolata	Lanceleaf Springbeauty
Collomia lincaris	Slenderleaf Collomia
Cynogglossum officinale	Houndstongue
Delphinium occidentale	Western Larkspur
Erigerion eatonii	Eaton Fleeabane
Fritillaria atropurpurea	Purplespot Fritillary
Geranium richardsonii	Richardson Geranium
Gilia spp.	Gilia
Helenium hoopesii	Orange Sneezeweed
Lathyrus pauciflorus	Utah Sweetpea
Ligusticum porteri	Porter Ligusticum

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Lupinus alpestris	Mountain Lupine
Lupinus argenteus	Silvery Lupine
Madia glomerata	Cluster Tarweed
Mertensia ciliata	Mountain Blubells
Osmorhiza occidentalis	Sweetanise
Penstemon rydbergii	Rydberg Penstemon
Penstemon strictus	Rocky Mountain Penstemon
Phacilia spp.	Phacilia
Potentilla gracilis	Beauty Cinquefoil
Rudbeckia occidentalis	Western Coneflower
Senecio serra	Butterweed Groundsel
Taraxacum officinale	Common Dandelion
Tragopogon dubius	Yellow Salsify
Veratrum californicum	False Hellebore
Vicia americana	American Vetch
Viguiera multiflora	Showy Goleneye
Wyethia amplexicaulis	Mulears Wyethia

Grasses and Grasslike Plants	
Scientific Name	Common Name
Agropyron scibneri	Scribner Wheatgrass
Agropyron smithii	Western Wheatgrass
Agropyron trachycaulum	Slender Wheatgrass
Agrostis exarata	Spike Bentgrass
Bromus anomalus	Nodding Brome
Bromus carinatus	Mountain Brome
Calamagrostis canadensis	Bluejoint Reedgrass
Calamagrostis stricta	Slimstem Reedgrass
Carex spp.	Sedge
Dactylis glomerata	Orchardgrass
Deschampsia cespitosa	Tufted Hairgrass
Eleocharis spp.	Spikerush
Festuca idahoensis	Idaho Fescue
Festuca ovina	Sheep Fescue
Juncus spp.	Rush
Koelaria marcrantha	Prairie Junegrass
Melica bulbosa	Oniongrass
Muhlenbergia richardsonis	Mat Muhly
Phleum alpinum	Alpine Timothy
Phleum pretense	Timothy
Poa fendleriana	Mutton Bluegrass
Poa pratensis	Kentucky Bluegrass
Stipa columbiana	Subalpine Needlegrass
Stipa lettermani	Letterman Needlegrass
Stipa nelsonii	Nelson's Nedlegrass
Trisetum spicatum	Spike Trisetum

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Appendix B-Project Maps

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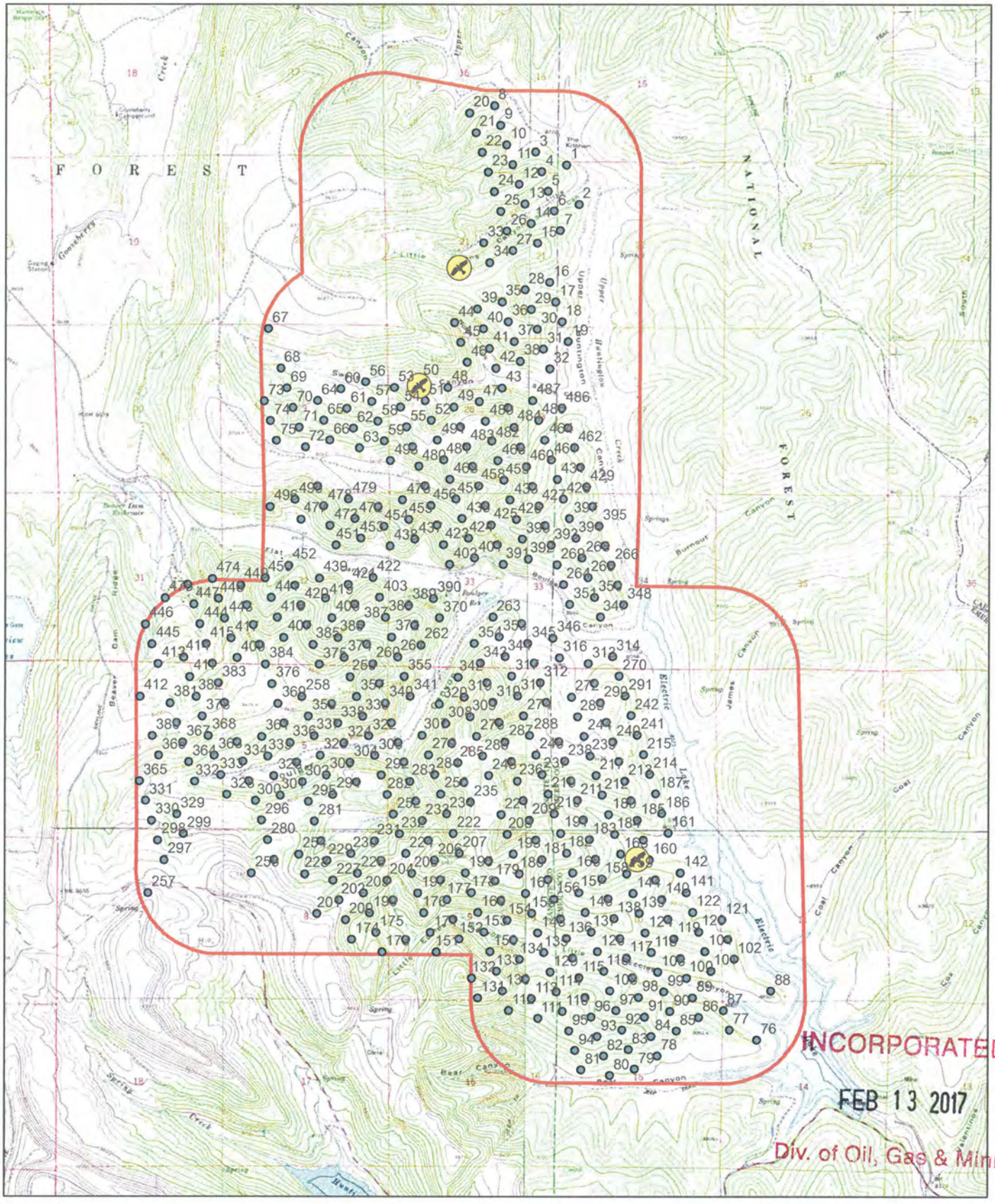

Skyline Mine
Southwest Reserve Project
WESTERN LAND SERVICES
Richfield, UT 84701 (435) 896-5501
CONFIDENTIAL
Prepared By: LB — Date: June 22, 2012

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No warranty is made for data usage purposes other than those intended by Western Land Services. Maps are created as part of a GIS that compiles records, information, and data from various sources. This data experiences frequent updates and accordingly, WLS shall not be liable for any errors or omissions herein.

Appendix C-UDOGM Raptor Survey Forms

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RAPTOR SURVEY FORM

Division of Oil Gas and Mining
Coal Regulatory Program

Instructions:

Complete the following by including as much information as possible. This survey is to be used by hand only if direct electronic data entry is not possible. All data collected with this survey must be submitted to the Division in an electronic format, suitable for uploading into AVUIS. Only nest status information should be collected initially. All other data can be collected in subsequent ground visits. Additional reporting requirements are located in the Raptor Survey Procedures provided by the Division of Oil, Gas and Mining.

1. Qualified Biologist: Trail Kwiatkowski
2. Mine: SKYLINE
3. Survey Date: July 21, 2012

4. Survey Type: (Check One)
- ☐ Aerial
- ☒ Other (airplane or drill hauling species)
- ☐ Ground (for ground nesting species)
- ☐ Call-in

Nest Number or "N-#"	Species	Nest Status (See Back)	Nest Condition (See Back)	Number of Eggs in the Nest	Number of Young in Nest	Age of young in nest (days)	Substrate (See Back)	Productivity (# nestlings)	Elevation/ Exposure of nest (degrees)	Comments
NEW	RTHA	Active	Excellent	✓	✓	✓	CON	2	8873 North	2 ADULT - 2 Hatchlings observed Vocalizations

UTM 0477430 4390469

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Active REHA Nest.

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RAPTOR SURVEY FORM

Division of Oil Gas and Mining
Coal Regulatory Program

DNR

Instructions:

Complete the following form including as much information as possible. This form is to be used for hand entry if direct electronic data entry is not possible. All data collected on this form must be submitted to the Division in an electronic format suitable for uploading into ArcGIS. Only nest status information should be collected aerially. All other data can be collected in a subsequent ground visit. Additional reporting requirements are located in the Raptor Survey Procedures provided by the Division of Oil, Gas and Mining.

1. Qualified Biologist: Trail Kreitzer
2. Mine: Sky Line
3. Survey Date: July 21, 2012

4. Survey Type: (Check One)
- ☐ Aerial
- ☒ Ground (for tree or cliff nesting species)
- ☐ Ground (for ground nesting species)
- ☐ Calling

Nest Number or "NEW"	Species	Nest Status (See Back)	Nest Condition (See Back)	Number of Eggs in the nest	Number of Young in nest	Age of young in nest (days)	Substrate (See Back)	Productivity (if fledged)	Elevation / Exposure of nest (optional)	Comments
NEW	RTHA	Active	Excellent	/	/	/	CON	1	8907 North	2 adult - 1 fledgling observed vocalization 12S 0477812 4371602
NEW	RTHA	Tended AL	Good	/	/	/	CON	/	8887 North	alt nest [illegible] lower in canyon

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Active REHA Nest.

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Append A-2
Vol. 2

Technical Memorandum

To: Gregg Galecki
Environmental Engineer
Bowie Resources Partners LLC
Canyon Fuel Company, LLC
HC 35 Box 380

From: Alpine Ecological
HC80 Box 570
Greenwich, UT 84732

Date: 8/29/2014

Re: Western (Boreal) Toad (*Bufo boreas*) Surveys

Background

According to the UNHP 2003 progress report there are records of occurrence of western toad in the area of Skyline Mine prior to 1983. The mapping scale within the report makes it difficult to determine exact locations. The Utah Conservation Database Center (UCDC) cites the last observations within the Scofield and Fairview Lakes map quadrants of documented records as 6/18/1950. Holland (2002) summarized some of the ecological requirements for this species in the southern Rocky Mountains which is applicable to the survey area:

> *"Ideal boreal toad breeding sites presumably contain still water, very shallow margins, and persistent water levels. Egg masses are typically deposited in the shallowest available areas of the breeding site. . . . For a wetland to be considered suitable it should contain at least 1 gradually sloping bank with water ≤10-cm deep during the breeding season. Potential sites should also be examined in August to ensure that breeding site persistence is sufficient to allow completion of the larval period. In addition, a deeper area of water may be necessary to provide tadpoles with a night refuge of warmer water . . . . An old, but active, American beaver pond complex seems an ideal model for a breeding locality because shallow, eutrophicated ponds exist in concert with water level maintenance by beaver." Holland (2002) found that both increased variation in daily water temperature and increased variation in water levels during summer had negative effects on tadpole development in this species. Terrestrial habitats of this species, even within Utah, are varied and include sagebrush steppe, piñon–juniper woodland, and mixed and coniferous forests of various species compositions. Adult males typically remain within a few hundred meters of breeding sites throughout the year, while adult females usually do not, often moving several kilometers from breeding sites after breeding in spring or early summer.*

Methodology

Inventories for the presence of western toads were completed during June, July, and August of 2014, in riparian areas and streams in Little Swens, Swens, Flat Canyon, and Boulger Creeks; between Huntington Creek and the end points displayed on Figure 1. Inventories were conducted by walking meandering transects in the riparian areas, which extended out to 20 feet on either side of the stream centerline. After the completion of the initial walking transects an additional night time spotlight survey was also conducted along the upper sections of the streams in Flat Canyon and Boulger Canyon. These areas

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contain the highest number of ecological attributes within the indicator parameters, as defined by Oliver and Tuhy (2010), necessary for western toad occupancy.

Results

Little Swens

There were no western toads observed in the stream in Little Swens Canyon.

Swens

There were no western toads observed in Swens Canyon. Although there was little or no surface water in the upper portions of the southern fork of the survey area, the inventory was conducted to the end point identified.

.

Flat Canyon

There were no western toads observed during the course of either inventory of the stream in Flat Canyon. The stream in Flat Canyon provided the best potential habitat for western toad according to ecological indicators identified by Oliver and Tuhy (2010) and the description by Holland (2002). The lower portions of the stream, next to the paved road, provides lower quality habitat, due to higher stream flow rates and steeply incised or rip-rapped constructed banks, in comparison to the upper reaches of the stream, which has slower flow rates and silted banks with small relatively deeper pools. As a result, it was determined that an additional spotlight survey should be conducted in the upper sections of the stream on private lands. There were no western toads observed during the spotlight survey of the stream in Flat Canyon.

Boulger Canyon

There were no western toads observed during the course of either inventory of the stream in Boulger Canyon. However, there was one individual western chorus frog (*Pseudacris triseriata*) observed within 200 feet of the Boulger Reservoir inlet. The stream has relatively higher flow rates when compared to those observed in Flat Canyon. There are however, micro-sites of slower flows distributed irregularly along the stream. As a result, it was determined that an additional spotlight survey should be conducted along the stream. There were no western toads observed during the spotlight survey of the stream in Boulger Canyon.

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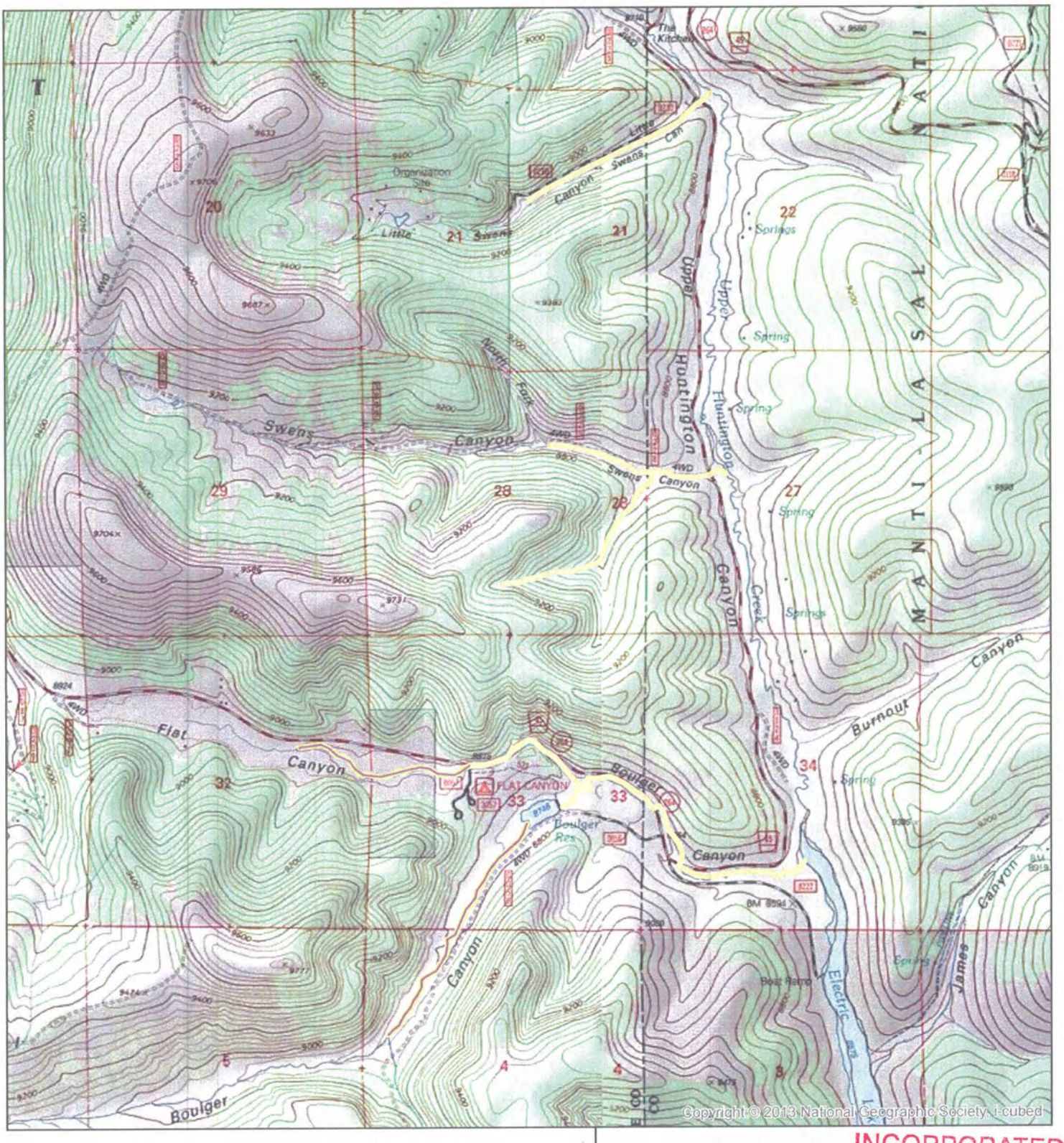

Spotlight Survey Area

Transect Survey Area

RECEIVED

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N

Skyline Mine 2014
Western Toad Survey

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FIGURE 1
Western Toad Survey Area

DATE DRAWN: 7/24/14

SCALE: 0.2 0.1 0 0.2 Miles

Gregg Galecki

From: Jeremiah Armstrong
Sent: Monday, August 25, 2014 12:48 PM
To: Gregg Galecki
Subject: FW: Prime Farmland
Attachments: Jeremiah_Armstrong_prime_Farmland.jgw; Jeremiah_Armstrong_prime_Farmland.jpg; Jeremiah_Armstrong_prime_FarmlandLSlp.jgw; Jeremiah_Armstrong_prime_FarmlandLSlp.jpg; UT045_JOIN.dbf; UT045_JOIN.prj; UT045_JOIN.sbn; UT045_JOIN.sbx; UT045_JOIN.shp; UT045_JOIN.shx

From: Dyer, Joseph - NRCS, Price, UT <joseph.dyer@ut.usda.gov>
Sent: Thursday, June 19, 2014 12:15 PM
To: Jeremiah Armstrong
Cc: Gardner, Lowell - NRCS, Castle Dale, UT; Miller, Brian - NRCS, Ephraim, UT
Subject: Prime Farmland

Joseph Dyer
Area Resource Soil Scientist
Office 435 637 0041 ext 102
Cell 435 630 3137

Jeremiah Armstrong
Environmental Engineer – Skyline Mine

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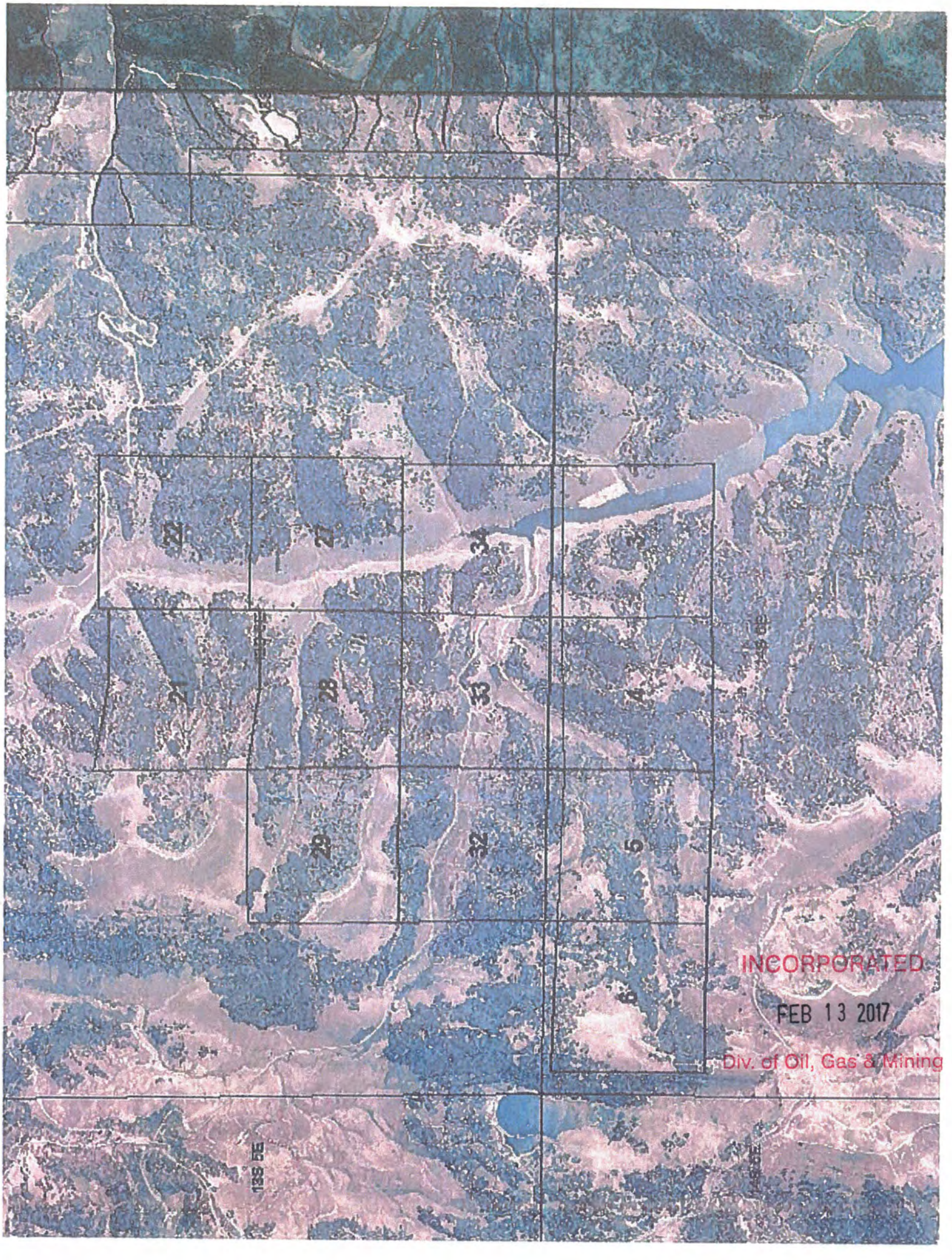
Canyon Fuel Company, LLC
A Subsidiary of Bowie Resource Partners, LLC
HC 35 Box 380
Helper, Utah 84526
O: (435) 448-2645

Jeremiah,

I contacted Robert Davidson from the forest service and got his mapping, unfortunately the soils and concepts are not related to NRCS soils with no OSD's or Prime and unique farmland designation's. I then contacted Lowell Gardner, and Brian Miller, the District Conservationists for this area, and they both agreed there was **no Prime or unique farm lands** in the Area of concern (See attached map) I concur, I see no area that would fit into the definition of Prime and Unique Farm lands. I have attached the soils map for your area to assist your planning efforts. Two of the file are Write world file so if you have Arc map they will self locate the soils file is vector file that will do the same. The jgw is the location file for each picture respectively. UT045_JOIN is the Soils file joined with attributes like Hydrologic Group AWC, Rooting Depth etc as entered by the forest service employees. The area I have considered is:
Township 13S, Range 6E, Sections 21, 22, 27, 28, 29, 32, 33, and 34 and for Township 14S, Range 6E, Sections 3, 4, 5, & 6.


22
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5
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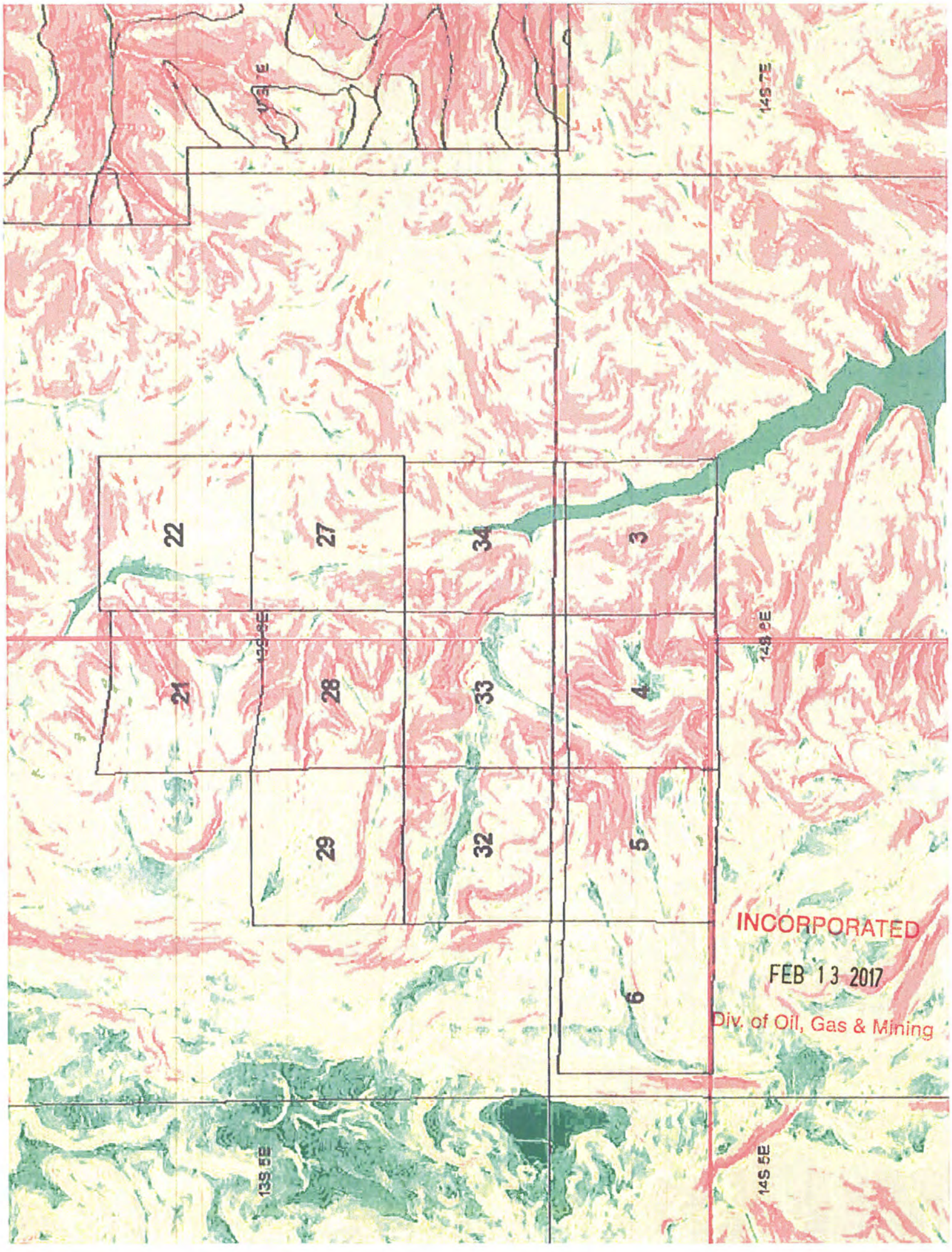
13S 5E


13S 7E
14S 7E
22
27
34
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13S 6E
14S 6E
21
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13S 5E
14S 5E

U.S. FISH AND WILDLIFE SERVICE'S SPECIES BY COUNTY REVIEW, SKYLINE MINE CARBON COUNTY, UTAH

Prepared for:

Skyline Mine
Canyon Fuel Company, LLC

Gregg Galecki
Environmental Engineer,

And

Jeremiah Armstrong
Environmental Engineer

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Prepared by:

Prepared By:
Alpine Ecological
HC 80 Box 570
Greenwich, UT 84732

Date: October 2, 2015

Environmental Baseline

The Assessment Area (Figure 1) is located in Carbon, Sanpete, and Emery Counties, Utah on the Manti-La sal National Forest. The elevation ranges from 8,092 to 9,622 feet. Precipitation ranges from 17 .2 to 29.4 and averages 23.9 inches. Monthly average temperatures at the mine range from 8.0 to 74.4°F.

Grassland communities in the area are dominated by slender wheatgrass (*Elymus trachycaulus*), mountain brome (*Bromus marginatus*), and Letterman's needlegrass (*Achnatherum lettermanii*). Several forb species also occur in the grassland community type. Primary species found in the dry meadow communities include Kentucky bluegrass (*Poa pratensis*), bentgrass (redtop) (*Agrostis gigantean*), and Ross sedge (*Carex rossii*). Wet meadow communities are composed primarily of species such as water sedge (*Carex aquatilis*), Nebraska sedge (*Carex nebrascensis*), beaked sedge (*Carex utriculata*), and tufted hairgrass (*Deschampsia cespitosa*). The sagebrush/grass communities are dominated by mountain big sage (*Artemisia tridentate spp.*) and silver sage (*Artemisia cana*). Grass species associated with the sagebrush type include slender wheatgrass, Letterman's needlegrass, and sandberg bluegrass (*Poa secunda*).

Conifer cover types in the area occur primarily on the upper sloping hillsides, typically on northern or eastern exposures. These sites are dominated by Englemann spruce (*Picea engelmannii*) and subalpine fir (*Abes lasiocarpa*). Understory vegetation within these conifer stands varies in density and distribution, depending on canopy cover of the overstory. Representative understory species include gooseberry (*Ribes spp.*), arnica (*Arnica L.*), butterweed (*Packera glabella*), and lupine (*Lupinus spp*).

The aspen community is the most common forested type within the tract and is dominated by mature aspen (*Populus tremuloides*) in the overstory with snowberry (*Symphoricarpos albus*), elderberry (*Sambucus nigra*), Oregon grape (*Mahonia aquifolium*), and butterweed making up the primary species in the understory.

Riparian communities occur within all vegetative types and are associated with stream and spring influence areas. The extent of these riparian communities varies from those areas adjacent to the stream channel to expanses of sub-irrigated acreage covering an entire drainage bottom (**Flat Canyon - Final Environmental Impact Statement 2002**).

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Species by County Lists

Alpine reviewed the U.S Fish and Wildlife Service (USFWS) species by county lists for Sanpete, Carbon, and Emery Counties on the USFWS website (i.e., accessed on September 22, 2015) and the Information for Planning and Conservation (IPaC) System (i.e., accessed September 21, 2015). Alpine assessed the habitat requirements of each species listed in comparison to habitat within the Assessment Area, suitable habitat values were then ranked; ranking categorizes were unsuitable, marginal, and suitable (**Table 1**). Habitat requirements were identified for each

species using U.S. Fish and Wildlife Service's Federal Register publications and species profile reports, and the Utah Conservation Database Center (UCDC).

Table 1. Species by County Listed Species, Habitat Requirements, and Probability of Occurrence.

Species	County List	Status	Habitat Requirements	Habitat Suitability
Fish				
Humpback Chub *(Gila cypha)*	Sanpete, Carbon, Emery	Endangered	Species spawns in the spring and summer in shallow, backwater areas with cobble substrate. Species is confined to few white-water areas in the Colorado, Green, and White Rivers; suitable habitat in Carbon and Emery is limited to the Green River.	**Unsuitable**- No suitable habitat present; Assessment Area is outside of known species distribution.
Colorado Pikeminnow *(Ptychocheilus Lucius)*	Sanpete, Carbon, Emery	Endangered	Prefers medium to large rivers where they can be found in habitats ranging from deep turbid rapids to flooded lowlands. Spawning occurs during the spring over riffle areas with gravel or cobble substrates. Species only exists in the upper Colorado River System; suitable habitat in Carbon and Emery is limited to the Green River.	**Unsuitable** - No suitable habitat present; Assessment Area is outside of known species distribution.

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Species	County List	Status	Habitat Requirements	Habitat Suitability
Bonytail Chub *(Gila elegans)*	Sanpete, Carbon, Emery	Endangered	Prefers eddies, pools, and backwaters near swift currents in large rivers. Species spawns in the spring over gravelly substrates. Suitable habitat in Carbon and Emery Counties is limited to the Green River.	**Unsuitable** - No suitable habitat present; Assessment Area is outside of known species distribution.
Razorback Sucker *(Xyrauchen texanus)*	Sanpete, Carbon, Emery	Endangered	Species prefers slow backwater habitats and impoundments. Suitable habitat in Carbon and Emery Counties is limited to the Green River.	**Unsuitable** - No suitable habitat present; Assessment Area is outside of known species distribution.
Birds				
Greater sage-grouse *(Centrocercus urophasianus)*	Sanpete, Carbon, Emery	Candidate- USFWS determined the species was not warranted for listing September 2015.	Inhabit sagebrush plains, foothills, and mountain valleys. Sagebrush is the predominant plant of quality habitat. A good understory of grasses and forbs, and associated wet meadow areas, are essential for optimum habitat.	**Marginal**- The Assessment Area is located within the SGMA, near the southern boundary. Suitable habitat does occur within micro-sites on the southern portion of the Assessment Area. However, some of these areas have been mapped as non-habitat by the UDWR.

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Species	County List	Status	Habitat Requirements	Habitat Suitability
Western yellow-billed Cuckoo *(Coccyzus americanus occidentalis)*	Sanpete, Carbon, Emery	Threatened	Riparian obligate species which requires dense cottonwood-willow forested tracts. In some areas, birds required 17+ ha (42 acres), including a minimum of 3+ ha (7.5) of closed-canopy, broad-leaved forest. Nests are placed in willows, but cottonwoods are used extensively for foraging.	**Unsuitable** - Only a small portion of the Assessment Area is within the species' elevation range. Multi-layered riparian habitats are not present in the Assessment Area.
Mexican Spotted Owl *(Strix occidentalis lucida)*	*Carbon, Emery*	Threatened	Primary habitat in Utah includes narrow steep rocky canyons. The species is located in the southern and eastern parts of the state of Utah. In Carbon County, they occur along eastern county line. Although individuals are not documented in Emery, suitable habitat occurs throughout the southern and eastern portions of the county.	**Unsuitable** - Suitable habitat is not present within the Assessment Area. Assessment Area is outside of the known species distributions in Carbon or Emery County.
California Condor *(Gymnogyps californianus)*	*Emery*	Endangered	Preferred habitat is mountainous country at low to moderate elevations, especially near rocky brushy areas with cliffs available for nesting. Primary nesting habitat are cavities located on step rock formations Colonies roost in snags, tall open- branched trees, or cliffs, often near important foraging areas.	**Unsuitable** - Suitable habitat is not present in the Assessment Area. Assessment Area is outside of the known species distributions Emery County.

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Species	County List	Status	Habitat Requirements	Habitat Suitability
Southwest Willow Flycatcher *(Empidonax traillii extimus)*	Emery	Endangered	Habitat includes dense willows along riparian habitats. This species is rare in extreme southern Utah. Distribution maps in the UCDC show occurrence in Washington, Kane, and San Juan Counties along the Utah-Arizona border.	**Unsuitable** - Assessment Area is outside of the known species distributions in Emery County. Known species distribution map in the UCDC show species occurrence in Washington, Kane and San Juan Counties. Generally, suitable habitat is not present in the Assessment Area. There are small patches of willow habitat along some riparian areas however; they are typically small and isolated.
Mammals				
Canada Lynx *(Lynx canadensis)*	Carbon	Threatened	Preferred habitat is montane coniferous and boreal forests. The distribution of lynx in North America is closely associated with the distribution of North American boreal forests.	**Marginal**- Coniferous forest do occur within the Assessment area; primarily on the northern aspects however they are inter-mixed with aspen stands and sagebrush openings on the southern aspects. Large contiguous acreages of montane coniferous stands are not present in the Assessment Area.

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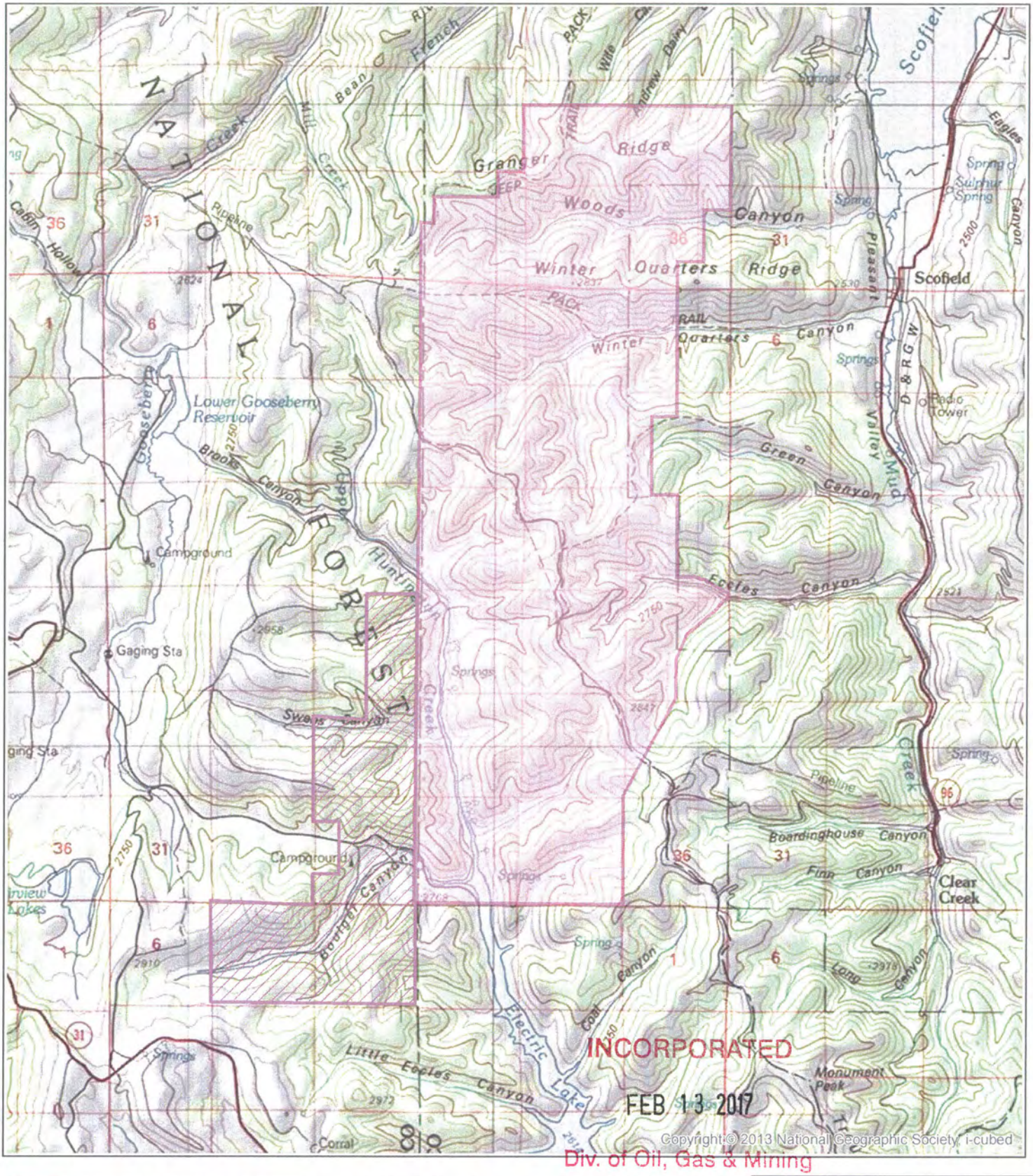

Existing Lease Area

Flat Canyon Lease Area

Assessment Area
Species by County Lists

FIGURE 1

10.02.2015

1:80,000

Skyline Mine
Vegetative Analysis of Seven Proposed Drill Sites and Seven Reference Sites

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Report Prepared By

Alpine Ecological
HC 80 Box 570
Greenwich, UT 84732

By Allan R. Stevens Ph.D

For
Bowie Resource Partners, LLC.
Skyline Mine
HC 35 Box 380
Helper, Utah 84526

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Introduction

The purpose of the 2015 drilling program is to further investigate the coal reserves in the Southwest Reserves Lease. Information gathered from the drilling program will assist Skyline Mine in developing mine plans to more efficiently utilize the resource.

Total estimated disturbance for the 2015 drilling program is 7 acres. Disturbance from drilling activity is expected to be less than 1 acre per site for a total of 7 acres. Disturbance from access road improvements is estimated to be 3 acres. Currently four of the seven drilling locations will not require any additional surface disturbance to improve the access road or drill sites. The three remaining sites will be drilled using heliportable drill rigs and will not require the construction of access roads. Reclamation of all disturb areas will occur during the late fall of 2015.

Skyline Mine is a coal mine with its surface facilities located about 4 miles southwest of the town of Scofield in Carbon County, Utah. The drill sites are located west to southwest of the surface facilities of the mine. Most of the drill sites are located upper Huntington Creek and Electric Lake in Sanpete and Emery Counties. The 7 drill sites are generally located in openings in conifer and quaking aspen forests. One of the sites is located in a mountain big sagebrush community. The elevations of the drill sites ranges from 8,600 to 8,900 feet above sea level.

Methods

Sampling Standards

Methodologies used for this analysis were performed in accordance with vegetation guidelines supplied by the State of Utah, Division of Oil, Gas and Mining (DOGM). In July of 2015, quantitative and qualitative data were collected in the plant communities proposed for drilling activities as well as reference areas that were chosen for future revegetation success standards.

Sampling Methodology for Cover, Frequency and Composition

The areas that are proposed to be disturbed are centered on proposed drill sites. Therefore, the vegetation around each drill site needed to be analyzed. It was determined that the best method to determine vegetative cover frequency and composition on these areas would be nested frequency belt lines as described in the U.S. Forest Service

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Rangeland Ecosystem Analysis and Monitoring Handbook (FSH 2209.21). Five 100 ft. beltlines were established in five different compass directions radiating from the proposed drill site and reference site point. With this methodology the vegetation composition around each proposed drill site and reference site would be determined. The five compass directions used were the following from magnetic North: Belt 1 at 23 degrees, Belt 2 at 121 degrees, Belt 3 at 173 degrees, Belt 4 at 269 degrees and Belt 5 at 296 degrees. Every 5 ft. along each transect line a ½ m^2 nested frequency frame was placed on alternating sides of the transect line. Species composition and frequency were recorded using the frame. Ground cover was also determined using the frame. The percent cover of each species was then estimated within each frame. A total of 100 nested frequency data points were therefore taken at each proposed drill site and each reference site. Plant nomenclature follows the USDA-ARS Plant Database (plants.usda.gov).

Placement of Reference Sites

The reference sites were chosen to represent future revegetation success standards. A reference site was chosen in each area where there was a proposed drill site. The reference sites were chosen by walking far enough away from the proposed drill site so they would not be disturbed during the drilling activity. Locations for the reference sites were chosen by visually looking at the site and trying to choose a site that looked similar in vegetative composition to the proposed drill site.

Sampling Methodology for Forage Production

Clip and weigh methods described in Utilization Studies and Residual Measurements interagency technical reference were used to estimate forage production. Twenty random samples were taken around each proposed drill site location and reference area site. A 0.96 ft^2 plot was placed at each random site and vegetation was clipped and weighed. Percent dry mater was determined by using standard drying table estimates and dry forage production was estimated and converted to pounds per acre by taking the average grams collected x 100.

Sampling Methodology for Density

Density estimates for the woody plant species on the proposed drill site and reference areas were made using a distance method called the point-quarter technique. In this method, random points were placed on the sample sites and measured into four quarters. The distance to the nearest woody plant species were then recorded in each quarter. The

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average point to individual distance was equal to the square root of the mean area per individual.

Photographs and Maps

A map was created with each proposed drill site and reference site (Appendix 29). In addition photographs were taken of each belt line from the center point (Appendix 15-28).

Threatened, Endangered, Candidate and Sensitive Species

The inventory of federally listed threatened, endangered and candidate plant species for Emery and Sanpete counties was consulted prior to field work. In addition the State of Utah, Department of Natural Resource's biodiversity database and the USDA Forest Service Intermountain Region's list of proposed, endangered, threatened and sensitive species for the Manti portion f the Manti-La Sal National Forest was consulted for possible impacts by the proposed project. If applicable, this information would be used to drive species of concern field surveys if any of the species or habitats were found on or near the proposed project.

Results

Drill Site 1

Drill Site 1 is located within a girl's camp (Appendix 29). The proposed drill site is surrounded by vegetation but some of the area around the proposed site is severely disturbed (i.e. roads and trails). Most of the vegetation in this area has been disturbed, probably by frequent foot traffic around the area. The site is located in the bottom of a valley. Most of the vegetation around this site is composed of grasses and forbs with some woody shrubs and trees.

The only overstory species was subalpine fir (*Abies lasiocarpa*). The most common understory species were Rydberg's penstemon (*Penstemon rydbergii*), Kentucky bluegrass (*Poa pratensis*), variegated scouringrush (*Equisetum variegatum*), slender wheatgrass, and orange sneezeweed. A list of all species encountered in the sample quadrats is listed in appendix 1.

Total living cover for this area was estimated at 64.46%, of which 56.46% was from understory cover and 8% was from overstory cover (Appendix 1). The composition of the understory cover was 36.5% grasses, 52.8% forbs and 10.7% shrubs.

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The total woody species density was 51.9 individuals per acre (Appendix 1), with the dominant species being subalpine fir.

The estimates made for total available dry forage for this site 650 lbs/acre.

Drill Site 1 Reference Site

Drill site 1 reference site is located with a girl's camp (Appendix 29). Most of the vegetation in this area has been disturbed by frequent foot traffic which is indicated by pathways and trails in the area. The site is located in the bottom of the same valley as the proposed drill site. Most of the vegetation around this site is composed of grasses and forbs with some woody shrubs and trees.

The only overstory species was subalpine fir. The most common understory species were Carex (*Carex*), mountain bluebell (*Mertensia ciliate*), slender cinquefoil (*Potentilla gracilis*) Virginia strawberry (*Fragaria virginiana*) and slender wheatgrass (*Elymus trachycaulus*). A list of all species encountered in the sample quadrats is listed in Appendix 2.

Total living cover for this area was estimated at 60%, of which 57% was from understory cover and 3% was from overstory cover (Appendix 2). The composition of the understory cover was 50.7% grasses, 46.1% forbs and 3.2% shrubs.

The total woody species density was 46 individuals per acre (Appendix 2), with the dominant species being subalpine fir.

The estimates made for total available dry forage for this site 950 lbs/acre.

Drill Site 2

Drill site 2 is located within a girl's camp (Appendix 29). The site however is far enough away from the main area of the girl's camp that the vegetation does not appear to be disturbed significantly by foot traffic. The site is located on a terrace of a North-facing slope. The vegetative community around this site is dominated by grasses and forbs, with a mixed conifer/aspen forest scattered throughout.

The overstory species were subalpine fir and quaking aspen (*Populus tremuloides*). The most common understory species were Great Basin lupine (*Lupinus alpestris*), mountain

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brome (*Bromus marginatus*), fewflower pea (*Lathyrus pauciflorus),* nodding brome (*Bromus anomalus*) and Fendler's medow-rue (*Thalictrum fendleri*). A list of all species encountered in the sample quadrats is listed in Appendix 3.

Total living cover for this area was estimated at 58.7%, of which 41.3% was from understory cover and 17.4% was from overstory cover (Appendix 3). The composition of the understory cover was 49.1% grasses, 38.4% forbs and 12.5% shrubs.

The total woody species density was 69.6 individuals per acre (Appendix 3), with the dominant species being subalpine fir.

The estimates made for total available dry forage for this site 1100 lbs/acre.

Drill Site 2 Reference Site

Drill site 2 reference site is located within a girl's camp (Appendix 29). The site however is far enough away from the main area of the girl's camp that the vegetation does not appear to be disturbed significantly by foot traffic. The site is located on a terrace of a North-facing slope. The vegetative community around this site is dominated by grasses and forbs, with a mixed conifer/aspen forest scattered throughout.

The overstory species recorded were subalpine fir and quaking aspen. The most common understory species were Canada wildlrye (*Elymus canadensis*), fewflower pea, carex, mountain bluebell and nodding brome. A list of all species encountered in the sample quadrats is listed in Appendix 4.

Total living cover for this area was estimated at 59.83%, of which 46.43% was from understory cover and 13.4% was from overstory cover (Appendix 4). The composition of the understory cover was 52.4% grasses, 38.3% forbs and 9.3% shrubs.

The total woody species density was 95.7 individuals per acre (Appendix 4), with the dominant species being subalpine fir.

The estimates made for total available dry forage for this site 1100 lbs/acre.

Drill Site 3

Drill site 3 is located within a girl's camp (Appendix 29). The site however is far enough away from the main area of the girl's camp that the vegetation does not appear to be

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disturbed significantly by foot traffic. This site has evidence of being logged in the past. There are only a few young trees scatted sparsely throughout the area. In addition cut stumps are encountered and there is an old slash pile next to the proposed drill site. The site was located on an East-facing slope. The vegetative community around this site is dominated by grasses and forbs.

There were no overstory species recorded. The most common understory species were Canada wildrye, carex, mountain brome, common yarrow (*Achillea millefolium*), and fewflower pea. A list of all species encountered in the sample quadrats is listed in Appendix 5.

Total living cover for this area was estimated at 46.6%, of which 46.6% was from understory cover and 0% was from overstory cover (Appendix 5). The composition of the understory cover was 68.3% grasses, 30.7% forbs and 0.8% shrubs.

The total woody species density was 5.8 individuals per acre (Appendix 5), with the dominant species being Gooseberry currant (*Ribes montigenum*).

The estimates made for total available dry forage for this site 870 lbs/acre.

Drill Site 3 Reference Site

Drill site 3 reference site is located within a girl's camp (Appendix 29). The site however is far enough away from the main area of the girl's camp that the vegetation does not appear to be disturbed significantly by foot traffic. This site is locates on an East-facing slope. The vegetative community around this site is dominated by grasses and forbs, with a sparsely scattered quaking aspen stand.

The overstory species were subalpine fir and quaking aspen. The most common understory species were mountain brome, fewflower pea, carex, Canada wildrye and mayflower stickseed (*Hackelia floribunda*). A list of all species encountered in the sample quadrats is listed in Appendix 6.

Total living cover for this area was estimated at 79%, of which 61% was from understory cover and 18% was from overstory cover (Appendix 6). The composition of the understory cover was 58% grasses, 41.8% forbs and 0.2% shrubs.

The total woody species density was 81.2 individuals per acre (Appendix 6), with the dominant species being quaking aspen.

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The estimates made for total available dry forage for this site 1150 lbs/acre.

Drill Site 4

Drill site 4 is located on a slightly North facing slope. This site was logged at some point in the past as indicated by numerous stumps. The vegetative community is dominated by grasses and forbs with a few scattered conifers.

The only overstory species was subalpine fir. The most common understory species were Canada wildrye, mountain brome, carex, fewflower pea and slender wheatgrass. A list of all species encountered in the sample quadrats is listed in Appendix 7.

Total living cover for this area was estimated at 53.65%, of which 44.65% was from understory cover and 9% was from overstory cover (Appendix 7). The composition of the understory cover was 62.2% grasses, 27.5% forbs and 10.3% shrubs.

The total woody species density was 72.5 individuals per acre (Appendix 7), with the dominant species being red elderberry (*Sambucus racemosa*).

The estimates made for total available dry forage for this site 1080 lbs/acre.

Drill Site 4 Reference Site

Drill site 4 reference site is located on a slightly North facing slope (Appendix 29). This site was logged at some point in the past as indicated by numerous stumps. The vegetative community is dominated by grasses and forbs with a few scattered conifers.

The only overstory species was subalpine fir. The most common understory species were mountain brome, Canada wildrye, Fendler's medow-rue, slender wheatgrass and fewflower pea. A list of all species encountered in the sample quadrats is listed in Appendix 8.

Total living cover for this area was estimated at 59%, of which 50% was from understory cover and 9% was from overstory cover (Appendix 8). The composition of the understory cover was 53.4% grasses, 33.2% forbs and 13.4% shrubs.

The total woody species density was 106.3 individuals per acre (Appendix 8), with the dominant species being red elderberry.

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The estimates made for total available dry forage for this site 1060 lbs/acre.

Drill Site 5

Drill site 5 is located on a flat area in the bottom of a valley (Appendix 29). The vegetative community is a mountain big sagebrush/grass community. It is located near a well-traveled highway and dirt road.

There were no overstory species at this site. The most common understory species were Kentucky bluegrass, mountain big sagebrush (*Artemisia tridentata vaseyana*), carex, muttongrass (*Poa fendleriana), and* Letterman's needlegrass (*Achnatherum lettermanii*). A list of all species encountered in the sample quadrats is listed in Appendix 9.

Total living cover for this area was estimated at 54%, of which 54% was from understory cover and 0% was from overstory cover (Appendix 9). The composition of the understory cover was 25.8% grasses, 4.4% forbs and 69.8% shrubs.

The total woody species density was 494.4 individuals per acre (Appendix 9), with the dominant species being mountain big sagebrush.

The estimates made for total available dry forage for this site 770 lbs/acre.

Drill Site 5 Reference Site

Drill site 5 reference site is located on a flat area in the bottom of a valley (Appendix 29). The vegetative community is a mountain big sagebrush/grass community. It is located near a well-traveled highway and dirt road.

There were no overstory species at this site. The most common understory species were Kentucky bluegrass, carex, mountain big sagebrush, Rydberg's penstemon and Letterman's needlegrass. A list of all species encountered in the sample quadrats is listed in Appendix 10.

Total living cover for this area was estimated at 56%, of which 56% was from understory cover and 0% was from overstory cover (Appendix 10). The composition of the understory cover was 37.4% grasses, 9.4% forbs and 53.2% shrubs.

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The total woody species density was 512.8 individuals per acre (Appendix 10), with the dominant species being mountain big sagebrush.

The estimates made for total available dry forage for this site 790 lbs/acre.

Drill Site 6

Drill site 6 is located on an East facing slope (Appendix 29). The vegetative community is dominated by grasses and forbs with a few scattered conifers and quaking aspen.

The overstory species were subalpine fir and quaking aspen. The most common understory species were fewflower pea, mountain brome, orange sneezeweed, Canada wildrye and common yarrow. A list of all species encountered in the sample quadrats is listed in Appendix 11.

Total living cover for this area was estimated at 67.4%, of which 52% was from understory cover and 15.4% was from overstory cover (Appendix 11). The composition of the understory cover was 59.3% grasses, 37.5% forbs and 3.2% shrubs.

The total woody species density was 43.5 individuals per acre (Appendix 11), with the dominant species being quaking aspen.

The estimates made for total available dry forage for this site 930 lbs/acre.

Drill Site 6 Reference Site

Drill site 6 reference site is located on an East facing slope (Appendix 29). The vegetative community is dominated by grasses and forbs with a few scattered conifers and quaking aspen.

The overstory species were subalpine fir and quaking aspen. The most common understory species were fewflower pea, mountain brome, Kentucky bluegrass, orange sneezeweed, and common yarrow. A list of all species encountered in the sample quadrats is listed in Appendix 12.

Total living cover for this area was estimated at 69.6%, of which 54% was from understory cover and 15.6% was from overstory cover (Appendix 12). The composition of the understory cover was 55.3% grasses, 35.9% forbs and 8.8% shrubs.

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The total woody species density was 29 individuals per acre (Appendix 12), with the dominant species being quaking aspen.

The estimates made for total available dry forage for this site 890 lbs/acre.

Drill Site 7

Drill site 7 is located on a northeast facing slope (Appendix 29). This area has been logged in the past as indicated by remaining stumps. The vegetative community is dominated by grasses and forbs with a few scattered conifers.

The only overstory species was subalpine fir. The most common understory species were Canada wildrye, fewflower pea, carex, common yarrow and Kentucky bluegrass. A list of all species encountered in the sample quadrats is listed in Appendix 13.

Total living cover for this area was estimated at 73.2%, of which 56% was from understory cover and 17.2% was from overstory cover (Appendix 13). The composition of the understory cover was 64.7% grasses, 33.3% forbs and 2% shrubs.

The total woody species density was 70.1 individuals per acre (Appendix 13), with the dominant species being subalpine fir.

The estimates made for total available dry forage for this site 1120 lbs/acre.

Drill Site 7 Reference Site

Drill site 7 reference site is located on a northeast facing slope (Appendix 29). This area has been logged in the past as indicated by remaining stumps. The vegetative community is dominated by grasses and forbs with a few scattered conifers.

The only overstory species was subalpine fir. The most common understory species were Canada wildrye, fewflower pea, carex, common yarrow and Fendler's medow-rue. A list of all species encountered in the sample quadrats is listed in Appendix 14.

Total living cover for this area was estimated at 77%, of which 58% was from understory cover and 19% was from overstory cover (Appendix 14). The composition of the understory cover was 58.5% grasses, 38.1% forbs and 3.4% shrubs.

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The total woody species density was 70.1 individuals per acre (Appendix 14), with the dominant species being subalpine fir (*Abies lasiocarpa*).

The estimates made for total available dry forage for this site 1090 lbs/acre.

Analysis of Similarities Between Drill Sites and Reference Sites

Specific parameters for those plant communities that would be disturbed by the proposed drilling activities were compared statistically using an unpaired t test with the correlating reference area that could be used for revegetation success standard following final reclamation of the site. When total living cover values of the proposed drill sites were compared to the corresponding reference sites there were no significant differences found at any paired site.

When total woody species density values of the same communities were compared to the corresponding reference areas there were no significant differences in drill sites 1, 2, 4, 5, 6, and 7. A significant difference was found between proposed drill site 3 and the reference area. This however may be unimportant because neither area had high density values. The reason for the significant difference is probably not due to original vegetative cover but to previous logging activity that has occurred on the proposed drill site.

Threatened, Endangered, Candidate and Sensitive Species

The following is a table of potential endangered, threatened, candidate and sensitive plant species know to occur in Sanpete and Emery counties. Next to each species name information is provided about the likelihood of occurrence for each species in the proposed drill site areas.

Federally listed endangered, threatened, candidate and sensitive species for Emery and Sanpete County.	
Endangered	
Pediocactus despainii (San Rafael cactus)	This species is found in open pinyon-juniper communities at 6,000-6,200 ft. elevation. The study areas are above the elevation range for this species. The vegetative types

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	are very different. The proposed project will not impact this plant species.
Schoenocrambe barnebyi (Barnaby reed-mustard)	This species is found in mixed shadscale, eriogonum and ephedra communities at 5,600-5,700 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species
Sclerocatus wrightiae (Wright fishhook cactus)	This plat is found on the Mancos Shale Formation in salt desert shrub to juniper communities at 4,790-6,120 ft. elevation. The study area is above the elevation range for this species. The vegetative types are very different and there is no Mancos Shale in the study area. The proposed project will not impact this plant species.
Threatened	
Astragalus montii (Heliotrope milk-vetch)	This species is found in alpine on windblown ridges and snowdrift sites at 10,500-11,000 ft. elevation. The study areas are below the elevation range for this species. The habitat is different. The know locations of this species are well South of the study area. The proposed project will not impact this plant species
Cycladenia humilis var jonesii (Jones	This species is found in cool desert shrub

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Cyladenia)	and juniper communities at 4,400-6,000 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Pediocactus despainii (Despain Footcactus)	This species is found in open piyon-juniper communities at 6,000-6,200 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Townsendia aprica (Last Chance townsendia)	This species is found in salt desert shrub and pinyon-juniper communities in the Arapien and Mancos Shale formations at 6,100-8,000 ft. elevation. The study areas are not found in the Arapien or Mancos Shale formation. The vegetative types are very different. The proposed project will not impact this plant species.
Candidate/Sensitive	
Aster kingie var barnebyana (Barneby woody aster)	This species is found in mountain mahogany-oak communities in rock outcrops composed of Precambrian quartzite at 7,345-7,610 ft. elevation. There are not outcrops of Precambrian quartzite in the study areas. The vegetative types are very different.

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	The proposed project will not impact this plant species.
Astragalus consobrinus (Bicknell milkvetch)	This species is found in sagebrush-grassland and pinyon-juniper communities on the Mancos Shale formation at 5,200-9,000 ft. elevation. The study areas are not found in the Mancos Shale formation. The vegetative types are very different. The proposed project will not impact this plant species.
Astragalus subcinereus var. basalticus (Basalt milkvetch or Silver milkvetch)	This species is found in pinyon-juniper and ponderosa communities at 4,520-7,970 ft. elevtation. The vegetative types of the study areas are very different and the know population of this plant are found in southern Emery County. The proposed project will not impact this plant species.
Cryptantha compacta (Mound cryptanth)	This species is found in salt desert shrub and mixed desert shrub communities at 4,950-9,250 ft. elevation. The vegetative types of the study areas are very different. The proposed project will not impact this plant species.
Cryptantha creutzfeldtii (Creutzfeldt-flower)	This species is found in mat atriplex communities on the Mancos Shale formation at 5,250-6,495 ft. elevation.

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	The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Cymopterus coulteri (Coulter biscuitroot)	This species is found in black sagebrush, shadscale, desert shrub and juniper communites at 4,955-6,000 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Erigeron carringtonae (Carrington daisy)	This species is found in medows and escarpment margins at 10,000-11,000 ft. elevation. The study areas are below the elevation range. The proposed project will not impact this plant species.
Erigonoum corymbosum var. smithii (Big Flattop buckwheat or Smith wild buckwheat)	This species is found in purple-sage matchweed, ephedra-Indian ricegrass and rabbitbrush communities at 5,200-5,610 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Festuca dasyclada (Sedge fescue)	This species is found on open slopes and ridges in sagebrush, mountain brush, and

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	juniper communities on the Green River Shale Formation and limestone gravels at 6,990-10,000 ft. elevation. The study areas are in a different formation. The proposed project will not impact this plant species.
Gilia tenuis (Mussentuchit Gilia)	This species is found in pinyon-juniper woodlands. The study sites have a very different vegetative type. The proposed project will not impact this plant species.
Hedysarum occidentale var. canone (Canyon sweetvetch or Coal sweetvetch)	This species is found in pinyon-juniper, sagebrush and wash communities at 5,000-8,000 ft. elevation. The study sited have a very different vegetative type. The proposed project will not impact this plant species.
Hymenoxys depressa (Low hymenoxys or Depressed bitterweed)	This species is found in ephedra, sagebrush, shadscale and pinyon-juniper communities at 4,400-7,100 ft. elevation. The study sites have a very different vegetative type. The proposed project will not impact this plant species.
Hymenoxys helenioides (Helenium hymenoxys or Intermountain bitterweed)	This species is found in mountain brush, sagebrush, aspen and meadow communities at 8,800-10,700 ft. elevation.

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	Know populations of this species are found at quite a distance south and north of the study site. The proposed project will not impact this plant species.
Lygodesmia entrada (Entrada rushpink)	This species is found in mixed desert shrub and juniper communities at 4,400-4,800 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Mentzelia argillosa (Arapien stickleaf)	This species is found in salt desert shrub and pinyon-juniper communities on the Arapien Shale formation at 5,000-6,200 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The Arapien Shale formation is not found in the study areas. The proposed project will not impact this plant species.
Mentzelia multicaulis var. librina (Book Cliffs blazing star)	This species is found in sagebrush, rabbitbrush, and pinyon-juniper communities at 6,200 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this

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	plant species.
Penstemon tidestromii (Tidestrom beardtongue)	This species is found in desert shrub, sagebrush, and pinyon-juniper communities at 5,300-8,200 ft elevation. The study sites have a very different vegetative type. The proposed project will not impact this plant species.
Penstemon wardii (Ward beardtongue)	This species is found in desert shub, pinyon-juniper, sagebrush, shadescale and greasewood communities on the Arapien Shale formation at 5,495-6,810 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Phacelia utahensis (Utah phacelia)	This species is found in salt desert shrub communites on the Arapien Shale Formation at 5,500-5,700 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Psorothamnus polydenius var. jonesii (Jones indigo-bush or glandular indigo-bush)	This species is found in salt desert shrub communities on Mancos Shale formations at 4,820 ft. elevation. The study areas are above the elevation range for this species. The vegetative types

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	are very different. The proposed project will not impact this plant species.
Silene petersonii (Maguire campion, Wasatch limestone catchfly or Peterson catchfly)	This species is found in ponderosa pine, rocky mountain juniper, bristlecone pine, spruce-fier, and aspen-sagebrush communities on open calcareous and igneous gravels at 6,955-11,200 ft. elevation. The study sites have no open calcareous and igneous gravels. The proposed project will not impact this plant species.
Sphaeralcea psoraloides (Psoralea globemallow)	This species is found in zuckia ephedra communities at 4,000-6,000 ft. elevation. The study areas are above the elevation range for this species. The vegetative types are very different. The proposed project will not impact this plant species.
Talinum thompsonii (Thompson talinum)	This species is found on silicious conglomeratic gravels in pinyon-juniper and ponderosa pine communities at 7,500 ft. elevation. The study sites do not contain any silicious conglomeratic gravels. The proposed project will not impact this plant species.

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Summary

Total estimated disturbance for the 2015 drilling program is 7 acres. Disturbance from drilling activity is expected to be less than 1 acre per site for a total of 7 acres. Disturbance from access road improvements is estimated to be 3 acres. Currently four of the seven drilling locations will not require any additional surface disturbance to improve the access road or drill sites. The three remaining sites will be drilled using heliportable drill rigs and will not require the construction of access roads. Reclamation of all disturb areas will occur during the late fall of 2015.

Drilling activities will necessitate disturbance to the vegetation in the areas. The amount of disturbance will vary with drilling technique. Some of the plant communities that will be impacted have been disturbed before, or are being disturbed at the current time whereas others were present in their native condition. The plant communities where drilling is proposed were quantitatively sampled along with reference areas chosen to be used for final revegetation success standards. Additionally, endangered, threatened, candidate and sensitive plant species know to occur in Sanpete and Emery counties will not be impacted by the proposed drilling action.

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Appendix 1- Data Summary Tables for Drill Site 1

Drill Site 1	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
OVERSTORY		
Abies lasiocarpa (Subalpine Fir)	8	0.75
UNDERSTORY		
GRASSES		
Achnatherum nelsonii (Columbia Needlegras)	1.49	11
Bromus marginatus (Mountain Brome)	1.72	10.25
Carex (Carex spp.)	7.63	31
Elymus canadensis (Canada Wildrye)	0.45	4.75
Elymus trachycaulus (Slender Wheatgrass)	3.08	16.25
Poa fendleriana (Muttongrass)	0.47	3
Poa pratensis (Kentucky Bluegrass)	5.77	19.75
FORBS		
Cirsium arvense (Canada Thistle)	3.77	13.25
Equisetum variegatum (Variegated scouringrush)	4.19	17.25
Erigeron eatonii (Eaton's Fleabane)	0.51	1.75
Fragaria virginiana (Virginia Strawberry)	1.46	13.25
Geranium richardsonii (Richardson's Geranium)	0.17	1.75
Hackelia floribunda (Mayflower Stickseed)	2.12	10.25
Hymenoxys hoopesii (Orange Sneezeweed)	2.98	15.75
Lathyrus pauciflorus (Fewflower pea)	0.4	1.25
Mertensia ciliate (Mountain Bluebell)	5.02	14.75
Penstemon rydbergii (Rydberg's Penstemon)	3.8	20.25
Phacelia sericea (Silky Phacelia)	0.8	5.5
Potentilla gracilis (Slender Cinquefoil)	2.22	14.75
Rudbeckia occidentalis (Western Coneflower)	0.09	0.75
Veratrum califonicum (California False Hellebore)	0.28	0.25
Vicia americana (American Vetch)	1.98	12.25
TREES/SHRUBS		
Ribes montigenum (Gooseberry Currant)	5.73	14
Sambucus racemosa (Red Elderberry)	0.14	0.75
Symphoricarpos oreophilus (Mountain Snowberry)	0.19	0.5

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Drill Site 1	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	8
Understory Cover	56.46
Litter	15
Bareground	26.77
Rock	1.77
Total Living Cover	64.46
% Composition	
Grasses	36.5
Forbs	52.8
Shrubs	10.7

Drill Site 1	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Abies lasiocarpa (Subalpine Fir)	20.3
Ribes montigenum (Gooseberry Currant)	11.6
Sambucus racemosa (Red Elderberry)	5.8
Symphoricarpos oreophilus (Mountain Snowberry)	14.5
TOTAL	51.9

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Appendix 2- Data Summary Tables for Drill Site 1 Reference Site

Drill Site 1 Reference Site	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
OVERSTORY		
Abies lasiocarpa (Subalpine Fir)	3	0.75
UNDERSTORY		
GRASSES		
Achnatherum nelsonii (Columbia Needlegras)	0.3	1.75
Bromus marginatus (Mountain Brome)	7.54	37
Carex (Carex spp.)	12.86	42.75
Elymus canadensis (Canada Wildrye)	1.14	4.25
Elymus trachycaulus (Slender Wheatgrass)	2.06	15.25
Melica spectabilis (Purple Oniongrass)	0.13	0.75
Muhlenbergia richardsoni (Mat Muhly)	0.82	6.75
Poa fendleriana (Muttongrass)	1.94	8
Poa pratensis (Kentucky Bluegrass)	2.11	9.75
FORBS		
Achillea millefolium (Common Yarrow)	0.03	0.75
Fragaria virginiana (Virginia Strawberry)	1.86	15.5
Geranium richardsonii (Richardson's Geranium)	0.18	1.75
Hackelia floribunda (Mayflower Stickseed)	4.34	18
Hymenoxys hoopesii (Orange Sneezeweed)	0.95	4.75
Mertensia ciliate (Mountain Bluebell)	11.42	35.75
Penstemon rydbergii (Rydberg's Penstemon)	2.76	17
Phacelia sericea (Silky Phacelia)	0.3	2.25
Potentilla gracilis (Slender Cinquefoil)	3.41	24.75
Rudbeckia occidentalis (Western Coneflower)	0.52	1.75
Vicia americana (American Vetch)	0.52	5.75
TREES/SHRUBS		
Ribes montigenum (Gooseberry Currant)	1.77	9
Sambucus racemosa (Red Elderberry)	0.04	1

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Drill Site 1 Reference Site	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	3
Understory Cover	57
Litter	29
Bareground	14
Rock	0
Total Living Cover	60
% Composition	
Grasses	50.7
Forbs	46.1
Shrubs	3.2

Drill Site 1 Reference Site	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Abies lasiocarpa (Subalpine Fir)	8.7
Ribes montigenum (Gooseberry Currant)	17.4
Sambucus racemosa (Red Elderberry)	14.5
TOTAL	40.6

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Appendix 3- Data Summary Tables for Drill Site 2

Drill Site 2	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
OVERSTORY		
Abies lasiocarpa (Subalpine Fir)	16.2	1.5
Populus tremuloides (Quaking Aspen)	1.2	1.75
UNDERSTORY		
GRASSES		
Bromus anomalus (Nodding Brome)	2.5	16.5
Bromus marginatus (Mountain Brome)	3.8	22.5
Carex (Carex spp.)	2.18	13
Dactylis glomerata (Orchardgrass)	0.3	0.75
Elymus canadensis (Canada Wildrye)	8.86	37
Elymus trachycaulus (Slender Wheatgrass)	0.84	8.25
Melica spectabilis (Purple Oniongrass)	0.86	0.5
Phleum pratensis (Timothy)	0.69	37
Poa pratensis (Kentucky Bluegrass)	0.26	1.5
FORBS		
Achillea millefolium (Common Yarrow)	0.32	4.75
Delphinium occidentale (Western Larkspur)	0.22	2.25
Fragaria virginiana (Virginia Strawberry)	0.39	4.75
Hackelia floribunda (Mayflower Stickseed)	0.34	1.75
Hymenoxys hoopesii (Orange Sneezeweed)	1.26	10.5
Lathyrus pauciflorus (Fewflower pea)	2.37	20.25
Lupinus alpestris (Great Basin Lupine)	3.85	23.5
Mertensia ciliate (Mountain Bluebell)	4.97	20
Penstemon cyananthus (Wasatch Beardtongue)	0.5	0.5
Phacelia sericea (Silky Phacelia)	0.31	1.75
Rudbeckia occidentalis (Western Coneflower)	0.26	1.25
Solidago canadensis (Canada Goldenrod)	0.07	0.75
Taraxacum officinale (Common Dandelion)	0.04	0.75
Thalictrum fendleri (Fendler's Medow-rue)	0.97	14.25
TREES/SHRUBS		
Ribes montigenum (Gooseberry Currant)	4.84	19.75
Sambucus racemosa (Red Elderberry)	0.3	1.5

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Drill Site 2	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	17.4
Understory Cover	41.3
Litter	37.4
Bareground	21.3
Rock	0
Total Living Cover	58.7
% Composition	
Grasses	49.1
Forbs	38.4
Shrubs	12.5

Drill Site 2	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Abies lasiocarpa (Subalpine Fir)	29
Populus tremuloides (Quaking Aspen)	8.7
Ribes montigenum (Gooseberry Currant)	11.6
Sambucus racemosa (Red Elderberry)	20.3
TOTAL	69.6

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Appendix 4- Data Summary Tables for Drill Site 2 Reference Site

Drill Site 2 Reference Site	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
OVERSTORY		
Abies lasiocarpa (Subalpine Fir)	11	1
Populus tremuloides (Quaking Aspen)	2.4	5.5
UNDERSTORY		
GRASSES		
Bromus anomalus (Nodding Brome)	2	17.25
Bromus marginatus (Mountain Brome)	2.39	15.5
Carex (Carex spp.)	5.94	29.75
Dactylis glomerata (Orchardgrass)	0.86	0.25
Elymus canadensis (Canada Wildrye)	11.95	46.5
Elymus trachycaulus (Slender Wheatgrass)	1.2	6.75
FORBS		
Achillea millefolium (Common Yarrow)	0.26	3.75
Delphinium occidentale (Western Larkspur)	0.04	0.25
Fragaria virginiana (Virginia Strawberry)	0.56	5
Hackelia floribunda (Mayflower Stickseed)	0.22	1.75
Heliomeris multiflora (Showy Goldeneye)	0.3	1.75
Hymenoxys hoopesii (Orange Sneezeweed)	0.34	1.5
Lathyrus pauciflorus (Fewflower pea)	6.79	34.75
Lupinus alpestris (Great Basin Lupine)	2.6	15.25
Mertensia ciliate (Mountain Bluebell)	4.4	27.5
Penstemon cyananthus (Wasatch Beardtongue)	0.17	1.5
Phacelia sericea (Silky Phacelia)	0.27	1.25
Rudbeckia occidentalis (Western Coneflower)	0.26	1
Solidago canadensis (Canada Goldenrod)	0.13	0.75
Taraxacum officinale (Common Dandelion)	0.05	1.5
Thalictrum fendleri (Fendler's Medow-rue)	1.39	14.25
TREES/SHRUBS		
Ribes montigenum (Gooseberry Currant)	3.42	14
Sambucus racemosa (Red Elderberry)	0.89	2.25

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Drill Site 2 Reference Site	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	13.4
Understory Cover	46.43
Litter	32.78
Bareground	20.79
Rock	0
Total Living Cover	59.83
% Composition	
Grasses	52.4
Forbs	38.3
Shrubs	9.3

Drill Site 2 Reference Site	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Abies lasiocarpa (Subalpine Fir)	34.8
Populus tremuloides (Quaking Aspen)	17.4
Ribes montigenum (Gooseberry Currant)	20.3
Sambucus racemosa (Red Elderberry)	23.2
TOTAL	95.7

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Appendix 5- Data Summary Tables for Drill Site 3

Drill Site 3	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
UNDERSTORY		
GRASSES		
Achnatherum nelsonii (Columbia Needlegras)	0.23	2.5
Bromus anomalus (Nodding Brome)	0.77	5.75
Bromus marginatus (Mountain Brome)	4.72	27.25
Carex (Carex spp.)	7.69	34.5
Dactylis glomerata (Orchardgrass)	2.07	10.5
Elymus canadensis (Canada Wildrye)	14.78	57.75
Elymus trachycaulus (Slender Wheatgrass)	0.49	2
Muhlenbergia richardsoni (Mat Muhly)	1.05	6.75
Phleum alpinum (Alpine Timothy)	0.04	0.5
FORBS		
Achillea millefolium (Common Yarrow)	1.10	16
Cirsium arvense (Canada Thistle)	0.15	1.5
Erigeron eatonii (Eaton's Fleabane)	0.35	3.5
Fragaria virginiana (Virginia Strawberry)	0.16	2.75
Geranium richardsonii (Richardson's Geranium)	0.9	6.75
Hackelia floribunda (Mayflower Stickseed)	2.09	7.75
Hymenoxys hoopesii (Orange Sneezeweed)	0.57	6.25
Lathyrus pauciflorus (Fewflower pea)	1.39	14.25
Lupinus alpestris (Great Basin Lupine)	1.53	11
Mertensia ciliate (Mountain Bluebell)	2.17	10
Phacelia sericea (Silky Phacelia)	2.12	14
Potentilla gracilis (Slender Cinquefoil)	0.39	4
Rudbeckia occidentalis (Western Coneflower)	1.22	9.5
Thalictrum fendleri (Fendler's Medow-rue)	0.23	2.75
TREES/SHRUBS		
Ribes montigenum (Gooseberry Currant)	0.39	1.75

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Drill Site 3	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	0
Understory Cover	46.6
Litter	24.1
Bareground	28
Rock	1.3
Total Living Cover	46.6
% Composition	
Grasses	68.3
Forbs	30.7
Shrubs	0.8

Drill Site 3	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Ribes montigenum (Gooseberry Currant)	5.8
TOTAL	5.8

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Appendix 6- Data Summary Tables for Drill Site 3 Reference Site

Drill Site 3 Reference	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
OVERSTORY		
Abies lasiocarpa (Subalpine Fir)	1	0.25
Populus tremuloides (Quaking Aspen)	17	1.25
UNDERSTORY		
GRASSES		
Achnatherum nelsonii (Columbia Needlegras)	0.71	5.75
Bromus marginatus (Mountain Brome)	13.54	65.5
Carex (Carex spp.)	11.57	37.75
Elymus canadensis (Canada Wildrye)	7.53	32.5
Elymus trachycaulus (Slender Wheatgrass)	0.56	6.5
Melica spectabilis (Purple Oniongrass)	0.15	1.75
Poa pratensis (Kentucky Bluegrass)	1.3	10
FORBS		
Achillea millefolium (Common Yarrow)	0.07	1
Carduus nutans (Musk Thistle)	0.07	0.5
Descurainia incana (Mountain Tansymstard)	0.16	3.25
Erigeron eatonii (Eaton's Fleabane)	0.28	3
Fragaria virginiana (Virginia Strawberry)	0.04	0.25
Hackelia floribunda (Mayflower Stickseed)	3.1	19.25
Hymenoxys hoopesii (Orange Sneezeweed)	0.35	2.75
Lathyrus pauciflorus (Fewflower pea)	10.35	66.5
Mertensia ciliate (Mountain Bluebell)	0.39	1.25
Phacelia sericea (Silky Phacelia)	0.04	1
Rudbeckia occidentalis (Western Coneflower)	2.2	13.25
Thalictrum fendleri (Fendler's Medow-rue)	0.14	0.75
TREES/SHRUBS		
Ribes montigenum (Gooseberry Currant)	0.11	0.25
Sambucus racemosa (Red Elderberry)	0.51	3.25
Symphoricarpos oreophilus (Mountain Snowberry)	0.07	0.25

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Drill Site 3 Reference Site	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	18
Understory Cover	61
Litter	11
Bareground	28
Rock	0
Total Living Cover	79
% Composition	
Grasses	58
Forbs	41.8
Shrubs	0.2

Drill Site 3 Reference Site	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Abies lasiocarpa (Subalpine Fir)	5.8
Populus tremuloides (Quaking Aspen)	34.8
Ribes montigenum (Gooseberry Currant)	5.8
Sambucus racemosa (Red Elderberry)	31.9
Symphoricarpos oreophilus (Mountain Snowberry)	2.9
TOTAL	81.2

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Appendix 7- Data Summary Tables for Drill Site 4

Drill Site 4	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
OVERSTORY		
Abies lasiocarpa (Subalpine Fir)	9	0.25
UNDERSTORY		
GRASSES		
Bromus marginatus (Mountain Brome)	4.57	28.5
Carex (Carex spp.)	7.3	22.25
Elymus canadensis (Canada Wildrye)	12.93	56.75
Elymus trachycaulus (Slender Wheatgrass)	1.68	13.25
Melica spectabilis (Purple Oniongrass)	0.03	1
Muhlenbergia richardsoni (Mat Muhly)	0.05	1.25
Phleum pratensis (Timothy)	0.61	6.25
FORBS		
Achillea millefolium (Common Yarrow)	0.48	8
Agastache urticifolia (Nettleleaf Giant Hyssop)	0.03	0.75
Carduus nutans (Musk Thistle)	0.16	1.25
Delphinium occidentale (Western Larkspur)	0.35	2.5
Fragaria virginiana (Virginia Strawberry)	0.41	6
Hackelia floribunda (Mayflower Stickseed)	0.64	8.25
Hymenoxys hoopesii (Orange Sneezeweed)	1.61	12.75
Lathyrus pauciflorus (Fewflower pea)	2.54	20.25
Lupinus alpestris (Great Basin Lupine)	0.67	5.25
Mertensia ciliate (Mountain Bluebell)	0.01	0.5
Penstemon cyananthus (Wasatch Beardtongue)	0.04	0.75
Phacelia sericea (Silky Phacelia)	0.13	2.5
Rudbeckia occidentalis (Western Coneflower)	2.23	9.5
Solidago canadensis (Canada Goldenrod)	0.36	2
Taraxacum officinale (Common Dandelion)	0.47	6.25
Thalictrum fendleri (Fendler's Medow-rue)	2.09	26
Utica dioica (Stinging Nettle)	0.07	1.25
TREES/SHRUBS		
Ribes montigenum (Gooseberry Currant)	1.69	5.5
Sambucus racemosa (Red Elderberry)	2.9	8.5

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Drill Site 4	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	9
Understory Cover	44.65
Litter	33.35
Bareground	22
Rock	
Total Living Cover	53.65
% Composition	
Grasses	62.2
Forbs	27.5
Shrubs	10.3

Drill Site 4	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Abies lasiocarpa (Subalpine Fir)	17.4
Ribes montigenum (Gooseberry Currant)	23.6
Sambucus racemosa (Red Elderberry)	31.5
TOTAL	72.5

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Appendix 8- Data Summary Tables for Drill Site 4 Reference Site

Drill Site 4 Reference Site	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
OVERSTORY		
Abies lasiocarpa (Subalpine Fir)	3	0.25
Populus tremuloides (Quaking Aspen)	6	0.5
UNDERSTORY		
GRASSES		
Achnatherum nelsonii (Columbia Needlegras)	0.04	1
Bromus marginatus (Mountain Brome)	8.72	50.25
Carex (Carex spp.)	3.3	13.75
Elymus canadensis (Canada Wildrye)	9.56	46.25
Elymus trachycaulus (Slender Wheatgrass)	4.12	30.5
Melica spectabilis (Purple Oniongrass)	0.27	2.5
Phleum pratensis (Timothy)	0.23	2
Poa pratensis (Kentucky Bluegrass)	0.47	3.75
FORBS		
Achillea millefolium (Common Yarrow)	2.27	12.25
Agastache urticifolia (Nettleleaf Giant Hyssop)	0.11	1.75
Delphinium occidentale (Western Larkspur)	0.34	2.5
Erigeron eatonii (Eaton's Fleabane)	0.02	0.75
Fragaria virginiana (Virginia Strawberry)	0.21	2.75
Hackelia floribunda (Mayflower Stickseed)	2.41	13.25
Hymenoxys hoopesii (Orange Sneezeweed)	2.01	17.25
Lathyrus pauciflorus (Fewflower pea)	2.58	18.5
Lupinus alpestris (Great Basin Lupine)	2.21	12
Mertensia ciliate (Mountain Bluebell)	0.06	1.25
Penstemon cyananthus (Wasatch Beardtongue)	0.06	0.5
Phacelia sericea (Silky Phacelia)	0.51	3.75
Rudbeckia occidentalis (Western Coneflower)	1.54	8.25
Solidago canadensis (Canada Goldenrod)	0.39	1.25
Taraxacum officinale (Common Dandelion)	0.07	1.5
Thalictrum fendleri (Fendler's Medow-rue)	1.89	23.25
TREES/SHRUBS		
Ribes montigenum (Gooseberry Currant)	2.15	12.25
Sambucus racemosa (Red Elderberry)	4.37	13.25

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Drill Site 4 Reference Site	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	9
Understory Cover	50
Litter	29
Bareground	21
Rock	
Total Living Cover	59
% Composition	
Grasses	53.4
Forbs	33.2
Shrubs	13.4

Drill Site 4 Reference Site	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Abies lasiocarpa (Subalpine Fir)	14.5
Populus tremuloides (Quaking Aspen)	2.9
Ribes montigenum (Gooseberry Currant)	36.4
Sambucus racemosa (Red Elderberry)	52.5
TOTAL	106.3

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Appendix 9- Data Summary Tables for Drill Site 5

Drill Site 5	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
UNDERSTORY		
GRASSES		
Achnatherum lettermanii (Letterman's Needlegrass)	1.10	22.25
Bromus marginatus (Mountain Brome)	0.1	3.5
Carex (Carex spp.)	2.26	31.25
Elymus lanceolatus (Thickspike Wheatgrass)	0.33	8.25
Poa fendleriana (Muttongrass)	1.1	22.25
Poa pratensis (Kentucky Bluegrass)	9.58	78
FORBS		
Achillea millefolium (Common Yarrow)	0.18	7
Antennaria (Pussytoes)	0.05	1
Carduus nutans (Musk Thistle)	0.03	0.75
Equisetum arvense (Field Horsetail)	0.03	1
Erigeron eatonii (Eaton's Fleabane)	0.03	1
Hymenoxys hoopesii (Orange Sneezeweed)	0.51	13.25
Melilotus officinalis (Sweetclover)	0.06	5.75
Orthocarus tolmiei (Tolmie's Owl's-clover)	0.55	14.75
Penstemon rydbergii (Rydberg's Penstemon)	0.68	10
Phlox austromontana (Mountain Phlox)	0.61	9
Potentilla gracilis (Slender Cinquefoil)	0.21	4.25
TREES/SHRUBS		
Artemisia cana (Silver Sagebrush)	0.1	0.75
Artemisia tridentata vaseyana (Mountain Big Sagebrush)	32.9	38
Chrysothamnus viscidiflorus (Yellow Rabbitbrush)	4	1.5
Dasiphora fruticosa (Shrubby Cinquefoil)	0.7	1.75

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Drill Site 5 2015	
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	0
Understory Cover	54
Litter	3
Bareground	37
Rock	6
Total Living Cover	54
% Composition	
Grasses	25.8
Forbs	4.4
Shrubs	69.8

Drill Site 5 2015	
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Artemisia cana (Silver Sagebrush)	3.6
Artemisia tridentata vaseyana (Mountain Big Sagebrush)	473.7
Chrysothamnus viscidiflorus (Yellow Rabbitbrush)	7.9
Dasiphora fruticosa (Shrubby Cinquefoil)	9.2
TOTAL	494.4

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Appendix 10- Data Summary Tables for Drill Site 5 Reference Site

Drill Site 5 Reference Site	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
UNDERSTORY		
GRASSES		
Achnatherum lettermanii (Letterman's Needlegrass)	1.61	15.25
Carex (Carex spp.)	8.32	78.25
Elymus lanceolatus (Thickspike Wheatgrass)	0.34	4.5
Poa fendleriana (Muttongrass)	0.12	0.75
Poa pratensis (Kentucky Bluegrass)	10.58	79.5
FORBS		
Achillea millefolium (Common Yarrow)	0.56	13.25
Antennaria (Pussytoes)	0.2	3.25
Carduus nutans (Musk Thistle)	0.08	1.75
Crepis acuminate (TapertipHawksbeard)	0.04	0.75
Erigeron eatonii (Eaton's Fleabane)	0.1	1.75
Fragaria virginiana (Virginia Strawberry)	0.42	8
Hymenoxys hoopesii (Orange Sneezeweed)	0.12	1.75
Melilotus officinalis (Sweetclover)	0.01	0.75
Orthocarus tolmiei (Tolmie's Owl's-clover)	0.33	8
Penstemon rydbergii (Rydberg's Penstemon)	2.22	22.75
Phlox austromontana (Mountain Phlox)	0.57	9.25
Potentilla gracilis (Slender Cinquefoil)	0.56	11.25
Taraxacum officinale (Common Dandelion)	0.02	1
TREES/SHRUBS		
Artemisia tridentata vaseyana (Mountain Big Sagebrush)	28.6	29.25
Dasiphora fruticosa (Shrubby Cinquefoil)	1.2	0.75

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Drill Site 5 Reference Site	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	0
Understory Cover	56
Litter	5
Bareground	36
Rock	3
Total Living Cover	56
% Composition	
Grasses	37.4
Forbs	9.4
Shrubs	53.2

Drill Site 5 Reference Site	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Artemisia tridentata vaseyana (Mountain Big Sagebrush)	467.5
Dasiphora fruticosa (Shrubby Cinquefoil)	26.3
TOTAL	512.8

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Appendix 11- Data Summary Tables for Drill Site 6

Drill Site 6	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
OVERSTORY		
Abies lasiocarpa (Subalpine Fir)	3.4	4.25
Populus tremuloides (Quaking Aspen)	12	2.25
UNDERSTORY		
GRASSES		
Achnatherum nelsonii (Columbia Needlegras)	0.04	0.75
Achnatherum thurberianum (Thurber's Needlegrss)	0.08	0.5
Bromus marginatus (Mountain Brome)	13.35	52.25
Carex (Carex spp.)	3.47	17.25
Elymus canadensis (Canada Wildrye)	6.48	33.5
Elymus trachycaulus (Slender Wheatgrass)	1.57	14.5
Melica spectabilis (Purple Oniongrass)	0.61	5.5
Muhlenbergia richardsoni (Mat Muhly)	0.04	0.75
Poa fendleriana (Muttongrass)	0.04	0.5
Poa pratensis (Kentucky Bluegrass)	5.13	27
FORBS		
Achillea millefolium (Common Yarrow)	2.57	32
Carduus nutans (Musk Thistle)	0.14	2.5
Crepis acuminate (Tapertip Hawksbeard)	0.1	1.5
Hymenoxys hoopesii (Orange Sneezeweed)	4.89	34.75
Lathyrus pauciflorus (Fewflower pea)	11.25	52.75
Potentilla gracilis (Slender Cinquefoil)	0.02	0.75
Rudbeckia occidentalis (Western Coneflower)	1.68	7.5
Taraxacum officinale (Common Dandelion)	0.37	7
Thalictrum fendleri (Fendler's Medow-rue)	0.17	3.5
TREES/SHRUBS		

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Drill Site 6	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	15.4
Understory Cover	52
Litter	27
Bareground	21
Rock	
Total Living Cover	67.4
% Composition	
Grasses	59.3
Forbs	37.5
Shrubs	3.2

Drill Site 6	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Abies lasiocarpa (Subalpine Fir)	14.5
Populus tremuloides (Quaking Aspen)	29
TOTAL	43.5

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Appendix 12- Data Summary Tables for Drill Site 6 Reference Site

Drill Site 6 Reference Site	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
OVERSTORY		
Abies lasiocarpa (Subalpine Fir)	0.2	0.75
Populus tremuloides (Quaking Aspen)	15.4	1
UNDERSTORY		
GRASSES		
Achnatherum nelsonii (Columbia Needlegras)	.1	1.5
Bromus marginatus (Mountain Brome)	9.12	53.5
Carex (Carex spp.)	6.91	29.5
Elymus canadensis (Canada Wildrye)	4.97	28.25
Elymus trachycaulus (Slender Wheatgrass)	0.8	10.5
Melica spectabilis (Purple Oniongrass)	0.07	1
Muhlenbergia richardsoni (Mat Muhly)	0.04	0.25
Poa pratensis (Kentucky Bluegrass)	7.83	48.5
FORBS		
Achillea millefolium (Common Yarrow)	2.12	29.75
Carduus nutans (Musk Thistle)	0.04	0.75
Crepis acuminate (Tapertip Hawksbeard)	0.04	1
Hymenoxys hoopesii (Orange Sneezeweed)	4.25	32.25
Lathyrus pauciflorus (Fewflower pea)	12.48	64.5
Penstemon cyananthus (Wasatch Beardtongue)	0.01	0.5
Potentilla gracilis (Slender Cinquefoil)	0.04	0.5
Taraxacum officinale (Common Dandelion)	0.17	5.25
Thalictrum fendleri (Fendler's Medow-rue)	0.24	5
TREES/SHRUBS		
Abies lasiocarpa (Subalpine Fir)		0.75
Artemisia tridentata vaseyana (Mountain Big Sagebrush)	4.73	7
Populus tremuloides (Quaking Aspen)		1

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Drill Site 6 Reference Site	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	15.6
Understory Cover	54
Litter	26
Bareground	20
Rock	
Total Living Cover	69.6
% Composition	
Grasses	55.3
Forbs	35.9
Shrubs	8.8

Drill Site 6 Reference Site	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Abies lasiocarpa (Subalpine Fir)	2.9
Artemisia tridentata vaseyana (Mountain Big Sagebrush)	8.7
Populus tremuloides (Quaking Aspen)	17.4
TOTAL	17.4

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Appendix 13- Data Summary Tables for Drill Site 7

Drill Site 7	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
OVERSTORY		
Abies lasiocarpa (Subalpine Fir)	17.2	3.25
UNDERSTORY		
GRASSES		
Bromus anomalus (Nodding Brome)	1	1.75
Bromus marginatus (Mountain Brome)	1.1	5
Carex (Carex spp.)	7.23	29.5
Elymus canadensis (Canada Wildrye)	20.87	64
Muhlenbergia richardsoni (Mat Muhly)	0.33	3
Phleum alpinum (Alpine Timothy)	0.05	0.5
Phleum pratensis (Timothy)	1.1	5.25
Poa pratensis (Kentucky Bluegrass)	4.55	15.5
FORBS		
Achillea millefolium (Common Yarrow)	2.62	19.75
Carduus nutans (Musk Thistle)	0.05	0.75
Fragaria virginiana (Virginia Strawberry)	0.89	7.25
Geranium richardsonii (Richardson's Geranium)	0.25	1.75
Hackelia floribunda (Mayflower Stickseed)	0.1	1
Hymenoxys hoopesii (Orange Sneezeweed)	0.52	4.5
Lathyrus pauciflorus (Fewflower pea)	7.87	36.5
Lupinus alpestris (Great Basin Lupine)	2.63	9.75
Penstemon cyananthus (Wasatch Beardtongue)	0.03	0.75
Phacelia sericea (Silky Phacelia)	0.2	0.25
Rudbeckia occidentalis (Western Coneflower)	1.05	4.5
Solidago canadensis (Canada Goldenrod)	0.2	0.75
Taraxacum officinale (Common Dandelion)	0.98	10.5
Thalictrum fendleri (Fendler's Medow-rue)	1.23	10.25
TREES/SHRUBS		
Ribes montigenum (Gooseberry Currant)	0.45	2.5
Sambucus racemosa (Red Elderberry)	0.7	2

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Drill Site 7 2015	
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	17.2
Understory Cover	56
Litter	28
Bareground	16
Rock	
Total Living Cover	73.2
% Composition	
Grasses	64.7
Forbs	33.3
Shrubs	2

Drill Site 7 2015	
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Abies lasiocarpa (Subalpine Fir)	40.6
Ribes montigenum (Gooseberry Currant)	20.3
Sambucus racemosa (Red Elderberry)	9.2
TOTAL	70.1

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Appendix 14- Data Summary Tables for Drill Site 7 Reference Site

Drill Site 7 Reference Site	2015	
Percent Cover and Percent Frequency by Species		
Species Name (Common Name)	Mean Percent Cover	Percent Frequency
OVERSTORY		
Abies lasiocarpa (Subalpine Fir)	19	3.5
UNDERSTORY		
GRASSES		
Achnatherum nelsonii (Columbia Needlegras)	0.04	0.75
Bromus anomalus (Nodding Brome)	1.92	10.25
Bromus marginatus (Mountain Brome)	1	4.5
Carex (Carex spp.)	6.8	33.25
Elymus canadensis (Canada Wildrye)	22.4	75
Melica spectabilis (Purple Oniongrass)	0.12	1.25
Phleum pratensis (Timothy)	0.16	1.5
FORBS		
Achillea millefolium (Common Yarrow)	2.11	26
Fragaria virginiana (Virginia Strawberry)	1.53	14
Geranium richardsonii (Richardson's Geranium)	0.29	3
Hackelia floribunda (Mayflower Stickseed)	0.12	2
Heliomeris multiflora (Showy Goldeneye)	0.2	1.25
Hymenoxys hoopesii (Orange Sneezeweed)	0.56	4
Lathyrus pauciflorus (Fewflower pea)	11.13	53.75
Lupinus alpestris (Great Basin Lupine)	3.69	17.5
Phacelia sericea (Silky Phacelia)	0.04	0.25
Rudbeckia occidentalis (Western Coneflower)	0.36	1.25
Taraxacum officinale (Common Dandelion)	0.25	4.5
Thalictrum fendleri (Fendler's Medow-rue)	1.8	21.25
TREES/SHRUBS		
Abies lasiocarpa (Subalpine Fir)		3.5
Ribes montigenum (Gooseberry Currant)	1.56	4.75
Sambucus racemosa (Red Elderberry)	0.44	3.25

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Drill Site 7 Reference Site	2015
Total Cover and Composition	
	Mean Percent cover
TOTAL COVER	
Overstory Cover	19
Understory Cover	58
Litter	24
Bareground	17
Rock	1
Total Living Cover	77
% Composition	
Grasses	58.5
Forbs	38.1
Shrubs	3.4

Drill Site 7 Reference Site	2015
Woody Species Density	
	Number/Acre
SPECIES (COMMON NAME)	
Abies lasiocarpa (Subalpine Fir)	43.5
Ribes montigenum (Gooseberry Currant)	20.3
Sambucus racemosa (Red Elderberry)	6.3
TOTAL	70.1

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Appendix 15- Photos of Drill Site 1

Drill Site 1 Belt 1

Drill Site 1 Belt 2

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Drill Site 1 Belt 3

Drill Site 1 Belt 4

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Drill Site 1 Belt 5

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Appendix 16- Photos of Drill Site 1 Reference Site

Drill Site 1 Reference Belt 1

Drill Site 1 Reference Belt 2

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Drill Site 1 Reference Belt 3

Drill Site 1 Reference Belt 4

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Drill Site 1 Reference Belt 5

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Appendix 17- Photos of Drill Site 2

Drill Site 2 Belt 1

Drill Site 2 Belt 2

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Drill Site 2 Belt 3

Drill Site 2 Belt 4

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Drill Site 2 Belt 5

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Appendix 18- Photos of Drill Site 2 Reference Site

Drill Site 2 Reference Belt 1

Drill Site 2 Reference Belt 2

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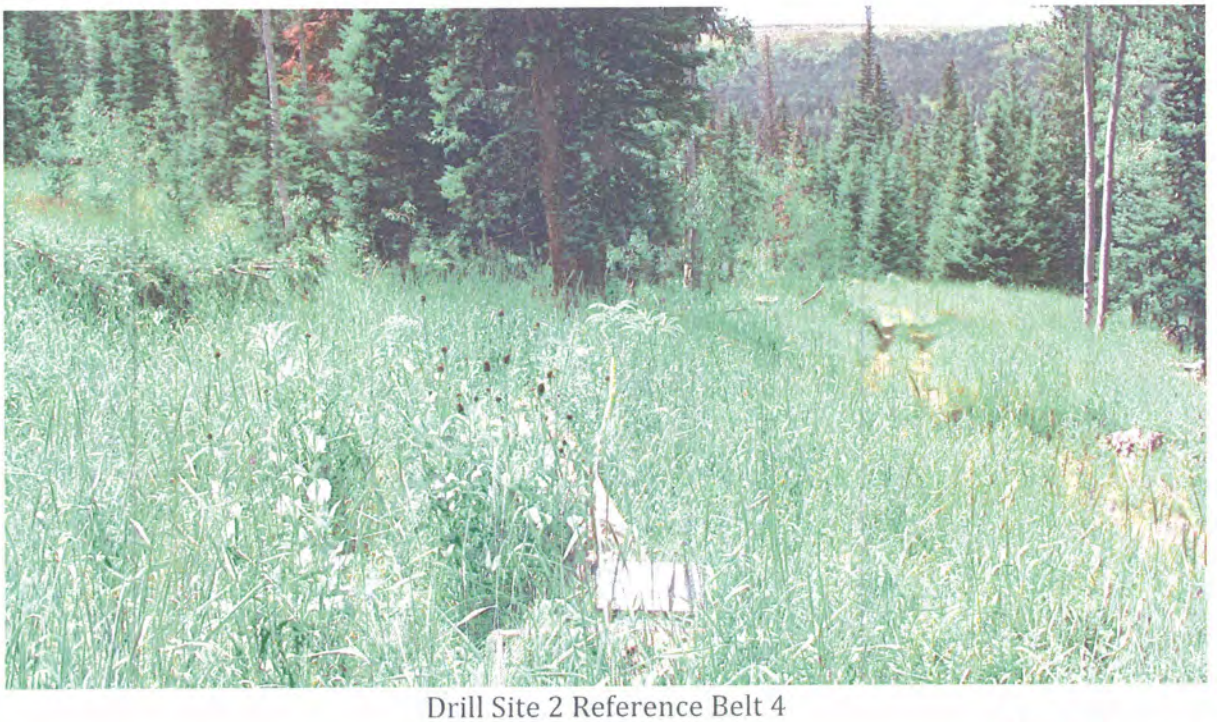
Drill Site 2 Reference Belt 3



Drill Site 2 Reference Belt 4

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Drill Site 2 Reference Belt 5

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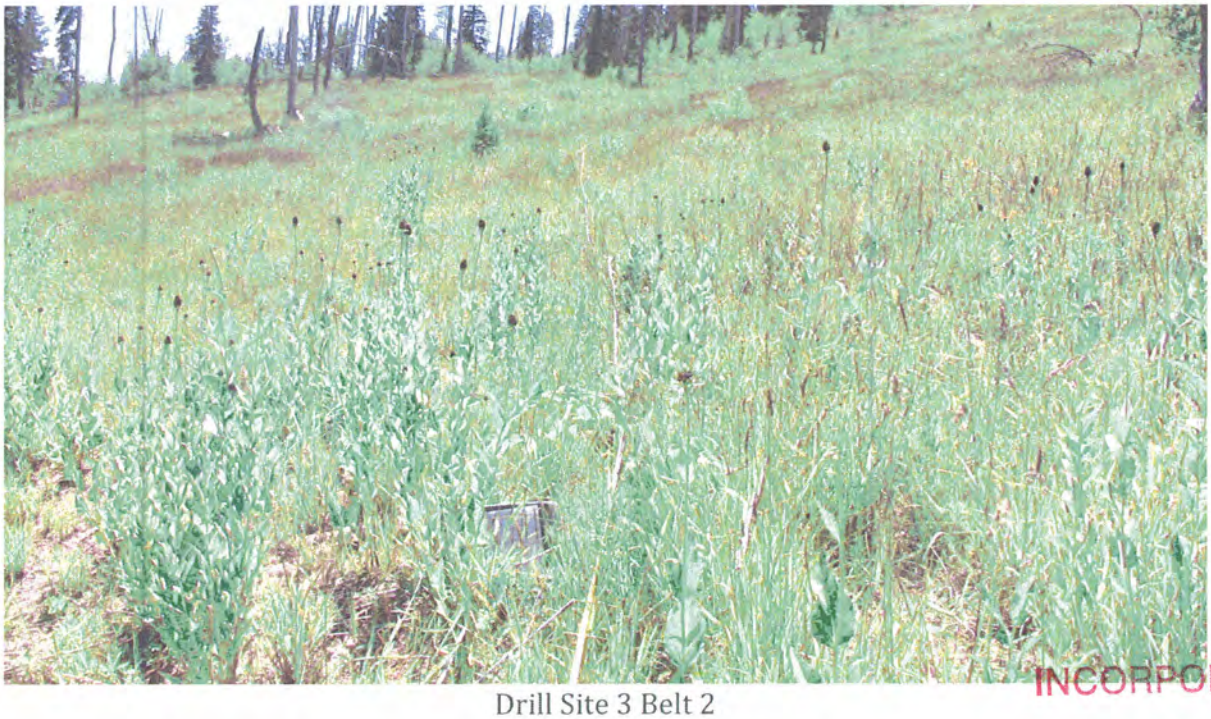
Appendix 19- Photos of Drill Site 3

Drill Site 3 Belt 1



Drill Site 3 Belt 2

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Drill Site 3 Belt 3

Drill Site 3 Belt 4

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Drill Site 3 Belt 5

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Appendix 20- Photos of Drill Site 3 Reference Site

Drill Site 3 Reference Belt 1

Drill Site 3 Reference Belt 2

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Drill Site 3 Reference Belt 3

Drill Site 3 Reference Belt 4

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Drill Site 3 Reference Belt 5

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Appendix 21- Photos of Drill Site 4

Drill Site 4 Belt 1

Drill Site 4 Belt 2

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Drill Site 4 Belt 3

Drill Site 4 Belt 4

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Drill Site 4 Belt 5

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Appendix 22- Photos of Drill Site 4 Reference Site

Drill Site 4 Reference Belt 1

Drill Site 4 Reference Belt 2

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Drill Site 4 Reference Belt 3

Drill Site 4 Reference Belt 4

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Drill Site 4 Reference Belt 5

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Appendix 23- Photos of Drill Site 5

Drill Site 5 Belt 1

Drill Site 5 Belt 2

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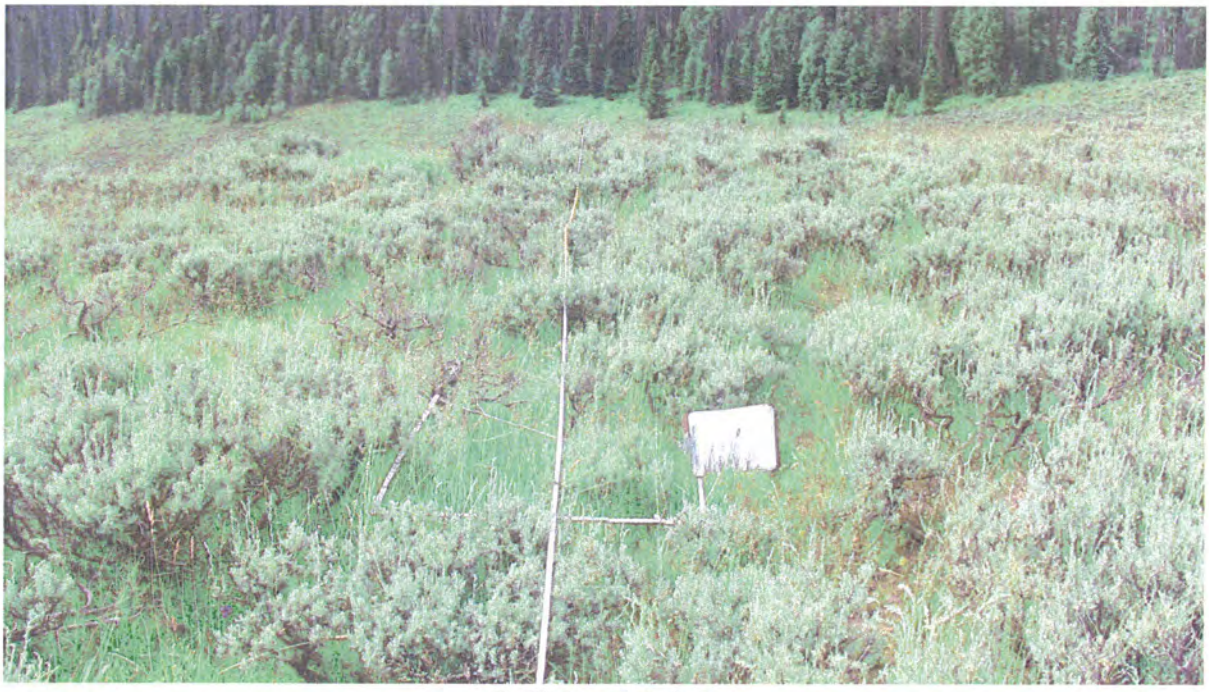

Drill Site 5 Belt 3

Drill Site 5 Belt 4

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Drill Site 5 Belt 5

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Appendix 24- Photos of Drill Site 5 Reference Site

Drill Site 5 Reference Belt 1

Drill Site 5 Reference Belt 2

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Drill Site 5 Reference Belt 3

Drill Site 5 Reference Belt 4

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Drill Site 5 Reference Belt 5

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Appendix 25- Photos of Drill Site 6

Drill Site 6 Belt 1

Drill Site 6 Belt 2

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Drill Site 6 Belt 3

Drill Site 6 Belt 4

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Drill Site 6 Belt 5

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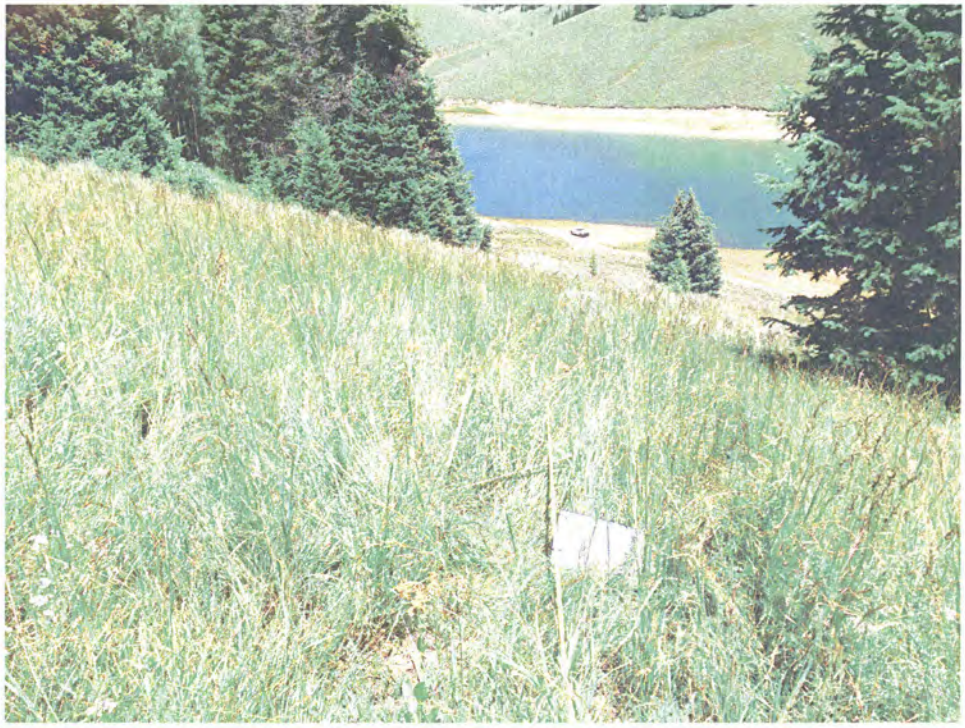
Appendix 26- Photos of Drill Site 6 Reference Site



Drill Site 6 Reference Belt 1

Drill Site 6 Reference Belt 2

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Drill Site 6 Reference Belt 3

Drill Site 6 Reference Belt 4

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Drill Site 6 Reference Belt 5

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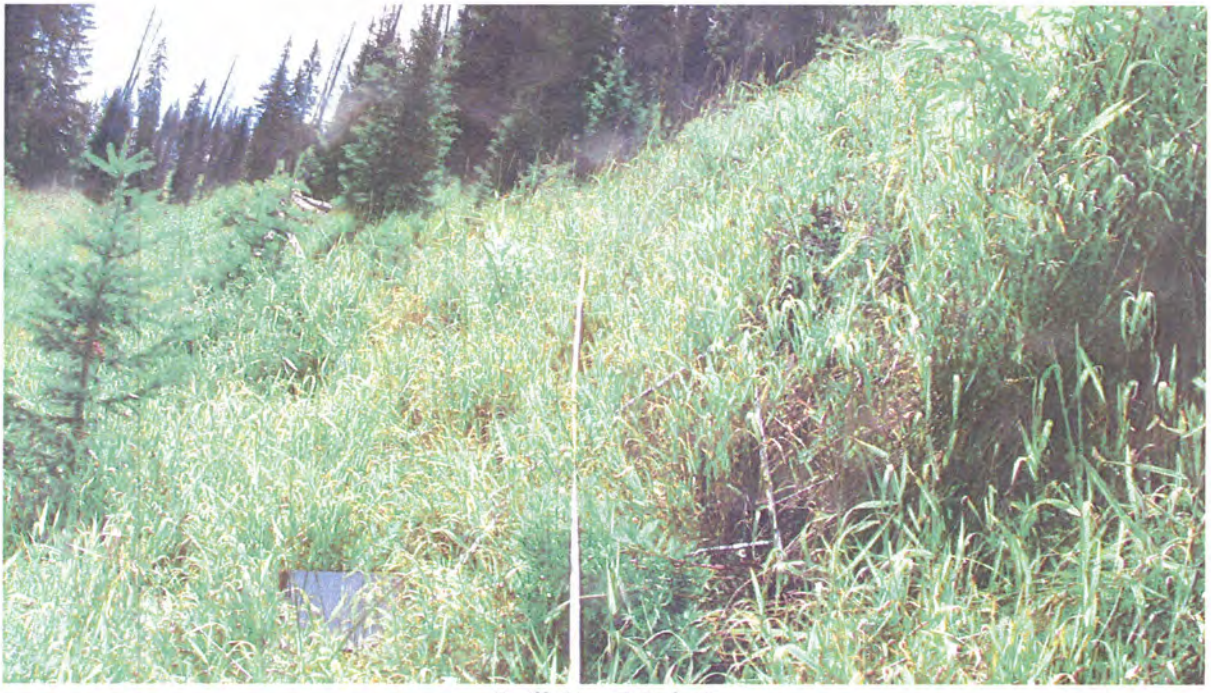
Appendix 27- Photos of Drill Site 7

Drill Site 7 Belt 1



Drill Site 7 Belt 2

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Drill Site 7 Belt 3

Drill Site 7 Belt 4

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Drill Site 7 Belt 5

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Appendix 28- Photos of Drill Site 7 Reference Site

Drill Site 7 Reference Belt 1

Drill Site 7 Reference Belt 2

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Drill Site 7 Reference Belt 3

Drill Site 7 Reference Belt 4

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Drill Site 7 Reference Belt 5

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Appendix 29- Study Area Maps

Drill Site 1 and Drill Site 1 Reference Site

Drill Site 2 and Drill Site 2 Reference Site

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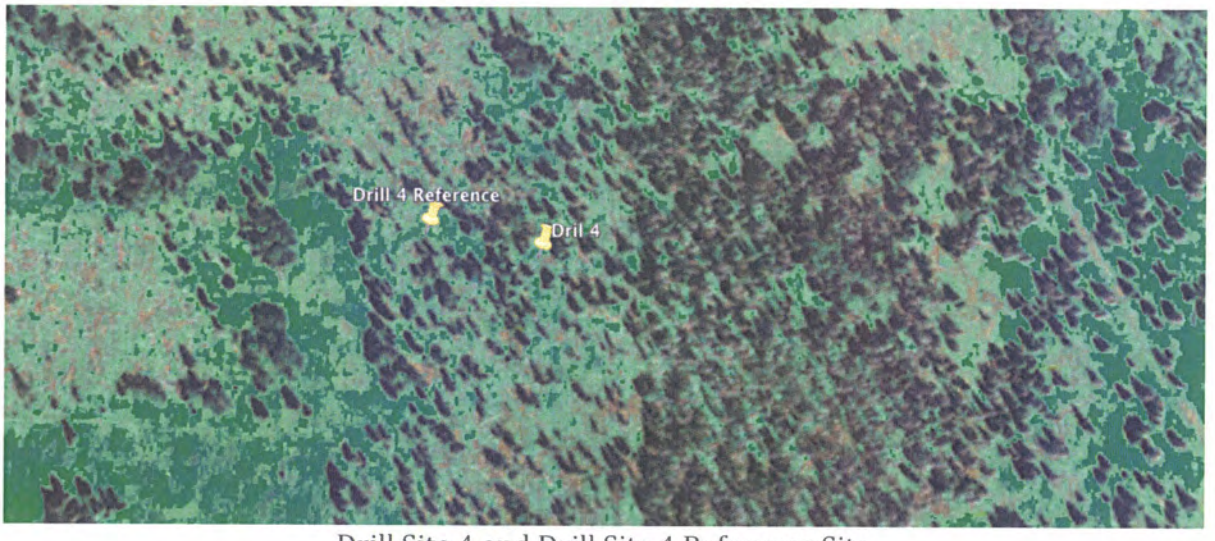
Drill Site 3 and Drill Site 3 Reference Site



Drill Site 4 and Drill Site 4 Reference Site

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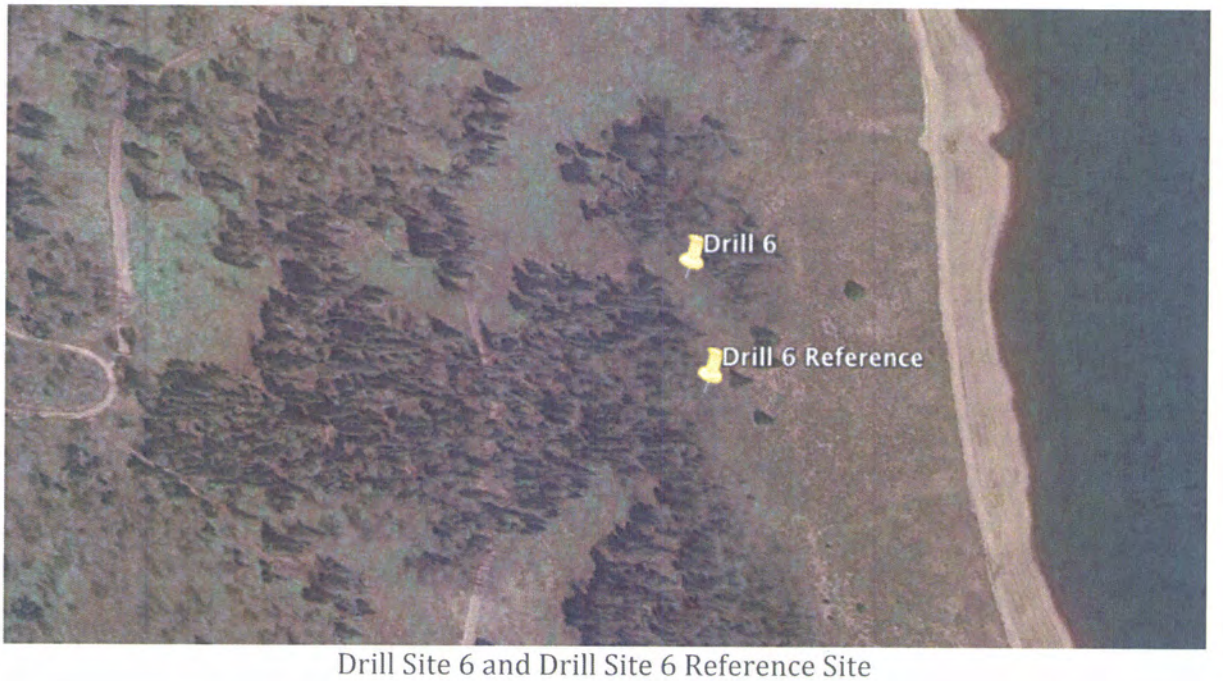
Drill Site 5 and Drill Site 5 Reference Site



Drill Site 6 and Drill Site 6 Reference Site

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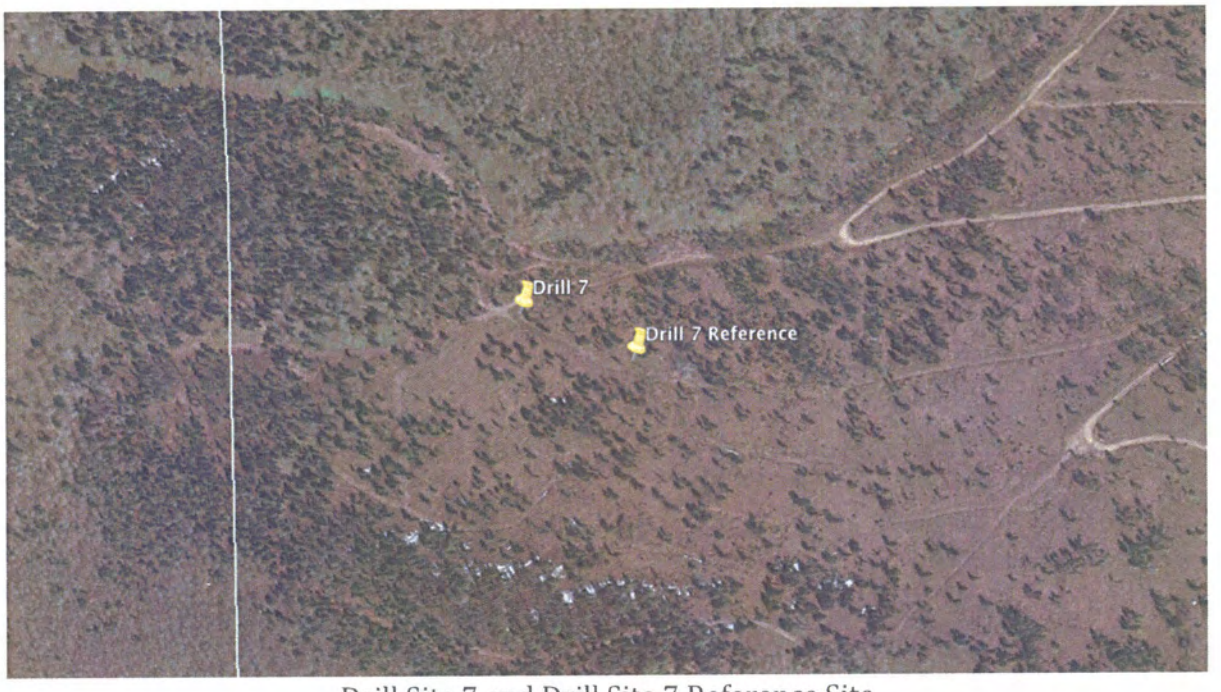

Drill Site 7 and Drill Site 7 Reference Site

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Appendix 30- UTM Coordinates of Reference Areas

Drill 1 Reference	0477575 E	4391748 N
Drill 2 Reference	0477865 E	4391526 N
Drill 3 Reference	0477529 E	4391215 N
Drill 4 Reference	0477010 E	4389991 N
Drill 5 Reference	0478707 E	4388177 N
Drill 6 Reference	0479848 E	4386360 N
Drill 7 Reference	0479055 E	4385515 N

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Technical Memorandum

To: Gregg Galecki
Environmental Engineer
Skyline Mine

Jeremiah Armstrong
Environmental Engineer
Skyline Mine

From: Alpine Ecological
HC80 Box 570
Greenwich, UT 84732

Date: 10/12/2015

Re: **Subsidence Area Vegetative Monitoring Protocol**

Background

The techniques presented herein are a brief summary of the riparian vegetation monitoring protocol to be implemented prior to subsurface mining. The baseline data collected will be used to identify capability groups for greenline successional status, riparian successional status, and greenline bank stability. The full sampling methodology can be found in the Forest Service, Rocky Mountain Research Station's General Technical Report RMRS-GTR-47 titled *Monitoring the Vegetation Resources in Riparian Areas* by Alma Winward (2000).

Monitoring the Vegetation Resources in Riparian Areas

Sampling sites will be identified within the potential subsidence area by using publicly available aerial imagery to ensure that community types within the potential subsidence area are included in the sample. Permanent transects will be established and samples of areas of streams will be taken prior to the potential subsidence. Baseline sampling will include vegetation above the area of potential subsidence. Data will include the following:

1. Greenline sampling of a 363-foot section on either side of the stream.
2. 5 perpendicular samples in the riparian areas of the sample site.

Data gathered from these samples will be used to determine the following:

1. Greenline successional status based on capability groups (Appendix A)
2. Riparian successional status based on capability groups (Appendix A)
3. Greenline bank stability (Appendix B)

In the event diminished stream flows warrant follow-up vegetation monitoring, vegetative data will then be resampled on the permanent transect in the area of potential subsidence to determine if the potential subsidence has affected the vegetation along the stream. If the values of any two of the

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three indices goes to a lower successional state or stability class (Appendix A & B) then a re-inventory of above and below stream permanent transects will be conducted to determine if the changes are due to subsidence or to some other environmental change.

Appendix A – Greenline and Riparian Successional Status Based on Capability Groups

0-15 = Very Early
16-40 = Early
41-60 = Mid
61-85 = Late
85+ = Potential Natural Community

Appendix B – Greenline Bank Stability Classes Based on Capability Groups
1-2 = Very Low
3-4 = Low
5-6 = Mid
7-8 = High
9-10 = Excellent

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References
Winward, Alma H. 2000. Monitoring the vegetation resources in riparian areas. Gen. Tech. Rep. RMRSGTR-47. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 49 p.

Canyon Fuel
Company, LLC
A Subsidiary of Bowie Resource Holdings, LLC

Skyline Mine
Craig W. Brown, Engineering Manager
HC35, Box 380
Helper, Utah 84526
(435) 448-2643
Fax (435) 448-2632

*Via Certified Mail

May 25, 2016

Mr. Roger Bankert
Minerals Branch Chief
Bureau of Land Management
440 West 200 South, Suite 500
Salt Lake City, Utah 84101

RE: Federal Lease UTU-77114; Lease Stipulation #27; Canyon Fuel Company, LLC, Skyline Mines;

Mr. Bankert:

As outlined in "Special Stipulations for Coal Lease UTU-77114", stipulation 27, indicates the mine shall submit a subsidence mitigation plan for perennial streams within the lease and the associated effects to the aquatic ecosystems and wetlands to the Authorized Officer (AO) of the Bureau of Land Management (BLM). Attached is the said plan titled, "Subsidence Mitigation Plan for Perennial Streams, Ecosystems, and Riparian Areas within the Flat Canyon Lease". The BLM plan is identical to the commitments made in the Skyline Mine and Reclamation Plan (M&RP) held with the Division of Oil, Gas, & Mining.

If you have any questions regarding this letter or would like to discuss future mining plans for the above referenced sections, please call Gregg Galecki at (435) 448-2636 or me at (435) 448-2643.

Sincerely,

Craig W. Brown
Engineering Manager, Skyline Mine
Canyon Fuel Company, LLC

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Subsidence Mitigation Plan for Perennial Streams, Ecosystems and Riparian Areas within the Flat Canyon Lease

The following is submitted per Federal Coal Lease UTU-77114; Special Stipulation #27 which states:

"27. The Lessee shall submit a plan for monitoring the gradient of the perennial streams within the lease and the associated effects to aquatic ecosystems and wetlands. The plans shall also include measures for the mitigating detrimental effects discovered during monitoring. The plans shall be submitted to and be approved by the AO of the BLM, with consent of the surface management agency in addition to any requirements by the regulatory authority, prior to mining."

The Canyon Fuel Company, LLC, Skyline Mine as permitted through the Utah Division of Oil, Gas, & Mining (UDOGM) and regulated through the Surface Mining Control and Reclamation Act (SMCRA) is obligated and committed to the protection of the environment and to minimize the impacts from mining activities. The following outlines the various commitments that have been made in the UDOGM Mining and Reclamation Plan (M&RP) to monitor, minimize, and mitigate any adverse effects to the hydrologic balance within the Flat Canyon Lease (UTU-77114) as it pertains to protecting the perennial stream systems.

Water Monitoring

With the acquisition of the Flat Canyon Lease a total of five (5) stream monitoring sites and five (5) groundwater spring monitoring sites have been added to the Skyline Water Monitoring program. For the Upper Huntington basin, the total number of monitoring sites to thirty (34); seventeen (17) stream sites and seventeen (17) spring sites, respectively. This includes three (3) sites below Electric Lake, but does not include groundwater wells. See attached Plate 2.3.6-1_Rev16 for locations, and refer to Sections 2.3 and 2.4 of the UDOGM M&RP for specifics of the water monitoring program.

The additional stream and groundwater springs sites have been strategically selected based on extensive baseline water monitoring conducted prior to acquiring the lease. To address the affects to stream flow, stream monitoring sites have been positioned both above and below sections of perennial streams to be undermined by longwall mining methods subject to subsidence. Monitoring of these sites before, during, and after mining will be used determine any loss of stream-flow due to mining.

Similarly, springs have been selected based on distribution through the area, whether there is a beneficial use (i.e. Flat Canyon Campground drinking water supply – Spring SW4-429), and representative of the various geologic units within the area (Castlegate SS, Blackhawk Formation, etc.). These springs will also provide additional information to whether mining is having an impact on the surface hydrology within the lease area.

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Stream Gradient

As outlined in Section 4.17 – Subsidence Control Plan of the M&RP (page 4-95c), Skyline Mine commits to monitoring impacts of longwall mining to the gradient of the perennial streams by

conducting a detailed elevation survey of the stream channel prior to mining. The method of monitoring will include an on-ground survey using survey-grade equipment encompassing the length of the stream channel beginning upstream of the anticipated zone of subsidence, through the subsidence zone, and terminating downstream of the subsidence zone. The information will be added to Appendix A-1 of the M&RP. If necessary, this information will be used as baseline information for any future mitigation efforts by comparing the pre- and any post-mining surveys. Detailed post-mining surveys will not be conducted unless deemed necessary by the various regulatory agencies. General changes in the stream gradient will be documented using aerial subsidence surveys of the entire actively mined area that are conducted annually and are included in the UDOGM Annual report.

Aquatic wildlife

Baseline surveys of the creeks have been conducted, with only Boulger Creek having suitable fish habitat. Electro-fish surveys will be conducted in Boulger Creek per the commitments outlined in Chapter 2, Section 2.8 – Aquatic Wildlife Resources of the M&RP which states:

"A fish monitoring program for Boulger Creek will be implemented prior to undermining the lower portion of the creek. The electro fish survey will estimate the fish populations in the stream for one year and every third year thereafter. The fish survey will begin one year prior to undermining any portion of the creek. Unless otherwise noted, sampling methods will be consistent with surveys conducted previously on James, Burnout, Eccles, Woods, and Winter Quarters creeks.

Boulger Reservoir is an artificial, man-made fishery that is restocked with fish on a regular basis throughout the fishing season. In the event Boulger Reservoir is undermined additional permitting will outline the mitigation of possibly draining the reservoir. All necessary regulatory agencies concerns will addressed prior to undermining. "

Riparian Vegetation

The only possible scenario for mining to potentially impact the riparian areas would be related to subsidence where surface flow to the creek was significantly reduced. Any significant decrease in flow will be documented through the water monitoring program outlined in Section 2.3 or the Subsidence monitoring and Stream gradient monitoring as outlined in Section 4.17 above. Since established riparian areas naturally react slowly to seasonal climatic variations, a reduction in flow potentially due to mining would elicit a similar response. Baseline riparian vegetation evaluations will be collected prior to undermining the various creeks (See attached Figure 2.7.9-2 from the M&RP for baseline vegetation evaluation locations). If quarterly water monitoring flow measurements fall below the recorded historic low-flow values (not associated or explained by climatic seasonal variation) additional monitoring will continue on an annual basis until the cause of the lower flows is determined. No follow up vegetation monitoring will be conducted following the baseline survey unless historic low flows are observed during mining activities.

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The vegetation monitoring method will follow techniques outlined by Winward (2000) incorporating

data such as the Greenline Successional Status, Riparian Successional Status, and Greenline Bank Stability (See attached Technical Memo, Re: Subsidence Area Vegetation Monitoring Protocol). Following the collection of the baseline data, the vegetation monitoring will continue annually until conditions improve or the need for mitigation is determined. In the unlikely event it is determined that mining-related subsidence causes material damage or a loss of riparian habitat, the Permittee commits to using the best technology currently available (BTCA) to mitigate the damage. The repair efforts will be coordinated and agreed upon by Mine, DOGM, and USFS personnel.

Attachments: Plate 2.3.6-1 – Location of Hydrologic Monitoring Stations
Figure 2.7.9-2 – Riparian Vegetation Evaluation
Technical Memo – Subsidence Vegetation Monitoring Protocol

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Technical Memorandum

To: Gregg Galecki
Environmental Engineer
Skyline Mine

Jeremiah Armstrong
Environmental Engineer
Skyline Mine

From: Alpine Ecological
HC80 Box 570
Greenwich, UT 84732

Date: 10/12/2015

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References

Winward, Alma H. 2000. Monitoring the vegetation resources in riparian areas. Gen. Tech. Rep. RMRSGTR-47. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 49 p.

data such as the Greenline Successional Status, Riparian Successional Status, and Greenline Bank Stability (see Appendix A-2, Volume 2 for detailed vegetation monitoring methods). Following the collection of the baseline data, the vegetation monitoring will continue annually until conditions improve or the need for mitigation is determined. In the unlikely event it is determined that mining-related subsidence causes material damage or a loss of riparian habitat, the Permittee commits to using the best technology currently available (BTCA) to mitigate the damage. The repair efforts will be coordinated and agreed upon by Mine, DOGM, and USFS personnel

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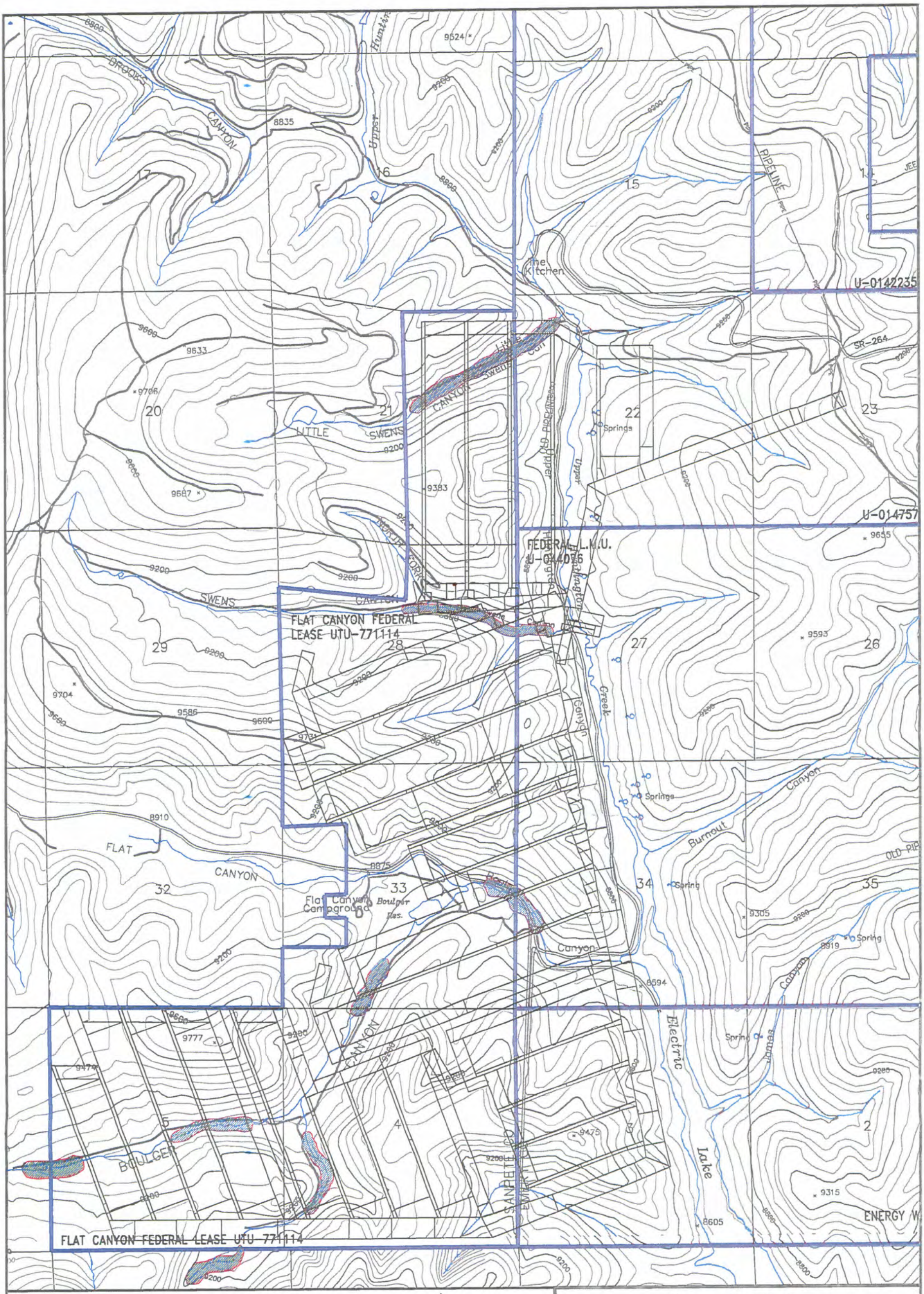

Figure 2.7.9-2
Riparian Vegetation Evaluation

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435-448-2632	DATE: 09/25/15	CK.BY: GGalecki	REVISION: 0 4/30/16
CAD FILE: Figure 2.7.9-2 pg 2-63cRev0.dwg		DR.BY: BBailey	
Figure 2.7.9-2		Pg. 2-63c	

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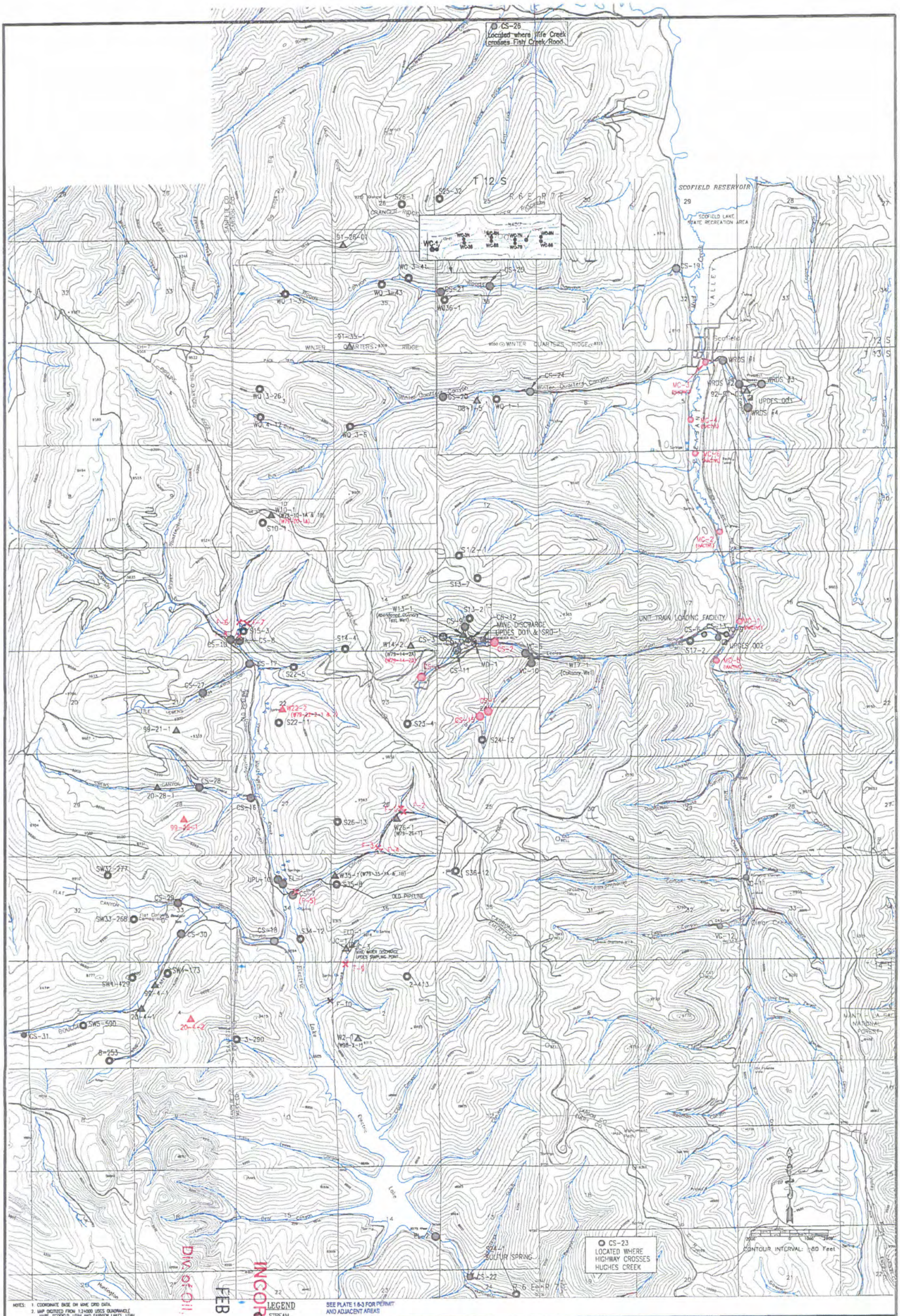
CS-26
Located where Fife Creek crosses Fish Creek Road
T 12 S
R 6 E
R 7 E
SCOFIELD RESERVOIR
SCOFIELD LAKE STATE RECREATION AREA
GRANGER RIDGE
WINTER QUARTERS RIDGE
WINTER QUARTERS CANYON
Scofield
UNIT TRAIN LOADING FACILITY
MINE DISCHARGE UPDES 001 & SRO-1
UPDES 002
WRDS #1
WRDS #2
WRDS #3
WRDS #4
UPDES 003
CS-23
LOCATED WHERE HIGHWAY CROSSES HUCHES CREEK
SULFUR SPRING
CONTOUR INTERVAL: 80 Feet
LEGEND
STREAM
SPRING
WELL - MONITORING
MINE DISCHARGE
STREAM SUBSIDENCE POINTS
FLUME LOCATION
UPDES DISCHARGE POINTS
DISCONTINUED/ABANDONED
SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS
NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.
LOCATIONS F-1 THROUGH F-4 AND F-6 THROUGH F-8 ARE PART OF A USFS SUBSIDENCE STUDY ON BURNOUT CREEK AND NOT PART OF THE MRRP WATER MONITORING PROGRAM
F-5 AND CS-7 ARE THE SAME LOCATION
BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH - 1984
Location of Hydrologic Monitoring Stations
Canyon Fuel Company, LLC
Skyline Mines
SCALE: 1" = 2000'
DATE: 04-04-01
CK.BY: CDH
DWG. NO.: 2.3.6-1
DR.BY: JLP
REVISION: 16
09/25/2015
DATE | No. | REVISIONS | BY/CHK
09/04/02 | 1 | | /CAC
10/07/02 | 2 | | /CAC
04/03/03 | 3 | | /CAC
06/04/03 | 4 | | /CAC
03/19/04 | 5 | | /CAC
08/18/04 | 6 | | /CAC
11/18/04 | 7 | | /CDH
05/25/05 | 8 | | /CDH
JUNE 07 | 9 | MODIFIED PERMIT BOUNDARY (EIC & WASTE ROCK) ADDED WD1-1; INACTIVATED MC SITES | DR/CC
DEC 09 | 11 | MODIFIED PERMIT BOUNDARY and Discontinued F-1 - F-8 | MRR/CAC
JULY 10 | 12 | REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE | JLH/CAC
SEPT | 13 | RELOCATED CS-24, ADDED CS-25 AND WD36-1 | MRR/CAC
JULY 11 | 14 | Added WC-1 thru WC-9S, Discontinued W30-4-2 | MRR/CAC
OCT 12 | 15 | Added NOC Sites 535-32, 526-1and CS-26 | MRR/CAC
SEPT 25 | 16 | Added CS-27,-28,-29,-30,-31; SW4-429,-173, SW33-268, SW32-277, SW5-590; Corrected location of CS-10, CS-13 | SLH/CAC
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PHC Addendum Vol. 2

Appendix N

Investigation of Groundwater And Surface-Water Systems In the Flat Canyon Tract and Adjacent Area; Probable Hydrologic Consequences of Coal Mining in the Flat Canyon Tract, Sanpete County, Utah

2 January 2017

Canyon Fuel Company, LLC
Skyline Mine
Helper, Utah

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PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Investigation of Groundwater And Surface-Water Systems In the Flat Canyon Tract and Adjacent Area; Probable Hydrologic Consequences of Coal Mining in the Flat Canyon Tract, Sanpete County, Utah

2 January 2017

Canyon Fuel Company, LLC
Skyline Mine
Helper, Utah

Prepared by:

Erik C. Petersen, P.G.
Principal Hydrogeologist
Utah P.G. No. 5373615-2250

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1.0 Introduction

The Canyon Fuel Company, LLC (CFC) Skyline Mine is located in the northern portion of the Wasatch Plateau coal district approximately three miles southwest of the town of Scofield, Utah (Figure 1). The mine, which was opened in December 1981, is an underground mine that produces bituminous coal from the lower Blackhawk Formation coal seams in the region. Mining operations at the Skyline Mine have been conducted in locations that are mostly east of Huntington Creek. Canyon Fuel is acquiring a new coal lease in the Flat Canyon Tract, which is located in upper Huntington Canyon west of Huntington Creek. The Flat Canyon Tract is contiguous with the existing Skyline Mine permit area.

This document presents the findings of an investigation of groundwater and surface-water systems in the Flat Canyon Tract area. The findings of this investigation are a framework for a determination of the potential for mining related impacts to the hydrologic regime. Specifically, this document addresses the requirements of Utah Coal Mining Rule R645-301-728, which requires that a determination of the probable hydrologic consequences (PHC) of coal mining be completed before a coal mining permit is issued by the Utah Division of Oil, Gas and Mining.

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2.0 Methods of Study

Existing Reports and Hydrologic Data

Existing hydrogeologic maps and reports were obtained and reviewed. These included previous hydrogeologic investigations of the Skyline Mine area (Mayo and Associates, 1996), reports of spring and seep surveys conducted on the Flat Canyon Tract and surrounding area (Mayo and Associates, 1997, 1998), the Flat Canyon Tract Final Environmental Impact Statement conducted by the United States Forest Service and Bureau of Land Management (USFS, 2002), and reports of Star Point Sandstone groundwater systems that were intercepted previously by the Skyline Mine (HCI, 2001). A professional paper that presents the findings of a comprehensive, multi-year investigation of active and inactive groundwater flow regimes in the stratified mountainous terrain of the Wasatch Plateau and Book Cliffs coal fields was also reviewed as part of this investigation (Mayo et al. 2003).

1997-1998 Spring and Seep Survey

A spring and seep survey of the Flat Canyon Tract and adjacent area was performed by Mayo and Associates during 1997 and 1998. The spring and seep surveys were conducted during low-flow conditions in the fall of 1997 and during high-flow conditions in the springtime of 1998. It should be noted that during the fall of 1997 and springtime of 1998 the Skyline Mine area was experiencing a period of sever wetness. A total of 502 springs and seeps were identified in the Flat Canyon Tract and the surrounding surveyed area during these surveys. As part of the spring and seep surveys, groundwater and surface-water discharge rates and field water quality parameters, including water temperature, pH, specific conductivity, were measured.

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The use of the water at each spring and seep site was observed and recorded in the field. Spring and seep locations were determined in the field using field reckoning on 1:24,000 scale topographic maps and also using Trimble Scoutmaster hand-held GPS units. It is noted that at that time, the GPS signal was intentionally degraded by the U.S. government (selective availability) resulting in location accuracies that were considerably poorer than those obtainable using the current GPS system. Selective availability was ended by the U.S. government in May 2000.

Perennial stream reaches were also identified in the Flat Canyon Tract area. Discharge rates at the stream sites were measured by either measuring the time-to-fill of water flowing into a calibrated bucket using a stopwatch or using a Marsh-McBirney brand portable flow meter.

Baseline Data Collection

Baseline hydrologic data for groundwaters and surface waters in the Flat Canyon area (Petersen Hydrologic (2000, 2006-2014)) were obtained using the following methods.

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Baseline Monitoring Site Selection

From the identified springs in the Flat Canyon and adjacent area, spring and seep sites were selected for monitoring based on several criteria. Springs were chosen 1) to provide spatial coverage over the extent of the Flat Canyon Tract and adjacent area, 2) to provide monitoring coverage from groundwater systems from the Price River Formation, Castlegate Sandstone, Castlegate Sandstone/Blackhawk Formation contact area, and the Blackhawk Formation. Springs of particular importance for their use were also selected.

including springs used for campground and private cabin water supplies. Spring monitoring sites were also selected to include springs discharging under varying discharge mechanisms, including springs that flow at high flow rates (that are likely highly influenced by the annual snowmelt event), and also springs that flow at lower rates that display less seasonal variability.

Discharge Measurements

Discharge measurements for springs were performed using a calibrated container and a stopwatch. Generally, spring discharge measurements were performed by damming and diverting the spring discharge through a pipe. Using an appropriately sized container, time-to-fill measurements were typically performed at least 3 times at each location. An average time-to-fill value was used to calculate the reported discharge measurement. At some spring locations with large discharge rates, spring discharge measurements were performed using a 90° v-notch weir, or using cross-sectional area – current velocity techniques. Discharge measurements at stream monitoring stations were performed using existing Parshall flumes, using a Marsh-McBirney model 2000 electromagnetic current-velocity meter and wading rod, or using a stopwatch and calibrated container as appropriate. Discharge measurements and calculations were performed using methods described by the United States Geological Survey and the U.S. Bureau of Reclamation.

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Discharge Temperature Measurements

Temperature measurements were performed using a Taylor brand electronic digital thermometer. Discharge temperature measurements at springs were performed as close

to the spring discharge locations as possible. Stream temperature measurements were performed, where possible, in a shaded, actively flowing portion of the stream.

Specific Conductance Measurements

Specific conductance measurements were performed using an Extech brand model EC400 conductivity meter with automatic temperature compensation. The instrument was regularly calibrated using NIST traceable conductivity standard solutions.

pH Measurements

pH Measurements were performed using an Oakton model pH Testr 30 or an Oakton model Acorn 6 pH meter, both having automatic temperature compensation . The instruments were regularly calibrated using NIST traceable pH standard solutions.

Dissolved Oxygen Measurements

Dissolved oxygen measurements were performed using a YSI brand Model 55 dissolved oxygen meter. The meter was routinely calibrated using atmospheric oxygen calibration methods.

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Water Quality Laboratory Measurements

Water quality laboratory analyses were performed by SGS Laboratories of Huntington, Utah, and Chemtech-Ford Laboratory of Sandy, Utah. Both of these laboratories are NELAC certified laboratories.

Compilation of Data

Solute, discharge, and isotopic data were obtained from Canyon Fuel Company, LLC and from the Utah Division of Oil, Gas and Mining on-line *Utah Coal Mining Water Quality Database (UDOGM, 2014).* Information from spring and seep surveys and baseline monitoring activities were also obtained. Hydrologic data for the Flat Canyon Tract from these sources were compiled into a single electronic database for analysis.

Data Analysis

Hydrologic data were analyzed using graphical and statistical methods. Solute chemical compositions were analyzed using Stiff (1951) diagrams and Piper plots. Groundwater mineral saturation indices were calculated using WATEQF (Plummer and others, 1976).

Isotopic Analysis

Groundwater and surface water samples for isotopic analysis have been collected as part of this and previous investigations at the Skyline Mine. Tritium analyses were performed using electrolytic enrichment and low level counting methods by the Tritium Laboratory, University of Miami, Florida and at the BYU Department of Geology Isotopic Laboratory of Provo, Utah. Radiocarbon analyses used for radiometric dating were performed by Geochron Laboratories of Cambridge, Massachusetts and the BYU isotopic laboratory.

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Groundwater mean residence times were determined using methods described by Pearson and Hanshaw (1970), Fontes (1980), and Mookes (1980). The radiocarbon dating models utilized in

this investigation were developed for use in carbonate terrains. Radiocarbon dating was performed on the dissolved inorganic carbon contained in the water samples. The carbon histories of groundwaters were evaluated using measured $\delta^{13}C$ compositions to account for sources of live (modern) and dead carbon and to verify the carbonate geochemical evolutionary pathway of the groundwaters (i.e. dissolution of carbonate minerals in the presence of soil-zone CO_2 gas).

3.0 Presentation of Data

Baseline hydrologic data were collected at the Flat Canyon Tract area by Mayo and Associates, LC beginning in 1997 and continuing through 2000. Beginning in 2006 and continuing to the present time, routine baseline monitoring of streams and springs in the Flat Canyon area has been performed. Monitoring at several of the baseline monitoring sites has been continuous as part of the Skyline Mine hydrologic monitoring activities. Baseline monitoring site locations in the Flat Canyon Tract are shown on Figure 2. Baseline monitoring site details are presented in Table 1. A complete listing of baseline hydrologic monitoring data from the Flat Canyon Tract is presented in Table 2. Additional monitoring data for springs, streams, and wells in and around the Flat Canyon Tract are available in the Utah Division of Oil, Gas and Mining on-line Coal Mining Water Quality Database (UDOGM, 2014). Average discharge and water quality information for the baseline monitoring sites is presented in Table 3. Plots of the Palmer Hydrologic Drought Index for Utah Regions 4 and 5 are presented in Figure 3. A geologic map of the Flat Canyon and adjacent area is shown in Figure 4. Discharge hydrographs for springs are presented in Figures 5. Discharge hydrographs for streams are presented in Figure 6. The

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solute compositions of groundwaters and surface waters in the Flat Canyon Tract are represented graphically as Stiff (1951) diagrams in Figure 7. Stiff diagrams are a useful way to compare the solute compositions of groundwaters. The shape of the Stiff diagram is a representation of chemical type, while the size of the Stiff diagram is a reflection of the total dissolved solids concentration of the water. Tritium and radiocarbon concentrations and radiocarbon mean residence times of groundwaters and surface waters in the Flat Canyon Tract and adjacent areas are listed in Table 4.

4.0 Climate

Climate data at the Skyline Mine are measured at NOAA weather station 427729, Scofield-Skyline Mine, Utah (WRCC, 2014). Station 427729 is located at the Skyline Mine surface facilities area. The yearly precipitation measured at the Skyline Mine station between 1985 and 2014 has ranged from a low of 17.69 inches in the 1986 water year to a high of 42.18 inches in the 2010 water year. Monthly average temperatures at the mine site have ranged from a low of 10.6 in the month of December to 75.9 °F in the month of July.

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Climatic conditions in the region that includes the Flat Canyon Tract varied substantially during the period of baseline monitoring (1997 – present). This is illustrated in plots of the Palmer Hydrologic Drought Index (PHDI) for Utah Regions 4 and 5 (Figure 3). The Flat Canyon Tract is situated near the border between Utah Region 4 (south central), and Utah Region 5 (northern mountains). The PHDI is a monthly value generated by the National Climatic Data Center using a variety of hydrologic parameters that indicates wet and dry spells. The PHDI is calculated

from several hydrologic parameters including precipitation, temperature, evapotranspiration, soil water recharge, soil water loss, and runoff. Consequently, it is a useful tool for evaluating the relationship between climate and groundwater and surface-water discharge data. It is apparent in Figure 3 that the region experienced a prolonged period of moderate to extreme wetness beginning in 1997 that continued through November 1999. It was during this period that the spring and seep surveys and the first two years of baseline hydrologic data were collected at the Flat Canyon Tract. Beginning in December 1999, the region rapidly transitioned to a period of moderate to severe drought that continued to late 2004. Beginning in late 2004, the region transitioned to a period of wetness that peaked in mid-2005. The period from 2006 through 2010 was characterized by generally near-normal climatic conditions with brief alternating periods of wetness and dryness. During 2011 the period experienced a period of severe wetness. During 2012, 2013, and early 2014 the region has experienced a period of continuous dryness.

5.0 Geology

Five Cretaceous- to Tertiary-age bedrock formations outcrop in the Flat Canyon Tract area (Figure 4). These include, in descending order, the North Horn Formation, Price River Formation, Castlegate Sandstone, and the Blackhawk Formation. The Star Point Sandstone and the Mancos Shale (which intertongues with the Star Point Sandstone) do not crop out in the Flat Canyon Tract area but are present in the subsurface beneath the area. Each of these formations, and their ability to transmit groundwater, is described briefly below.

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North Horn Formation

The Upper Cretaceous-Tertiary age North Horn Formation is exposed on the highest ridge tops within and adjacent to the Flat Canyon Tract. The formation consists primarily of shale with lesser amounts of interbedded sandstone, limestone, and conglomerate. Low permeability bentonitic mudstones dominate in the lower third of the formation. Isolated sandstone channels exist throughout the formation. In the Wasatch Plateau, where the North Horn Formation often forms the cap rock along ridges and plateaus, springs commonly discharge from hillsides near the ridge tops because of the inability of groundwater to migrate downward through the shales of the North Horn Formation.

Price River Formation

The Price River Formation consists primarily of fluvial sandstones that are interbedded with shale and some conglomerate. Consequently, in outcrop the formation commonly forms alternating ledge and slope exposures. The lenticular, discontinuous nature of the fluvial sandstones, and the fact that the sandstones are encased in low permeability fine-grained material, prevents the transmission of water significant distances through the formation. Where the formation is exposed at the surface, shallow groundwater systems can form in the soil zone or in shallow fractured bedrock horizons within the formation. Regionally in the Wasatch Plateau coal mining district, groundwaters flowing through the Price River Formation commonly acquire TDS concentrations that are somewhat elevated relative to the TDS of groundwaters flowing through the underlying Castlegate Sandstone.

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Castlegate Sandstone

The Castlegate Sandstone is made up primarily of fine- to medium-grained fluvial sandstone. The formation was deposited in a braided stream environment, resulting in a series of lenticular, interpenetrating deposits. Thin interbeds of siltstone and claystone are common. The existence of mudstone drapes and the tightly cemented nature of the formation limit its ability to transmit groundwater. In the Flat Canyon Tract area, the formation is exposed over a large area and thick soil and colluvial deposits are present in the shallow subsurface. Consequently, springs in the Castlegate Sandstone are common in the Flat Canyon Tract area.

Blackhawk Formation

The Blackhawk Formation consists of lenticular, discontinuous beds of sandstone, claystone, mudstone, shale, and coal. Because of the discontinuous nature of the rock strata, it is not possible to correlate individual rock layers over significant distances. The claystones of the Blackhawk Formation contain high percentages of montmorillonite and other swelling clays (UDOGM, 2013). Chempet Research Corporation (1989) found that claystone layers in the Blackhawk Formation contained up to 58% montmorillonite. Vaughan Hansen Associates (1982) report that boreholes drilled into the Blackhawk Formation are very unstable and, when left open for a few days, slough badly.

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Sandstone paleochannels (sinusoidal fluvial sandstones encased in the surrounding low permeability, fine-grained rocks) are present throughout the formation. Historically, sandstone channels encountered in the Skyline Mine sometimes contained water and other times were dry (Personal communication, Mark Bunnell, 2013).

Although regionally the Blackhawk Formation is known to have poor groundwater flow properties, many springs in the existing Skyline Mine permit area and many in the Flat Canyon Tract area occur in the Blackhawk Formation. This is likely due primarily to the fact that in most locations in the existing Skyline Mine permit area, the Blackhawk Formation is the only bedrock formation present at the surface. Because of the appreciable precipitation in the Skyline Mine area, the potential for groundwater recharge is substantial. However, the interbedded low permeability shales and mudstones present in the Blackhawk Formation generally prevent deep downward migration of recharge water and thus the groundwater circulation depths of most groundwaters in the Blackhawk Formation are probably of shallow or intermediate depth (as evidenced by the marked seasonal variability in discharge rates in most Blackhawk Formation springs). Within the Blackhawk Formation, springs commonly occur where sandstone paleochannels in the subsurface intersect the land surface. The presence of faulting and fracturing enhances the secondary porosity of sandstone rocks in the fluvial channels which results in increased groundwater flow rates at some springs.

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Star Point Sandstone

The Star Point Sandstone consists of massive, fine- to medium-grained sandstone that is moderately well consolidated. Individual massive sandstone units are separated by partings of low-permeability siltstone or mudstone. The Storrs Tongue of the Star Point Sandstone interfingers with the basal portion of the overlying Blackhawk Formation in the Skyline Mine area. The Storrs Tongue of the Star Point Sandstone, which exists beneath the current Skyline Mine permit area pinches out to the west in the Flat Canyon Tract area. The Panther Tongue of

the Star Point Sandstone underlies the Storrs Tongue in the existing permit area and the Flat Canyon Tract area. The Panther Tongue is in most locations separated from the overlying Storrs Tongue by several tens of feet of relatively impermeable shaley deposits.

Mayo and Associates (1999) report that groundwater inflows into the Skyline Mine from the Star Point Sandstone have radiocarbon ages in excess of 13,000 years. This suggests that groundwater flow rates in the Star Point Sandstone are low. This conclusion is supported by the low values of hydraulic conductivity reported for the Star Point Sandstone in the Wasatch Plateau. Slug tests performed in minimally-fractured Star Point Sandstone at the GENWAL Resources Crandall Canyon Mine, located south of the Flat Canyon Tract area indicate a hydraulic conductivity of approximately 4.8×10^{-8} ft/s to 7.4×10^{-8} ft/s (Mayo and Associates, 1997). Bills (2000) found a hydraulic conductivity of 4.06×10^{-6} ft/sec for the Star Point Sandstone in the Straight Canyon area. The higher hydraulic conductivity reported by Bills is likely the result of increased fracturing of the sandstone associated with the Straight Canyon Syncline. Because of its low permeability, unfractured Star Point Sandstone bedrock is generally not an important water bearing or water transmitting unit in the region. However, where the sandstone has been intensely fractured or faulted, the hydraulic conductivity of the formation and the water storage and water transmission potentials are greatly enhanced.

In the Skyline Mine, significant inflows of old groundwater have occurred that are associated with fault and/or fracture systems that are sourced from the Star Point Sandstone.

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Quaternary Alluvium

Deposits of Quaternary alluvium are present in all of the major canyon bottoms in the Flat Canyon and adjacent area. The Quaternary alluvial deposits in Flat Canyon are particularly well developed. Where exposed in stream channels, the alluvium in the area has been observed to consist primarily of unconsolidated deposits cobbles, gravels, sands, and silts.

Structure

Bedrock strata in the Flat Canyon Area generally dip to the west at approximately 4 to 10 degrees (Figure 4). Numerous faults have been mapped in the current Skyline Mine permit area and the adjacent Flat Canyon Tract area (Figure 4). The Flat Canyon Tract area and the Skyline Mine current permit area lie between two major north-south trending faults. The Pleasant Valley Fault is located in the Mud Creek area to the east and segments of the Joes Valley Fault are present near Gooseberry Creek to the west. The Pleasant Valley Fault system juxtaposes rocks of the Star Point Sandstone against the shale, mudstone, and sandstone rocks of the Blackhawk Formation. The Gooseberry Creek Fault system juxtaposes rocks of the Star Point Sandstone against the predominantly shale bedrock of the North Horn Formation.

Several north- to northeast-trending faults with displacements up to a few tens of feet have been mapped in the existing Skyline Mine permit area and in the Flat Canyon Tract area. Significant groundwater inflows at the Skyline Mine have been associated with these structures.

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6.0 Description of Groundwater Systems

Groundwater in the Flat Canyon Tract naturally discharges as springs and seeps from alluvial deposits, Price River Formation, Castlegate Sandstone, and Blackhawk Formation. Discharge hydrographs for springs in the Flat Canyon Tract area are presented in Figure 5. (Note: in Figures 5 and 6, discharge data for 2011 and 2012 are not plotted for locations not having both high flow and low flow data for the year). Throughout the extent of Skyline Mine underground workings, groundwater has been encountered in greater or lesser amounts as the mine workings have advanced. Most commonly, groundwater has been intercepted in Blackhawk Formation sandstone paleochannels in the mine roof in newly opened mining areas. These groundwater inflows are commonly short lived. Larger inflows were encountered during mining operations in the southwest portion of the existing Skyline Mine permit area beginning in about 1999. These larger inflows originated from the mine floor as warm water upwelled through faults and fractures in the underling Star Point Sandstone. Unlike discharges from the overlying sandstone paleochannels, discharges from the underlying Star Point Sandstone have been more persistent. Radiocarbon dating of the Star Point Sandstone groundwaters indicate very old mean residence times for these waters (several thousands of years). Tritium contents in the intercepted Star Point Sandstone groundwaters are generally low, indicating isolation of the groundwater from surface recharge sources for at least the past 50 years. Groundwater sampled from the 10-Left sump area (which originated from a fault/fracture that is apparently associated with the "Diagonal Fault" system) contained tritium at low but detectable levels (~1 TU), while having a radiocarbon mean groundwater residence time of more than 6,000 years. Because of mine flooding at the 10-Left inflow location, the groundwater could only be sampled where the sump/pool was accessible, which was a considerable distance from the actual submerged discharge source (personal

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communication, Doug Johnson, 2001). The degree to which the water sampled at the 10-Left sump could possibly have been contaminated with tritium from other floor waters comingling in the sump area is unknown. However, by comparison, it is noteworthy that the average of the tritium concentrations of all spring and stream tritium samples in 1997 and 1998 in the adjacent Flat Canyon area (i.e. shallow, active-zone groundwaters and surface-waters) was about 17 TU (Table 4).

Groundwater systems in the Skyline Mine and Flat Canyon areas are associated with one of two fundamental types of groundwater flow regime. These two regimes are described by a fairly simple conceptual model that includes "active" and "inactive" groundwater flow regimes (Mayo et. al, 2003). The operation of these two regimes is fundamentally a consequence of the vertical and horizontal heterogeneity and discontinuity of rock strata in the region. A discussion of the active- and inactive-zone groundwater regimes in the Flat Canyon area is presented below.

Active-Zone Groundwater Systems

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Active zone groundwater systems are characterized as having good hydraulic communication with groundwater recharge sources and having active groundwater flow from recharge to discharge areas. Thus, they are dependent on annual recharge events and are affected by short-term climatic variability. The elevated tritium concentrations (which indicate groundwaters that are less than about 50 years old) and the modern radiocarbon ages of spring waters in the Flat Canyon Tract indicate that the springs in the Flat Canyon Tract area discharge from active-zone groundwater systems (Table 4). With the exception of springs that discharge from the Pleasant Valley Fault system east of the Skyline Mine permit (Mayo and Associates, 1996), all springs

sampled for tritium and radiocarbon in the existing Skyline Mine permit area contain abundant tritium, contain modern radiocarbon, and are of modern origin. These springs discharge from active zone groundwater systems.

Discharge hydrographs for selected springs in the Flat Canyon Tract and surrounding area are presented in Figure 6. It is apparent in Figure 6 that the springs exhibit seasonal variations in discharge rate. Most of the springs also show rapid responses to significant periods of drought and wetness (climatic variability). The rapid response of most springs to the annual snowmelt event and the subsequent rapid declines in discharge rates during the late summer and fall months (seasonal variability) suggests that the travel times from recharge locations to discharge locations are generally short. This supports the conclusion that these springs discharge from active-zone systems.

In the Flat Canyon Tract area, active-zone groundwater systems develop where 1) there is adequate precipitation to facilitate groundwater recharge, 2) there is sufficient storage capacity in the near-surface unconsolidated sediments and/or shallow bedrock to sustain groundwater discharge for significant periods, and 3) there is a competent, impermeable perching layer present in the subsurface that prohibits the downward migration of groundwater. In the study area, the downward migration of active-zone groundwaters into deeper horizons is impeded by the presence of low permeability bedrock horizons that are present throughout the study area, creating perched groundwater conditions. The perched groundwater systems, being constrained largely by surface topography, are usually of limited aerial extent. (i.e., groundwater discharge locations are commonly near recharge locations).

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It is apparent from Table 2 and inspection of the Stiff (1951) diagrams in Figure 7 that all of the springs in the Flat Canyon area are of the low-TDS calcium-bicarbonate solute geochemical type. The average TDS concentrations for the Flat Canyon are springs range from 72 to 272 mg/L. This geochemical type is consistent with the dissolution of carbonate minerals in the presence of soil-zone CO_2 gas. The geochemical evolution that produces this solute geochemical type in carbonate terrains is described below:

Carbon dioxide gas is produced naturally in the soil at concentrations greatly exceeding atmospheric concentrations by root-zone respiration and also by the decay of organic matter. Recharge water (rain and snow melt), upon entering the soil mantle, reacts with CO_2 to produce carbonic acid according to:

$$CO_2 + H_2O = H_2CO_{3\ (carbonic\ acid)} \qquad \text{(Equation 1)}$$

The produced carbonic acid subsequently dissociates into hydrogen ions (acid) and bicarbonate according to:

$$H_2CO_3 = H^+ + HCO_3^- \qquad \text{(Equation 2)}$$

The H^+ produced from Equation 2 reacts with carbonate minerals pervasive in the rocks of the Wasatch Plateau coal field, yielding calcium (and in the Flat Canyon area to a lesser extent magnesium) ions and additional bicarbonate ions to the water according to:

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$$CaCO_{3\ (calcite)} + H^+ = Ca^{2+} + HCO_3^- \qquad \text{(Equation 3)}$$

And

$$CaMg(CO_3)_{2\ (dolomite)} + 2H^+ = Ca^{2+} + Mg^{2+} + 2\ HCO_3^- \qquad \text{(Equation 4)}$$

Because of the limited solubility of calcite and dolomite in the absence of an additional source of CO_2, waters acquiring their solute compositions through the geochemical evolutionary pathway described in Equations 1 through 4 typically have relatively low TDS concentrations.

Much lesser amounts of sulfate, sodium, and chloride are also present in groundwaters and surface-waters in the Flat Canyon area. These species are commonly produced by the dissolution of soluble minerals such as gypsum and halite according to:

$$CaSO_4 \cdot 2H_2O_{(gypsum)} = Ca^{2+} + 2H_2O \quad \text{(Equation 5)}$$

$$NaCl_{(halite)} = Na^{+} + Cl^{-} \quad \text{(Equation 6)}$$

Dissolution of halite used as road salt sometimes increases sodium and chloride concentrations in stream waters adjacent to salted roadways in the wintertime according to Equation 6.

Waters containing Ca^{2+} resulting from the dissolution of carbonate minerals or gypsum may subsequently undergo ion exchange on exchangeable clay minerals present in the region resulting in an increase in Na^{+} concentrations at the expense of exchanged Ca^{2+} ions according to:

$$Ca^{2+} + \text{Na-clay} = 2Na^{+} + \text{Ca-Clay} \quad \text{(Equation 7)}$$

Ion exchange may also occur on zeolite minerals such as the sodium zeolite analcime according to:

$$2NaAlSi_2O_6 \cdot H_2O + Ca^{2+} = Ca(AlSi_2O6)_2 \cdot H_2O + 2Na^{+} \quad \text{(Equation 8)}$$

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Inspection of concentrations of important water quality parameters in stream discharge waters in the Flat Canyon Tract area (Table 2) do not indicate any substantially elevated concentrations of these constituents.

Inactive-Zone Groundwater Systems

Inactive-zone groundwater systems are characterized by old groundwater (commonly from about 2,000 to 19,000 years) and a general lack of hydraulic communication with the ground surface or active recharge sources (Mayo et. al. 2003). This condition is the result of the lack of recharge potential to deeper groundwater systems, either vertically or horizontally, because of 1) the abundance of low-permeability rocks in the rock sequence, and 2) the lenticular, discontinuous nature of the interbedded more permeable horizons that limits the extent of potential groundwater movement. Inactive-zone groundwater systems are not influenced by either annual recharge events or by short-term climatic variability. This is evidenced by the lack of seasonal or climatic discharge responses of groundwater inflows into the mine. Rather, groundwater inflows encountered in the Skyline Mine (with the exception of the intercepted Star Point Sandstone fracture/fault inflows) typically drain rapidly after first being encountered (Personal communication, Mark Bunnell, 2013).

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Inactive-zone groundwaters in the Blackhawk Formation are not part of a regionally continuous aquifer. Groundwater in the inactive zone occurs primarily in isolated partitions created by the discontinuous nature of bedrock hydrostratigraphic horizons and poor recharge potential. Because of the internal structure of the Star Point Sandstone, the sizes of the partitions in that

formation are considerably greater. This condition may result in more sustained groundwater inflows from the Star Point Sandstone when intercepted by the mine openings. Where faulted and/or extensively fractured, the secondary fracture porosity of the Star Point Sandstone can cause that formation to behave more like an aquifer in the traditional sense due to the hydraulic interconnectedness of the fracture network. However, on a macro scale, the size of fracture-enhanced groundwater partitions are constrained by hydrogeologic features such as lithologic pinch-outs, bounding faults that juxtapose permeable zones against impermeable lithologies, fracture discontinuities, or lateral variation in fracture intensities. For example, because the Storrs Tongue of the Star Point Sandstone pinches out to the west in the Flat Canyon Tract area, groundwater flow in the partition associated with that member cannot extend westward beyond the Flat Canyon Tract area. Similarly, the Flat Canyon Tract and existing Skyline Mine areas are constrained on the east and west by the Pleasant Valley and Gooseberry Fault Systems, respectively. On both the east and west, these faults juxtapose the sandstones of the Star Point against rocks which likely have lower values of hydraulic conductivity. The decline in the historic discharge rates measured at CS-14 (southwest mine area) supports the conclusion of a partitioned groundwater system in the Star Point Sandstone. After peaking at more than 8,000 gpm during early 2003, the discharge rate from CS-14 had declined to less than 2,000 gpm by early 2014 (Figure 8).

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Mayo and Associates (1996) found that the old radiocarbon ages of groundwater discharging from faults in the Skyline Mine area substantiate the idea that about 10,000 and 20,000 years ago major groundwater recharge events recharged the deeper portions of the bedrock in the Skyline Mine area, and that the clustering of ^{14}C data suggests two major recharge events – one that

occurred about 10,000 years ago and another that occurred about 20,000 years ago – that occurred during very wet climatic cycles (i.e. glaciation). It should be noted that, because similar climatic/recharge conditions are not present currently, nor have they been present for likely several thousand years, similar major recharge events to the deep, inactive-zone groundwater systems have likely not occurred during the recent past nor are they occurring presently.

Over the life of the mine, mining operations in the Skyline Mine have encountered groundwater in some portions of the mine, while other nearby locations were dry. Wells drilled into both the mine roof and mine floor at the Skyline Mine encountered significant thicknesses of unsaturated bedrock (Mayo and Associates, 1996). The presence of unsaturated zones in the deep system is not consistent with a condition of continuous hydraulic saturation/connectivity with overlying or underlying groundwater systems (Mayo and Associates, 1996). This condition is likely the result of limited groundwater recharge potential and the limited potential for groundwater migration in the lenticular rock bodies of the Blackhawk Formation and unfractured Star Point Sandstone. Because of these circumstances (discontinuous saturation), it is not possible to create meaningful potentiometric surface contour maps of such disconnected inactive-zone groundwater systems adjacent to coal mining areas. However, water level responses in Star Point Sandstone monitoring wells in the Flat Canyon area have been observed over an area of several square miles in the Flat Canyon Tract and existing Skyline Mine area that appear to be related to the local depressurization of the Star Point Sandstone from fault-related groundwater inflows into the Skyline Mine.

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The lack of vertical communication between vertically juxtaposed inactive-zone groundwater systems in the study area is demonstrated by the hydrographs of wells 79-35-1A and 79-35-1B, a nested monitoring well pair in Burnout Canyon (Figure 9). Well 79-35-1B is completed in the Blackhawk Formation above the mined coal seams. Well 79-35-1A is completed in the Star Point Sandstone below the currently mined coal seams. In response to the substantial (several thousand gpm) groundwater inflows into the Skyline Mine that have occurred, the potentiometric level in 79-35-1A has experienced a marked decline (such as would be anticipated under such hydrogeologic conditions). In contrast, the potentiometric level in 79-35-1B, which is isolated from the underlying Star Point Sandstone by low-permeability rocks of the Blackhawk Formation, has remained remarkably stable during this same period. (The one-time drop in the water level at W79-35-1B corresponds with the passage of the longwall face within a few hundred feet of the well's location during mining of the 11L longwall panel in December 2002 and January 2003. This likely represents a local adjustment within the Blackhawk Formation groundwater system above the coal seam near the physical well location (i.e. response to subsidence) and is not related to the more regional water level response of groundwaters in the Star point Sandstone). What this means is that the Blackhawk Formation in the vicinity of 79-35-1A and -1B is not being dewatered as a result of mine-related dewatering/depressurization of the Star Point Sandstone.

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The conclusion that mine-related dewatering/depressurization of the Star Point Sandstone is not dewatering overlying formations is also supported by the fact that springs in the vicinity of the major 10-Left inflow have not experienced discharge declines since the time of the initial inflow.

Discharge rates from several Blackhawk Formation springs near the 10-Left inflow area (see data for springs 2-413, S35-8, and S34-12 in UDOGM, 2014) have not been impacted by the Star Point Sandstone dewatering/depressurization in the 10-Left area. Similarly, discharge rates in the James Canyon surface stream that directly overlies the 10-Left mining area (see data for F-9 and F-10 in UDOGM, 2014) has not be impacted in any measurable or perceptible way subsequent to the interception of large quantities of Star Point Sandstone groundwater directly beneath that surface-water drainage.

It is apparent from Table 3 that groundwater discharging from springs in the Flat Canyon area is uniformly low in TDS (the average TDS for all springs is less than 250 mg/L). Springs discharging from the Price River Formation generally have the highest concentrations of dissolved salts (average of 223 mg/L). The higher TDS concentrations in the Price River Springs are attributable to the presence of soluble minerals in the shaley sequences within the Price River Formation. The lowest TDS concentrations occur in the Castlegate Sandstone springs (Table 3). Because the fluvial sandstones of the Castlegate Sandstone generally have lower concentrations of soluble minerals than do geologic formations from other depositional environments, the potential for increased solute concentrations as groundwaters flow through the Castlegate Sandstone is lower. The low TDS of groundwater in the Castlegate Sandstone suggests that the Castlegate Sandstone groundwaters have not interacted with the rocks of the overlying Price River Formation. What this means is that vertical recharge through the Price River Formation to the Castlegate Sandstone and deeper geologic strata is likely not occurring to any appreciable extent.

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A determination of the mechanisms and directions of groundwater flow and groundwater gradients in the heterogeneous hydrogeologic framework of the Skyline Mine and Flat Canyon area is often not straightforward. Groundwater flow in the Blackhawk Formation is constrained largely by the geometry of permeable strata and stratigraphic dips. Most notably, groundwater flow mostly occurs within sandstone paleochannels which are commonly sinuous in their spatial extent and discontinuous laterally. Areas of unsaturated bedrock have been identified in the deep Blackhawk Formation groundwater system both above and below the mined coal seams.

The U.S.D.A. Forest Service (2002) suggests that the mechanics of the Star Point Sandstone groundwater systems are not well understood. Within the Star Point Sandstone, groundwater flow occurs primarily where the sandstone bedrock is significantly fractured or faulted. In areas of unfractured Star Point Sandstone, discharge from the bedrock as springs is rare, and major springs are only associated with fault systems (Bills, 2000). The geometries of permeable units in the Star Point are commonly discontinuous and lenticular (although typically at a larger scale than in the overlying Blackhawk Formation) with interbedded tongues of low permeability shaley strata being present in the formation. Regional faulting has resulted in the creation of discontinuous blocks of permeable bedrock being juxtaposed with blocks of low permeability strata. Geologic structures such as faulting and folding influence stratal dips which can influence groundwater flow in bedded sedimentary rocks. Additionally, calculating groundwater flow directions and gradients using data from dispersed monitoring wells in stratified groundwater systems, particularly with large vertical gradients, can prove problematic (i.e. where the monitoring wells are not all screened in the same continuous hydyrostratigraphic unit).

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Faults can be conduits through which groundwater can migrate. In some cases, the fault plane and any associated damaged zones can facilitate the movement of water along these structures. Groundwater flow may also occur along damaged zones associated with significant faulting. In other instances, particularly where faults intersect clay-rich strata, the potential for groundwater movement through the fault and its associated fault gouge is low. Where displacement along a fault juxtaposes low-permeability strata with higher permeability units, the fault can be a barrier to lateral groundwater flow. The U.S.D.A. Forest Service (2002) states that mining experience in the Wasatch Plateau suggests that large-offset faults are generally barriers to lateral flow across a fault due to the presence of low-permeability fault gouge.

It has been the experience at the Skyline Mine that in some locations where faults are encountered in the underground mine workings, the fault surfaces are dry. In other locations, similar faults will discharge appreciable amounts of groundwater when intercepted by the advancing mine workings (personal communication Gregg Galecki, 2016). Because of such variability in the water-transmitting potential of faults, there appears to be limited reliable predictive value in drilling into discrete fault plane segments to define the hydrologic characteristics of the larger fault zone.

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It is anticipated that because of the presence of low-permeability units (shales, claystones, and mudstones) interbedded vertically with the more permeable sandstone units, horizontal groundwater flow dominates in such stratified bedrock with vertical flow across the low permeability units being minimal. This conclusion is supported by rock testing performed on drilling cores of shales from the Blackhawk Formation. Laboratory testing of cores from the

Blackhawk Formation by the United States Geological Survey indicate low permeability for shales and siltstones from the Blackhawk Formation (UDOGM 2013). Permeability testing on a shale sample from the Blackhawk Formation indicated the shale was impermeable to water (in both vertical and horizontal directions) even at pressures of 5,000 pounds per square inch. Measured permeability for other shales and siltstones in the Blackhawk Formation were also very low.

Mayo and Associates (1996) did not attempt to use monitoring well data to construct a piezometric surface map because they found that the deep groundwater systems are discontinuous and, thus, water surface correlations between wells is not meaningful.
The U.S.D.A Forest Service suggested that, although the mechanics of the Star Point Sandstone groundwater systems are not well understood, that groundwater flow directions in the Flat Canyon area follow the direction of the bedrock dip (to the west).
In conjunction with the construction of their numerical groundwater model of the Skyline Mine and Flat Canyon areas, HCI (2001) projected a hydraulic gradient from south to north. Their analysis was based on a comprehensive analysis of all available data from the mine area.

7.0 Description of Surface Water Systems

Most surface water in the Flat Canyon Tract is tributary to the Upper Huntington Creek drainage, which is part of the San Rafael River drainage. The San Rafael River drains into the Green River approximately 80 miles southeast of the study area. A small portion of the Flat Canyon Tract (~40 acres) flows into the upper Gooseberry Creek drainage, which is part of the Price

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River drainage (Figure 2). However, mining is not currently proposed in this small area within the Gooseberry Drainage.

As shown in Figure 6, in the spring and early summer months, perennial, intermittent, and ephemeral stream drainages in the Flat Canyon Tract area convey large amounts of snowmelt water down the Wasatch Plateau during the annual snowmelt event. As the snowmelt period wanes in the summer months, discharges from the ephemeral and intermittent streams cease and discharges in perennial streams decrease dramatically, commonly to only small fractions of peak snowmelt period discharge rates (Table 2; Figure 6).

Perennial stream reaches have been identified in Boulger, Flat, Swens, Little Swens, and the upper portion of Cunningham Canyons (USFS, 2002). Huntington Creek, which is located immediately east of the Flat Canyon Tract is also a perennial stream.

Baseflow to perennial streams in the Flat Canyon Tract area is through discharge from active-zone groundwater systems (described previously). Thus, the mechanism whereby perennial streams in the Flat Canyon Tract operate is intimately related to the operation of active-zone groundwater systems. Fundamentally, perennial streams exist in the study area where 1) there is sufficient discharge from active-zone groundwater systems to exceed combined downstream losses resulting from evapotranspiration and infiltration, and 2) there is a competent perching layer beneath the stream to prevent the infiltration and downward migration of surface water

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The fact that most streams in the Flat Canyon Tract area are gaining streams over most of their reaches (USFS, 2002) suggests that the perching layers beneath the streams do effectively prevent downward migration of surface waters into the subsurface. This also suggests significant communication between perennial streams and adjacent active-zone groundwater systems. This communication is likely due to the fact that the same perching layers that allow for the operation of the perennial stream also support adjacent perched, active-zone groundwater systems.

In order to document the hydraulic disconnect between perennial streams and active-zone groundwater systems in the Skyline Mine area, a major, multi-year hydrologic investigation of the Burnout Canyon drainage was commenced by Canyon Fuel Company in 1991. Burnout Canyon is a tributary to Huntington Creek. The mouth of Burnout Canyon is located about 0.6 miles east of the Flat Canyon Tract (Figure 1). As part of this investigation, frequent discharge measurements were performed during the accessible period of the year in several locations in the Burnout Creek drainage. Concurrent with the extensive monitoring program, multiple-seam longwall undermining of the drainage has occurred. It is apparent that discharge rates in Burnout Creek respond rapidly to both seasonal and climatic variations. This observation is consistent with the finding that the perennial stream is sustained by active-zone groundwater discharge in the drainage basin. However, no perceptible or quantifiable diminutions in peak flow or baseflow discharge rates are apparent. The fact that discharge rates in the stream (and the active-zone groundwater systems that sustain them) were not impacted by multiple-seam longwall mining supports the conclusion that the inactive-zone groundwater systems encountered in the mine workings beneath Burnout Canyon are hydraulically isolated from the stream channel in

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Burnout Canyon (i.e., the impermeable perching layers separating the two hydrologic regimes effectively isolates these two systems).

Also as part of the Burnout Canyon study, topographic gradients of the stream channel thalweg were surveyed regularly, and stream characteristics were inventoried before and after longwall mining to determine the effects of subsidence of the stream drainage. It was the conclusion of these investigations that with the possible exception of an increase in the pool/riffle ratio in the drainage, no significant changes to the stream channel morphology occurred as a result of undermining of the stream (Sidel. 2000). Given the close proximity of Burnout Canyon to the Flat Canyon Tract and the overall similar conditions in the two areas, it is anticipated that the hydrologic response to mining in the Flat Canyon Tract will likely be generally similar to that which was observed in Burnout Canyon.

The solute compositions of surface waters in the Flat Canyon Tract area are similar to the compositions of springs in the area that discharge from active zone groundwater systems. These surface waters are of the calcium-bicarbonate chemical type with average TDS concentrations ranging from 137 to 198 mg/l. This chemical composition is consistent with the dissolution of carbonate minerals in the presence of CO_2 gas. The fact that the stream compositions are essentially the same as those for active-zone springs is expected, because stream discharge in the streams is derived primarily from active-zone groundwater discharge.

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Inspection of concentrations of important water quality parameters in stream discharge waters in the Flat Canyon Tract area (Table 2) indicate no elevated concentrations of any of these constituents.

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ination of Probable Hydrologic Consequences of Coal Mining in the Flat net.

Quality and quantity of surface water and groundwater under seasonal flow

antity of water quality and water quantity baseline data has been collected from the Tract and adjacent area over a period of more than 5 years. The baseline hydrologic been collected from groundwaters and surface waters in the Flat Canyon Tract and is adequate to determine potential future impacts resulting from the proposed coal reclamation activities in the Flat Canyon Tract.

and surface waters in the Flat Canyon Tract area are generally of the low TDS bonate chemical type (Table 2). Lesser amounts of magnesium and sulfate are also erage TDS concentrations of spring waters sampled during baseline monitoring approximately 72 to 272 mg/L. Stream waters sampled during baseline monitoring TDS concentrations ranging from 157 to 198 mg/L. Average pH values for springs in the Flat Canyon Tract area range from about 7.1 to 8.5.

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Baseline hydrologic information

and seep surveys were conducted at the Flat Canyon Tract during low-flow conditions in of 1997 and during high-flow conditions in the springtime of 1998. As part of the spring

and seep surveys, groundwater and surface-water discharge rates and field water quality parameters, including water temperature, pH, specific conductivity, were measured. The results of the 1997 and 1998 Mayo and Associates Spring and Seep surveys (including a map showing spring and seep locations and tables listing the discharge and field water quality parameters measured during high flow and low flow conditions as well as the geographical coordinates and uses of water at each spring and seep) are included in Appendix A-1 of the Skyline Mine MRP.

Baseline monitoring of selected springs and streams in the Flat Canyon Tract and surrounding area continued during both high-flow and low-flow conditions in 1998, 1999 and 2000. From 2006 through 2014, additional monitoring of stream and spring discharge rates and field water quality parameters were monitored in the Flat Canyon area. Operational monitoring of selected baseline monitoring sites has continued as part of the Skyline Mine hydrologic monitoring plan to the present (UDOGM, 2014). The results of baseline monitoring at the Flat Canyon Tract area are listed in Table 2.

728.310 Whether adverse impacts may occur to the hydrologic balance

The hydrologic balance is the sum of the flow interactions between surface waters and groundwaters and between various groundwater flow systems. Coal mining in the Flat Canyon Tract will likely not result in significant adverse impacts to the hydrologic balance.

Mine workings in the Flat Canyon Tract will likely intercept perched, inactive-zone groundwater systems in sandstone channels in the mine roof. As has been the case historically in the Skyline

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8.0 Determination of Probable Hydrologic Consequences of Coal Mining in the Flat Canyon Tract.

728.100 Quality and quantity of surface water and groundwater under seasonal flow conditions

A large quantity of water quality and water quantity baseline data has been collected from the Flat Canyon Tract and adjacent area over a period of more than 5 years. The baseline hydrologic data that has been collected from groundwaters and surface waters in the Flat Canyon Tract and adjacent area is adequate to determine potential future impacts resulting from the proposed coal mining and reclamation activities in the Flat Canyon Tract.

Groundwaters and surface waters in the Flat Canyon Tract area are generally of the low TDS calcium-bicarbonate chemical type (Table 2). Lesser amounts of magnesium and sulfate are also present. Average TDS concentrations of spring waters sampled during baseline monitoring range from approximately 72 to 272 mg/L. Stream waters sampled during baseline monitoring have average TDS concentrations ranging from 157 to 198 mg/L. Average pH values for springs and streams in the Flat Canyon Tract area range from about 7.1 to 8.5.

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728.200 Baseline hydrologic information

Spring and seep surveys were conducted at the Flat Canyon Tract during low-flow conditions in the fall of 1997 and during high-flow conditions in the springtime of 1998. As part of the spring

and seep surveys, groundwater and surface-water discharge rates and field water quality parameters, including water temperature, pH, specific conductivity, were measured. The results of the 1997 and 1998 Mayo and Associates Spring and Seep surveys (including a map showing spring and seep locations and tables listing the discharge and field water quality parameters measured during high flow and low flow conditions as well as the geographical coordinates and uses of water at each spring and seep) are included in Appendix A-1 of the Skyline Mine MRP.

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Mine, these inflows will likely be short lived and of magnitudes similar to those encountered previously. Mining operations will dewater these perched groundwater systems. However, because these systems are not in hydraulic communication with the ground surface or shallow overlying active-zone groundwater systems, dewatering of the deep perched systems will likely have no impact on overlying groundwater or surface water resources. This conclusion is supported by the fact that in the previous 30+ years of coal mining at the Skyline Mine, no appreciable impacts to groundwater or surface-water discharge rates in the Skyline Mine permit or adjacent areas have been identified.

There is the likelihood that as mine working progress westward (down-dip) large fault-related groundwater inflows could occur where mine openings intersect faults or fracture systems. This conclusion is based on 1) the general hydrogeologic similarities between the Flat Canyon Tract and the adjacent the southwestern portion of the Skyline Mine permit area, and 2) the history of encountering large fault-related groundwater inflows in the southwest portion of the Skyline Mine. As has been the case with previously encountered fault-related inflows in the Skyline Mine, the water discharging from these fault systems will likely emanate from water-bearing horizons below the coal seam, likely from the tongues of the Star Point Sandstone.

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As indicated previously, no perceptible or quantifiable impacts to discharge rates in the shallow groundwater systems that support springs or provide baseflow to streams have been noted during historic mining operations the Skyline Mine – even in areas where large inflows of groundwater from the Star Point Sandstone have been encountered. Long-term baseline monitoring data from springs and streams in the Flat Canyon area (1997-2014), collected prior to and subsequent to the

encountering of the large Star Point Sandstone groundwater inflows in the nearby Skyline Mine, do not show any perceptible or quantifiable impacts to overlying spring or surface-water discharge rates in response to this occurrence. A similar lack of impacts to groundwater or surface-water systems in the vicinity of the Flat Canyon Tract would be anticipated as a consequence of future coal mining activities in the Flat Canyon area.

As discussed previously, inactive-zone groundwater systems in the Star Point Sandstone occur in isolated partitions. However, the sizes of the Star Point Sandstone partitions are generally larger than are the partitions in the overlying Blackhawk Formation. In most instances, these partitions are not in hydraulic communication with the land surface or shallow overlying active-zone groundwater systems that support springs and seeps and provide baseflow to streams, or with adjacent groundwater partitions in the Star Point. (As noted above, the Star Point Sandstone groundwater inflow encountered in the 10-Left area at the Skyline Mine may have contained a low level of tritium (~1 TU) but the water had a radiocarbon mean residence time of greater than 6,000 years, indicating that the great majority of the intercepted water was ancient water derived from the Star Point Sandstone).

The lack of impacts to groundwater or surface-water discharge rates at springs or streams overlying in-mine Star Point Sandstone groundwater inflow areas indicates that there is not strong hydraulic communication between the Star Point and overlying active-zone groundwater systems. Rather, the observed water level responses in distant surrounding Star Point Sandstone wells to the interception of the Star Point Sandstone groundwaters in the mine suggests that the intercepted water is being taken out of storage from the Star point Sandstone. Accordingly, it is

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unlikely that springs, seeps, or perennial streams in the Flat Canyon area would be impacted as a result of intercepting deep Star point Sandstone groundwaters during the proposed coal mining activities in the Flat Canyon Tract.

At any coal mine, subsidence-related interruption and deformation of strata above longwall-mined areas has the potential to alter the pre-mining groundwater flow conditions. The potential for this impact to affect groundwater and surface-water resources in the Flat Canyon Tract is low. Subsidence of the land surface overlying coal mining areas is a commonly observed phenomenon in the Utah coal mining environment. Surface subsidence can occur where the rock strata overlying mined-out areas sags into the voids left by the extraction of the coal. The United States Mine Safety and Health Administration (MSHA 2009) describes zones of disturbance of geologic strata over mine workings. These zones include:

- Floor heave – Upward thrust of the floor in the mine working area.
- Caved zone – Caving of the overburden directly over a mine void and bulking of the caved material leading to support of overlying strata generally extending to a height of 3 to 10 times the extraction thickness. Assuming an extraction thickness of 10 feet. the caved zone would extend from 30 to 100 feet above the mining interval.
- Fractured zone – A zone of vertical fracturing and bed separations. Overburden in this zone moves vertically in large blocks along existing joints and new vertical fractures. Typically this zone extends no more than 24 times the extraction thickness above the mine, but can reach 30 times the extraction thickness. Assuming an extraction thickness of 10 feet, the Fractured zone would be anticipated to extend no more than 240 feet above

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the mine, possibly reaching 300 feet above the mine level.

- Main roof – This zone, which is sometimes subdivided into the Dilated Zone and the Constrained Zone, is an area of no significant increase in vertical hydraulic conductivity. This zone has been characterized as extending above the Fractured Zone up to 60 times the extraction thickness. Assuming a coal extraction thickness of 10 feet, the Main roof zone would extend for 600 feet above the mine level.

- Surface zone – Surface cracks are typically present in this zone and are generally limited to areas placed in tension by subsidence. Cracks can be created in dry clayey soil and joints can open in massive sandstones. Such cracks can extend downward to a depth of 50 feet.

Similarly, in order to estimate the height overlying mining areas to which subsidence-induced fracturing may extend, and to project minimum overburden thickness required to protect hydrologic resources, the Society for Mining, Metallurgy, and Exploration (SME, 2011) has developed empirical relationships between the thickness of the extracted coal seam and the upward fracture propagation distances (see SME Chapter 10.6, "Mine Subsidence"). Utilizing these relationships, the Mining Engineers Handbook recommends that a minimum vertical distance between the mine and an overlying water body with the potential for causing catastrophic damage should be a minimum of 60 times the coal mining height. The same minimum vertical separation distance is recommended for protection of aquifers overlying total extraction mining areas. Based on these considerations, it is considered unlikely that impacts to groundwater aquifers, springs, seeps and streams will occur as a result of upwardly propagating fracturing in areas where the overburden exceeds 600 feet. Because mining in the Flat Canyon

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Tract will occur in areas where the overburden exceeds 1,000 feet, subsidence-related impacts to shallow groundwater systems that support springs and provide baseflow to streams are not anticipated. The presence of a thick zone of unfractured, low-permeability bedrock prevents the downward migration of active-zone groundwaters into the deeper subsurface. Sealing of subsidence cracks by clays in the Blackhawk Formation is expected to minimize long-term effects of subsidence on the hydrologic systems (UDOGM, 2013).

Where tension cracks at the surface do form, they can temporarily divert shallow, active-zone groundwaters and cause minor changes to groundwater discharge locations. Spring discharge locations could be moved a short distance down-gradient as a result of groundwater flow path alterations. It has been the experience at the Skyline Mine that tension cracks that form at the surface (on hillsides and ridge lines) are rapidly filled with sediment over time. The impacts to groundwater systems that could potentially result from tension cracking at the surface are considered minimal.

In a similar fashion, tension cracking of the substrate of a perennial stream has the potential to divert surface waters. The potential for loss of surface waters to deeper groundwater systems through downward migration of water through subsidence fractures in the Flat Canyon Tract area is considered low. This is because 1) overburden thicknesses are appreciable (>1,000 feet), and 2) as discussed previously, the perching layers underlying perennial streams would likely not be compromised as a result of tension fracturing. This is considered likely for two reasons. First, the hydraulic conductivites of underlying bedrock formations are low and permeable horizons are lenticular and discontinuous. Thus, the underlying bedrock is likely not capable of accepting

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appreciable quantities of stream leakage, and rejected recharge occurs. Second, the presence of swelling clays in the bedrock formations in the Flat Canyon Tract area causes the natural healing of tension cracks in fine-grained bedrock lithologies. Surface cracks in stream substrates that occur in more brittle sandstones would likely be filled with sediment transported by the stream. Because active-zone groundwater systems will likely not be impacted by subsidence fracturing, the potential for diminution of baseflow in perennial streams is considered low. Thus, the overall potential for detrimental effects resulting from subsidence fracturing beneath perennial streams in the Flat Canyon Tract area is believed to be minimal. Most importantly, these conclusions are supported by the fact that during the more than 30-year history of mining in the Skyline Mine area, no substantial or long-term impacts to stream drainages in mined areas have been noted. The experience of multiple seam longwall extraction in the Burnout Canyon area, discussed previously, suggests the likelihood that longwall mining in the Flat Canyon Tract will, similarly, not result in detrimental impacts to springs or perennial streams. The operation of active-zone and inactive-zone groundwater regimes in the Flat Canyon Tract is believed to be generally similar to that in the existing Skyline Mine permit area. The similarity of the groundwater regimes and groundwater – surface-water interactions in the Flat Canyon and existing Skyline Mine permit areas suggests the likelihood that the experience of undermining surface-water drainages in the Flat Canyon area will be similar to the previous experience in Burnout Canyon (i.e., likely no significant impacts).

The deep, inactive-zone groundwater systems historically intercepted in the Skyline Mine underground workings are not in good hydraulic communication with overlying shallow active-zone groundwater systems. This is evidenced by the old radiocarbon ages and general lack of

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tritium in the intercepted deep groundwaters and the modern radiocarbon ages and abundant tritium concentrations of overlying shallow groundwaters. This condition results primarily as a consequence of the lenticular, interbedded, and discontinuous character of the sandstones and encasing low-permeability shales, claystones and mudstones of Blackhawk Formation. These stratigraphic characteristics result in a poor potential for vertical migration of fluids through the Blackhawk Formation rocks. For the same reasons, the potential for horizontal migration of groundwater through the Blackhawk Formation over large distances is also limited. These conclusions are consistent with the experience at surrounding coal mines in the Wasatch Plateau and Book Cliffs coal fields of Utah as described by Mayo et al (2003).

Electric Lake, a water storage reservoir constructed in 1974, is situated about one-half mile or more east of the Flat Canyon Tract (Figure 1). In the regions adjacent to the Flat Canyon Tract (including a 1-mile buffer zone around the tract) the floor of Electric Lake is situated on the Blackhawk Formation. A layer of clayey mud is also observed to be present on the immediate lake bottom and shores. The nearest proposed Flat Canyon Tract underground workings are located more than 1.5 miles northwest of locations near the dam where Star Point Sandstone bedrock is mapped beneath the reservoir. As described above, the deep, inactive-zone groundwater systems typically intercepted in the Skyline Mine underground workings are not believed to be in good hydraulic communication with overlying shallow groundwater systems. For these reasons, it is anticipated that mining in the Flat Canyon Tract will not appreciably impact shallow groundwater systems that may be present that are associated with the presence of the Electric Lake surface water body (i.e. it is considered unlikely that shallow groundwater systems near Electric Lake will be in good hydraulic communication with the deep, inactive-zone groundwaters that are anticipated to be intercepted in the proposed underground Skyline

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Mine workings in the Flat Canyon Tract. Further, it is considered unlikely that the Electric Lake water surface would provide a constant head source for the deep inactive-zone groundwater systems in the Flat Canyon area).

728.320 Whether acid-forming or toxic-forming materials are present that could result in the contamination of surface water or groundwater supplies

Acid- and toxic-forming materials in soil and rock disturbed by mining have the potential to impact groundwater and surface water quality. Mine discharge water and groundwater from monitoring wells at the waste rock piles at the current Skyline Mine are monitored for indicators of increased acidity (iron and manganese, pH) and toxic materials. Although the concentrations of iron in mine discharge water are occasionally elevated relative to springs in the region, mine discharge waters rarely exceed permitted discharge limits.

No new topsoil or waste rock piles are planned as a consequence of mining in the Flat Canyon Tract and no impact from acid- or toxic-forming materials is anticipated.

With the exception of pyrite, acid- or toxic-forming materials are not believed to be present in the Flat Canyon Tract area. Iron pyrite and other iron sulfide minerals are common in western coal mines. The oxidation of pyrite, when exposed to water and air, releases H^+ ions (acid) into the mine water. The acid produced from pyrite oxidation temporarily lowers the pH of the water. However, the acid produced from pyrite oxidation is rapidly consumed by reactions with the carbonate minerals which are pervasive in the rocks associated with the coal fields of the western United States. Thus, acid mine drainage in mine discharge water does not usually occur. The

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iron released into the water from pyrite oxidation is readily precipitated as iron-hydroxide when it contacts oxygenated water. This is because waters flowing in a well-aerated surface stream with near-neutral pH will generally not contain more than a few micrograms per liter of dissolved iron (Hem, 1985). Thus, the potential for acid-forming or toxic-forming materials to result in contamination of surface-water or groundwater supplies is low.

728.331 What impact the proposed coal mining and reclamation operation will have on sediment yield from the disturbed areas

The sediment load of streams can be impacted by increased sediment yield from disturbed areas and from land that has undergone subsidence. Canyon Fuel Company has implemented a rigorous sediment control program that is designed to minimize the sediment yield from disturbed areas. This includes the use of sediment control fences, re-vegetation of previously disturbed areas, and the diversion of surface waters around disturbed areas. Runoff from disturbed areas is collected near its source and diverted into sediment control ponds for retention and settlement of suspended solids before it is discharged to natural drainages. Because the Flat Canyon Tract will be accessed through the existing Skyline Mine in Eccles Canyon, the potential for additional impacts resulting from coal mining in the Flat Canyon Tract is minimal.

Where differential subsidence of the land surface occurs in stream drainages, there is the potential for the temporary increase of sediment yield in these drainages. This potential impact is primarily the result of subsidence induced gradient changes along areas of differential

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subsidence. However, this effect is generally expected to be short lived. This is because the channel substrate in areas of increased stream gradients is down-cut while sediment is being deposited in areas of decreased stream gradients and the stream gradually returns to equilibrium with its channel substrate.

728.332 What impact the proposed coal mining and reclamation operation will have on acidity, total suspended and dissolved solids and other important water quality parameters of local impact

As discussed previously, impacts to the active-zone groundwater systems that support springs and seeps and provide baseflow to streams in the Flat Canyon Tract area are not anticipated. Thus, detrimental impacts to important water quality parameters such as acidity, total suspended solids, and total dissolved solids in creeks and springs in the Flat Canyon Tract area are considered unlikely. This conclusion is supported by the fact that during the 30+ years of coal mining activity at the Skyline Mine, significant impacts to important water quality parameters in springs or streams overlying mined areas have not been observed.

Fuels, greases, and oils are used in the Skyline Mine permit area. There is the potential for spillage of these substances during equipment maintenance and operations, during filling of storage tanks and vehicle tanks and from leakage from potentially leaking storage tanks. However, because the Flat Canyon Tract will be accessed through the existing Skyline Mine (i.e. no new surface facilities), the potential for releases of these materials in the Flat Canyon Tract is considered minimal.

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The discharge of mine water to surface water drainages will have an impact on the water quality of the receiving water. Historically, with few exceptions, the mine discharge water has been of good quality and has met all of the beneficial use standards of the receiving water. It is anticipated that the water quality of groundwaters encountered underground in mine workings in the Flat Canyon Tract will be similar to that encountered in the existing Skyline Mine permit area. Therefore, the potential for significant detrimental impacts on receiving waters is low. This impact will be regulated under a UPDES permit issued from the Utah Division of Water Quality. There is the potential for increases in total suspended solids concentrations in the mine receiving water (Eccles Creek) if mine water discharge rate were to stabilize at or above the 15,000 gpm range (USFS, 2002). This condition could result from potential increased erosion and sediment transport in the stream channel in Eccles Creek under high flow conditions.

728.333 What impact the proposed coal mining and reclamation operation will have on flooding or streamflow alteration

It is anticipated that discharge rates from the Skyline Mine during mining in the Flat Canyon Tract will likely be of similar or perhaps somewhat greater magnitude than that currently discharging from the mine (possibly in the range of 15,000 gpm; USFS, 2002). Thus, no significant increase to the flooding or streamflow alteration potential of mine water discharge receiving waters is anticipated above that currently occurring. In the event that mine water discharge from the Skyline Mine during mining in the Flat Canyon Tract significantly exceed current levels, the potential for streamflow alteration in receiving waters will increase.

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During 2013, the mine water discharge rate from the Skyline Mine (MD-1) averaged 2,473 gpm, or about 5.5 cfs (UDOGM, 2014). During the early 2000s, when the mine discharge rate to Eccles Creek was about 22 cfs, an assessment of the stability of the stream channel in Eccles Creek after 10 weeks of mine discharge at approximately 22 cfs revealed few obvious changes in channel conditions (USFS, 2002). Based on theoretical calculations, sediment transport in Eccles Creek should begin at approximately 35 cfs (15,700 gpm). Thus, at a mine discharge rate of approximately 15,000 gpm, the receiving water (Eccles Creek) could be subject to flows capable of transporting sediment approximately 50% of the year and perhaps year-long. This could result in channel adjustments such as stream bank erosion, undercutting of valley side-slopes and sloughing, channel widening, and some headcutting (USFS, 2002).

A continuous discharge of 15,000 gpm would constitute a substantial contribution to the storage in Scofield Reservoir. During dry years, this additional recharge to the reservoir would likely be considered a benefit by water users. During extremely wet years, the addition of approximately 35 cfs to Scofield Reservoir would be small relative to the 6,200 cfs capacity of the Scofield Reservoir spillway. If downstream water courses were near flood stage, the addition of mine water would increase, although, based on the fact that the Price River has at times discharged in excess of 2,000 cfs, this additional discharge would constitute only a relatively minor impact.

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728.334 What impact the proposed coal mining and reclamation operation will have on groundwater and surface-water availability

As discussed previously, impacts to discharge rates from shallow, active-zone groundwaters that feed springs and provide baseflow discharge to streams in the region are not anticipated. Additionally, impacts to high-flow discharges in streams that are a result of seasonal snowmelt events and/or torrential precipitation runoff events are not anticipated. Therefore, the availability of these groundwaters and surface waters should not be impacted by the proposed mining activities in the Flat Canyon Tract.

Since 2004, Skyline Mine has monitored five locations in the Star Point Sandstone to determine whether the interception of Star Point Sandstone groundwaters in the mine has influenced regional discharge from the Star Point Sandstone. These stations include two stream monitoring locations in the Mud Creek drainage, VC-11 (Boardinghouse Creek) and VC-12 (Finn's Creek), and two creek monitoring stations in Huntington Canyon below Electric Lake, CS-22 (Valentines Creek), and CS-23 (Hughes Creek). Each of these creeks flows over Star Point Sandstone surface exposures. Monitoring is also performed at site S24-1 (sulfur spring in Huntington Canyon below Electric Lake). Discharge hydrographs for these five monitoring stations are presented in Figures 10 and 11. In Figure 10, all discharge data for the five monitoring sites are plotted. In Figure 11, only the baseflow discharge data are plotted. It is apparent in Figure 10 that discharge rates at all of the monitoring sites show seasonal variability in discharge. Additionally, responses to the prevailing climatic conditions (droughts and wet spells) are apparent in both Figures 10 and 11. There are no indications of any diminution of

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discharge at these monitoring locations that would indicate a loss of groundwater discharge from the Star Point Sandstone.

Current mining operations have made available several thousands of gallons per minute of mine discharge water that has previously been unavailable for use. It is anticipated that as mining progresses in the Flat Canyon Tract, additional groundwater inflows into the mine workings will occur and discharge of significant quantities of water to the surface will likely occur. It should be noted that historically, when inactive-zone mine water inflows from all sources have been encountered, the inflow rates have generally declined appreciably over time relative to the initial inflow rates when the water sources were first intercepted. Similarly, it would be anticipated that groundwater inflows that may be encountered during mining in the Flat Canyon Tract would likely decline over time. This is primarily because the intercepted inactive-zone groundwater is being removed from storage. Active recharge in appreciable quantities to these inactive-zone groundwater systems generally does not occur. Consequently, it should not be assumed that the groundwater discharging from the mine would necessarily be a long-term source of water.

It is anticipated that the Star Point Sandstone groundwater partition located beneath the Flat Canyon Tract will likely be depressurized as a result of mining operations if major fault-related groundwater inflows occur. However, there are no known uses of deep Star Point Sandstone groundwater in the vicinity of the Flat Canyon Tract.

Three important culinary supply springs exist in the Star Point Sandstone in lower Huntington Canyon more than 20 miles from the Flat Canyon Tract. These include Little Bear Spring, Big

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Bear Spring, and Birch Spring. For several reasons, the potential for detrimental impacts to these springs as a result of mining in the Flat Canyon Tract is considered remote. Mayo and Associates (2001) determined that Little Bear Spring is recharged primarily from surface water and alluvial groundwater losses in Mill Fork Canyon adjacent to the spring. The Gooseberry Fault System, which has been surmised as the location for groundwater discharge from the Panther Tongue (NorWest, 2001), is not structurally connected to fault systems from which Big Bear and Birch Springs discharge.

Source of the Star Point Sandstone In-Mine Inflow groundwater

Several lines of evidence provide valuable insight into the likely source(s) of the Star Point Sandstone groundwater inflows that have been encountered in the southwestern portion of the Skyline Mine since 1999. These are discussed below.

Stable and Unstable Isotopic Analysis

Tritium, carbon-14, deuterium, and oxygen-18 analyses were performed on in-mine Star Point Sandstone inflow groundwaters in the southwest portion of the Skyline Mine when the underground monitoring sites were accessible. By the end of September 2002, the 10-Left inflow area became flooded and samples of that groundwater could no longer be collected. By March 2003, the remainder of the region surrounding the 10-Left inflow area became mostly inaccessible and thus isotopic samples could no longer be collected from the area.

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After the southwest Skyline Mine area became inaccessible due to the flooding of the underground mine workings in that area, monitoring of the Star Point Sandstone groundwater was accomplished by sampling JC-1. As noted above, JC-1 is a pumping well that is screened in a fracture system that is near the 10-Left inflow area but it does not penetrate the underground mine workings. JC-3 is a water production well that is completed within the flooded underground mining voids very near the 10-Left inflow area. CS-14 is the monitoring point for the groundwater that is pumped from the southwest portion of the Skyline Mine to the mine surface facilities area where it is discharged to Eccles Creek.

During the 2002, groundwater samples were collected from JC-1 and also from the 10-Left inflow source area underground. The tritium and carbon-14 isotopic results from JC-1 and from the 10-Left sump during 2002 were generally similar. To assist in determining whether the groundwater pumped from JC-1 is representative of the groundwater that flows into the Skyline Mine, samples of groundwater from JC-3 and CS-14 were collected for tritium analysis. The results of these analyses are presented below.

Sample date(s)	JC-3	CS-14	JC-1
11 March 2004	1.78 TU	---	2.74 TU
15, 28 June 2004	1.41 TU	---	2.74 TU
3, 25 May 2005	---	0.92 TU	2.76 TU
18 July, 28 June 2005	---	0.95 TU	2.79 TU
14, 20 October 2005	---	1.00 TU	3.07 TU
27 January, 27 February 2006	---	1.07 TU	2.91 TU

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It is apparent from these data that the tritium concentrations measured at JC-1 were always significantly higher than those measured contemporaneously at JC-3 (the underground mine pool near the 10-Left inflow area), or at CS-14. It is unknown whether pumping-induced changes to the flow dynamics in the fracture system at JC-1 contribute to the higher tritium concentrations measured in JC-1 relative to the directly measured underground water tritium concentrations (i.e. whether pumping-related drawdowns induce flow towards the well from more distant locations).

As part of Skyline Mine's hydrologic monitoring plan, tritium concentrations are measured at JC-1 during the 2nd, 3rd, and 4th quarters of each year when accessible. The monitoring plan also calls for carbon-14, deuterium, and oxygen-18 analysis at JC-1.

Tritium concentrations at JC-1 are plotted in Figure 13. It is apparent that by January of 2004, the tritium concentrations in JC-1 had risen to 2.87 TU. For the seven-year period from 2004 through 2010, the tritium concentration in JC-1 groundwater was essentially unchanged, with an average concentration of 2.92 TU – ranging from a low of 2.74 TU to 3.14 TU. Interestingly, during 2012, tritium concentrations at JC-1 were appreciably lower than in the previous seven years, with a concentration of 2.2 TU measured in September 2012, and a concentration of 1.8 TU measured in October 2012. While the cause of the marked decline in tritium concentrations during 2012 is not fully understood, the lower tritium concentrations could be related to the resting of JC-1 for a 10-month period from July 2011 to May 2012 prior to the September 2012 and October 2012 sampling events.

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Carbon-14 compositions at JC-1 continue to indicate that the mean groundwater residence time of the JC-1 water is old (UDOGM, 2014). Considered together with the tritium concentrations in the well water, a mixed source is indicated in the groundwater in which the fracture in which JC-1 is completed (i.e. there is a component of old water and a component of younger water).

A plot of the deuterium and oxygen-18 compositions of JC-1 groundwater and Electric Lake surface waters is presented in Figure 14. Stable isotopic plots are often used in hydrologic investigations to "fingerprint" waters form different sources (i.e. waters that recharged under different climatic conditions). It is readily apparent from Figure 14 that JC-1 groundwater plot in a different location on the graph than do the surface water samples from Electric Lake. This indicates that the groundwater sampled at JC-1 is not the same as the average of the adjacent lake water. It is noted that the more recent stable isotopic data generally plot somewhat higher on the meteoric water line than do the earlier samples.

Microscopic Particulate Analysis (MPA)

Microscopic Particulate Analysis testing is included in the EPA Consensus Method for Determining Groundwaters Under the Direct Influence (GWUDI) of Surface Water Using Microscopic Particulate Analysis. MPA is one parameter used to determine if a groundwater source is under the direct influence of surface water. The testing procedure is performed using a flow-through filter unit with an in-line flow gauge. To collect the sample for the test, a large volume of water (several hundred gallons) is allowed to pass through the filter at a low flow rate. After a sufficient amount of water has passed through the filter, the filter is removed from the unit, placed in a sealed plastic bag and sent to the laboratory for analysis. At the laboratory, the

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filter is processed chemically and/or mechanically to separate any material trapped by the filter during the flow-through test. The recovered material is then examined under the microscope to ascertain whether particulates are present in the sample that would indicate the water was from a surface-water source. The sample is examined for the presence of "bioindicators" such as plant debris, algae, diatoms, insects, protozoa, rotifers, and other particulates that are characteristic of surface waters. The number and type of bioindicators are tabulated and used to calculate a risk rating score, which indicates the risk of surface water contamination (Analytical Services, Inc., 2006).

MPA testing was performed on groundwater from JC-1 on two occasions. The initial test was performed during January of 2003. The second MPA test was performed during July of 2006. The results of these tests are presented in Appendix A. The MPA risk rating for both samples was "Low", as biological particulates that contribute to the EPA Risk Raging score were not detected in either the 2004 or 2006 test. This information indicates that the water pumped from JC-1 is not under the direct influence of surface water based on the laboratory results. The lack of bioindicators in the MPA samples is not consistent with a conceptual model that includes rapid downward flow of surface water into the fracture in which JC-1 is completed.

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Aquifer Temperature

Petersen Hydrologic (2002) described the implications of groundwater discharge temperatures to groundwater circulation patterns. The average discharge temperatures of the upwelling fault groundwaters sampled within the mine from 1999 to 2003 range from approximately 13.2 to 15.6

°C, while groundwaters discharging from sandstone paleochannels in the mine roof near the fault inflows, such as 11 Left HG E1 XC62 (longwall set-up room) roof drip, which discharges at 8.9 °C, is more than 4 °C cooler. The water in the sandstone channel, with a radiocarbon age of 5,900 years and essentially no tritium and, prior to being intercepted by the mine workings, was not actively flowing, has equilibrated with the temperature of the surrounding rocks in the mine roof. Thus, based on an average geothermal gradient of approximately 23°C per kilometer depth (Written Communication, Dr. David S. Chapman, University of Utah, 2002), upwelling fault groundwater has a circulation depth on the general order of 187 to 291 meters (614 to 955 feet) below the mine workings. These circulation depths are consistent with groundwater residing in the Star Point Sandstone beneath the coal seams. It is difficult to envision a mechanism whereby warm groundwater could migrate downward vertically through horizons of colder rock and colder groundwater above the coal seams and subsequently emerge as warm groundwater in the mine floor.

Chemical Data

Petersen Hydrologic (2002) previously concluded that the solute chemical compositions of Star Point Sandstone groundwaters encountered underground at the Skyline Mine during 2002 were chemically distinct from nearby lake waters. Most notably, the average chloride content of the water in Electric Lake (6.5 mg/l) was nearly four times greater than the average chloride content in the fault-related systems (1.7 mg/l). Chloride is considered a conservative species, meaning that the constituent is not attenuated from a groundwater system, other than by dilution (Fetter,

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1988). In other words, there is no mechanism whereby the chloride in the lake water could be removed were it to flow through a fault system. Although the calcium contents of the in-mine and lake water were similar, the magnesium and bicarbonate content of the waters were dissimilar (Petersen Hydrologic, 2002). The average bicarbonate content of the fault-related groundwater (216 mg/l) was approximately 50% greater than the average lake content (148 mg/l). The average magnesium content of the fault-related groundwater (23.0 mg/l) was more than three times that of the average lake water (7.5 mg/l). Because the Star Point Sandstone inflow areas in the southwest portion of the Skyline Mine are no longer accessible, it is not currently possible to obtain a representative sample for water chemistry analysis.

Groundwater and Surface-Water Monitoring Data

Groundwater has been intercepted during underground mining operations at the Skyline Mine since the mine opened in December 2001. The Skyline Mine has carried out a rigorous hydrologic monitoring program for groundwaters and surface-waters. The results of these monitoring activities are submitted to the Utah Division of Oil, Gas and Mining quarterly (UDOGM, 2014). In the more than 30 years of the mine operation, no significant mining-related impacts to spring or stream discharge rates have been observed. The lack of impact to shallow groundwater systems and/or stream flows strongly suggests that the deep groundwater regime is hydraulically isolated from shallow groundwater and surface-water systems in the mine area.

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Groundwater Storage Reservoir

In investigating potential source areas for the deep Star Point Sandstone groundwater systems at the Skyline Mine, it is instructive to evaluate the groundwater storage capacity of potential sources. Petersen Hydrologic (2002) and HCI (2004) have previously determined that the likely source for the large groundwater inflows encountered in the southwest portion of the Skyline Mine is within the pore spaces of the sandstone members of the Star Point Sandstone.

In order to calculate the storage potential of a hypothetical bedrock reservoir, it is necessary to know the volume of the rock body that comprises the potential reservoir and also the effective porosity of the rock itself. In this evaluation of the potential for groundwater storage in the Star Point Sandstone, we have made the following assumptions:

Aerial extent of Star Point Sandstone: ***6 miles x 6 miles = 36 square miles***

This is a very conservative assumption, as the Star Point Sandstone underlies a very large area surrounding the Skyline Mine (probably several times this value).

Effective porosity of Star Point (average): ***15.5 %***

This is an average value provided by Bills (2000) based on analysis of Star Point bedrock over the Wasatch Plateau

Using these values and converting to cubic feet, it is calculated that an area six miles square and one foot thick can contain approximately 156 million cubic feet of water. Based on monthly average discharge rates, it is calculated that approximately 3.4 billion cubic feet has discharged from CS-14 since 1999. Using these values it is calculated that the entirety of the 3.4 billion total cubic feet of water that has been discharged from the southwest portion of the mine since

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1999 could be stored in a 22-foot thick sandstone unit with an aerial extent of 36 square miles – or in other words, a saturated Star Point Sandstone unit (under unconfined conditions) would be drawn down by 22 feet to release the 3.4 billion cubic feet of water.

Drawdown in Sandstone to release 3.4 billion cubic feet of groundwater: 22 feet

Because the Star Point Sandstone in the Skyline Mine area is more than 1,000 feet thick, a drawdown of 22 feet in the unit constitutes only a small percentage of a the potential Star Point Sandstone storage capacity. This storage volume calculation demonstrates that the large groundwater inflows that have been encountered at the Skyline Mine can easily be sourced from releases from storage in the Star Point Sandstone bedrock in the regions near the mine.

728.350 Whether the underground coal mining and reclamation activities may result in contamination, diminution or interruption of State-appropriated water

As discussed above, impacts to water quantity or water quality of active-zone groundwater systems that support springs and seeps and provide baseflow to perennial streams in the Flat Canyon Tract area are not anticipated. Consequently, the potential for contamination, diminution, or interruption of these groundwater systems is remote. Inactive-zone groundwater systems that will likely be encountered during mining in the Flat Canyon Tract include perched systems associated with sandstone channels in the Blackhawk Formation, and partitioned Star Point Sandstone groundwaters beneath the Flat Canyon Tract. While these groundwater systems will likely be impacted by mining activities, there are no known uses or State appropriations of these waters.

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9.0 Recommended Monitoring Plan

This recommended monitoring plan is based on the determination of probable hydrologic consequences for the Flat Canyon Tract presented previously. This plan is designed to monitor for potential hydrologic impacts to water quantity or water quality resulting from the proposed mining-related activities in the Flat Canyon Tract. The PHC anticipates no detrimental impacts to springs or streams in the Flat Canyon Tract. Consequently, the recommended monitoring plan for springs and streams is designed primarily to provide verification that mining in the Flat Canyon Tract does not cause detrimental impacts to water quality or discharge rates and also to document that the observed fluctuations in spring and stream discharge rates are a function of seasonal and climatic variability. Monitoring of wells in the Star Point Sandstone is included to evaluate the effects of the potential dewatering of the sandstone during coal mining in the tract. There are no surface exposures of the Star Point Sandstone in the Flat Canyon Tract area (Figure 4) and thus no springs or streams associated with the Star Point Sandstone are available for monitoring.

Shallow monitoring wells in the Blackhawk Formation are not recommended as part of the groundwater monitoring plan for the Flat Canyon Tract. As described previously in this report, the shallow, perched groundwater systems that support springs in the Blackhawk Formation are not believed to be well interconnected with surrounding regions or deeper strata. Consequently, monitoring wells placed in the shallow, perched systems would likely not provide any substantial information beyond what would be obtained by simply monitoring the discharge rates at the spring.

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The recommended monitoring plan is summarized in Tables 5, 6, 7, and 8. Recommended monitoring locations are shown on Figure 12.

The monitoring plan may be used to determine whether mining activities in the Flat Canyon Tract cause diminution in surface-water or groundwater discharge rates. Additionally, the data from the monitoring activities specified in this plan may be used to evaluate whether water supplies have been contaminated or otherwise impacted. This may be accomplished by comparing the water quantity and water quality information collected during and after the coal mining in the area is completed. This information may then be compared with baseline information collected prior to mining in the area to ascertain potential impacts to water quality or water quantity. Where significant differences between the historic baseline data and the operational or post-mining data are observed, it is possible that mining impacts have occurred. However, in making such an analysis, other factors that could potentially affect water quality or water quantity must be evaluated. This may be accomplished using statistical analysis or using graphical techniques. One useful technique for evaluating changes in water quality is by the use of Stiff (1951) diagrams. Information on Stiff diagrams is available at the internet site of the Utah Division of Oil, Gas and Mining at http://www.utah.gov. Factors that could influence water quantity or water quality in the Flat Canyon area could include any of the following: Seasonal or climatic variability (i.e. droughts and wet spells), land use practices, agricultural activities, water management practices, or several other factors.

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Table 5 Recommended Monitoring Plan

Streams	*Protocol*	*Comments*
CS-17	B, 1, 2	Little Swens Canyon Creek
CS-27	B, 1, 2	Little Swens Creek above mining area
CS-16	B, 1, 2	Swens Canyon Creek
CS-28	B, 1, 2	Swens Canyon Creek above mining area
CS-30 (C-8)	B, 1, 2	Boulger Creek above reservoir
C-18 (C-4)	B, 1, 2	Boulger Creek above Electric Lake
CS-29 (CS-6)	B, 1, 2	Flat Canyon Creek
CS-10 (C-1)	B, 1	Upper Left Fork Huntington Creek
UPL-10	B, 1	Huntington Creek above Electric Lake
Springs		
4-429	C, 3, 4	Castlegate Sandstone, USFS Flat Canyon Campground water supply
8-253	C, 3	Castlegate Sandstone spring in upper left fork Boulger Canyon
32-277	C, 3, 4	Blackhawk Formation spring in Flat Canyon area
33-268	C, 3,	Castlegate Sandstone spring in Flat Canyon area
28-110	C, 3, 4	Blackhawk Formation spring in lower Swens Canyon
3-290	C, 3	Spring in Cunningham Canyon area (includes surface water from above)

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Table 6 Monitoring protocols for springs, surface waters in the Flat Canyon Tract.

Water level and flow measurements

B Stream: 2nd, 3rd, and 4th quarter discharge measurements when accessible

C Spring: 2nd, 3rd, and 4th quarter discharge measurements when accessible

Water Quality

1 Stream: 2nd, 3rd, and 4th quarter water quality field measurements when accessible

2 Stream: 2nd, 3rd, and 4th quarter water quality operational laboratory measurements when accessible

3 Spring: 2nd, 3rd, and 4th quarter water quality field measurements when accessible

4 Spring: 2nd, 3rd, and 4th quarter water quality operational laboratory measurements when accessible

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Table 7 Recommended groundwater operational water quality parameters.

Field Measurements	Reported as
pH	pH units
Specific Conductivity	µS/cm @ 25°C
Temperature	°C
Laboratory Measurements	
Total Dissolved Solids	mg/L
Carbonate	mg/L
Bicarbonate	mg/L
Calcium (dissolved)	mg/L
Chloride	mg/L
Iron (dissolved)	mg/L
Iron (total)	mg/L
Manganese (dissolved)	mg/L
Potassium (dissolved)	mg/L
Sodium (dissolved)	mg/L
Sulfate	mg/L

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Table 8 Recommended surface water operational water quality parameters.

Field Measurements	Reported as
pH	pH units
Specific Conductivity	µS/cm @ 25°C
Temperature	°C
Dissolved oxygen	mg/L
Laboratory Measurements	
Total Dissolved Solids	mg/L
Total Suspended Solids	mg/L
Carbonate	mg/L
Bicarbonate	mg/L
Calcium (dissolved)	mg/L
Chloride	mg/L
Iron (dissolved)	mg/L
Iron (total)	mg/L
Manganese (dissolved)	mg/L
Manganese (total)	mg/L
Potassium (dissolved)	mg/L
Sodium (dissolved)	mg/L
Sulfate	mg/L

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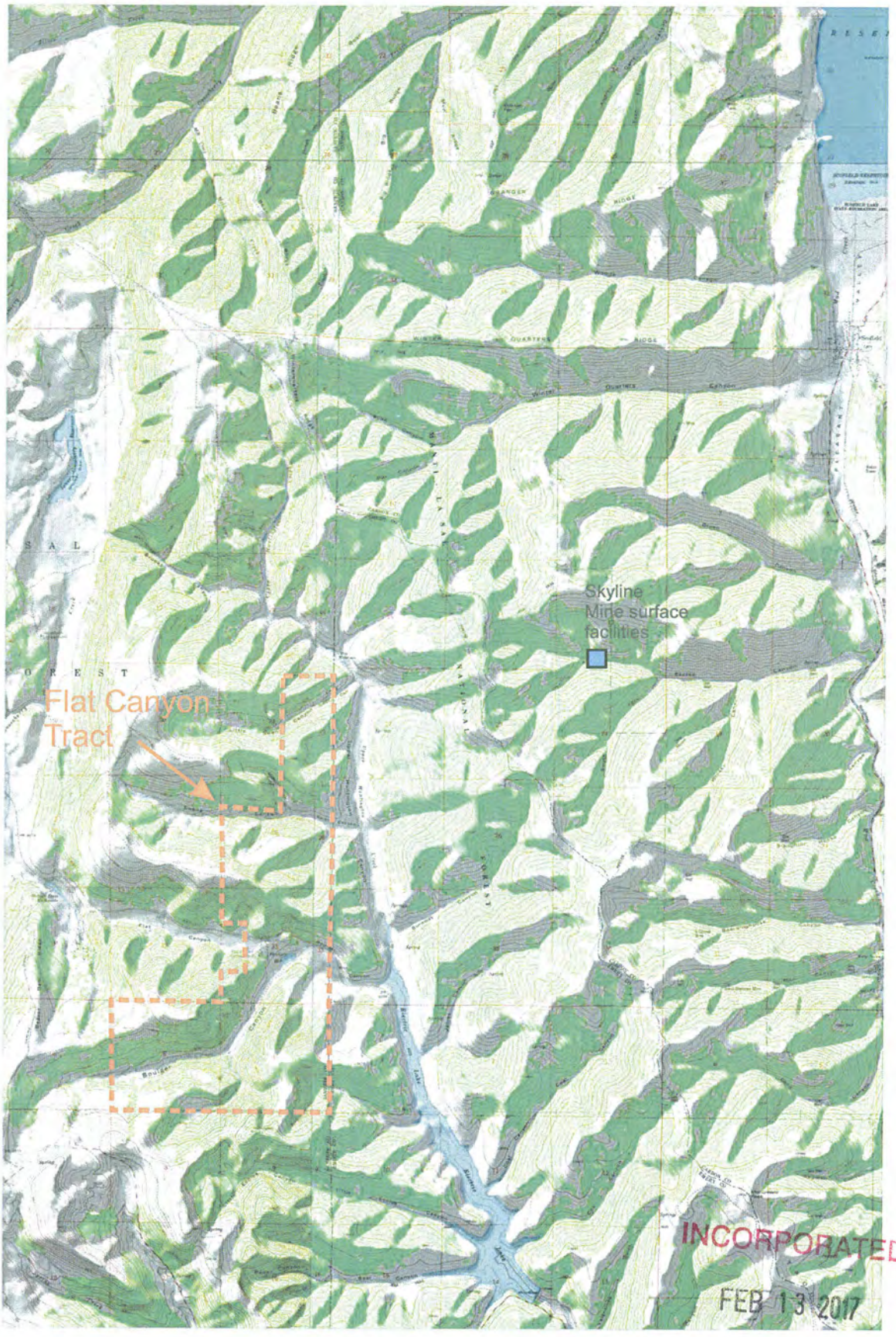
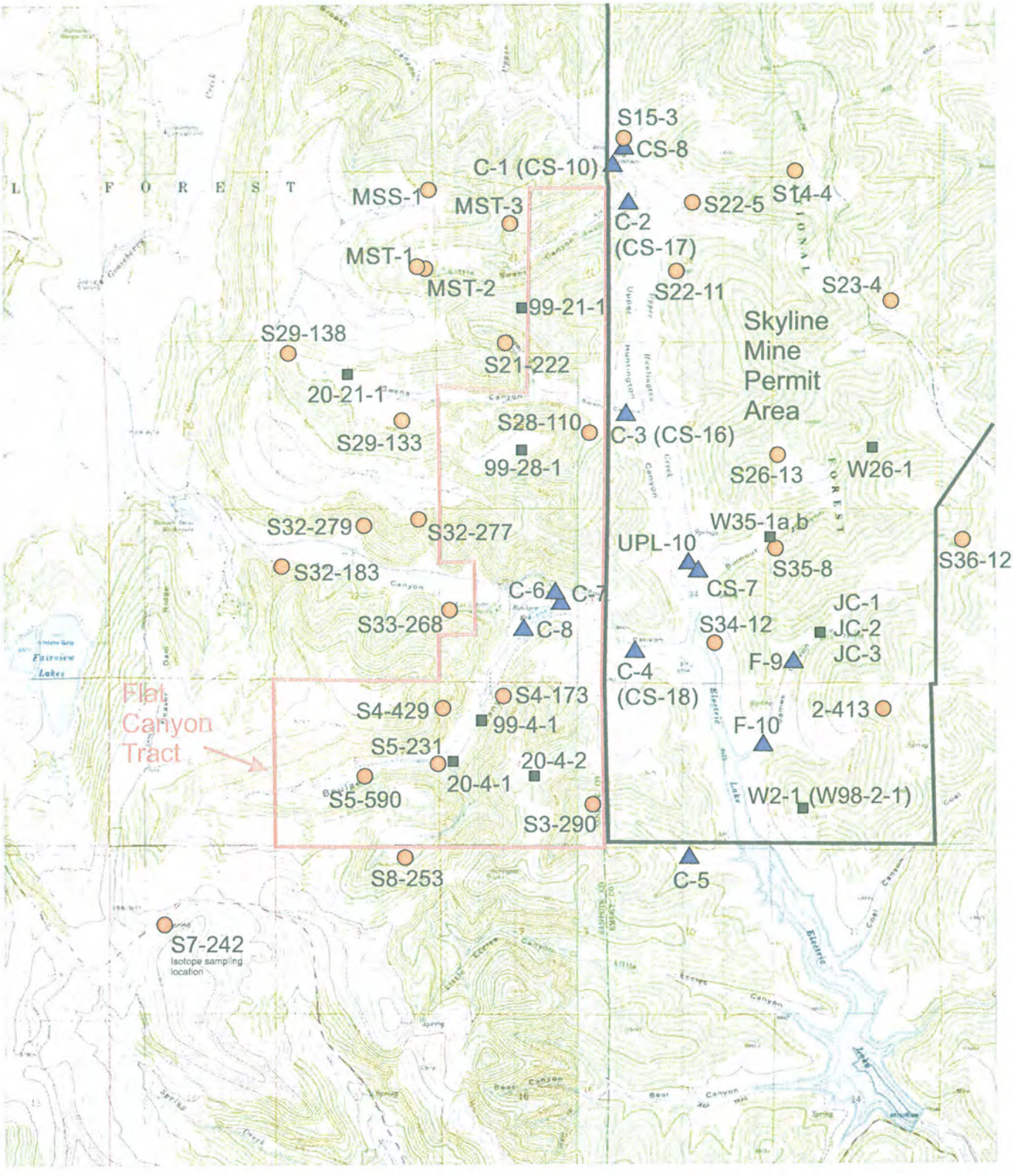


Figure 1 Locations of the Skyline Mine and Flat Canyon area.



1927 North American Datum, UTM grid zone 12
Generated by BigTopo7 (www.igage.com)
Map compiled from USGS Quads: Fairview Lakes, UT; Scofield, UT; Huntington Reservoir, UT; Candland Mountain, UT

0 ½ 1 2 Miles
1000 0 2000 4000 6000 8000 10,000 Feet
1,000 Meters 500 0 ½ 1 2 Kilometers

- Spring monitoring station
- Stream monitoring station
- Monitoring well

Note: Selected long-term Skyline Mine monitoring stations east of Huntington Creek are also shown on this map. Data for these stations are available at www.utah.gov.

Figure 2 Baseline monitoring station locations

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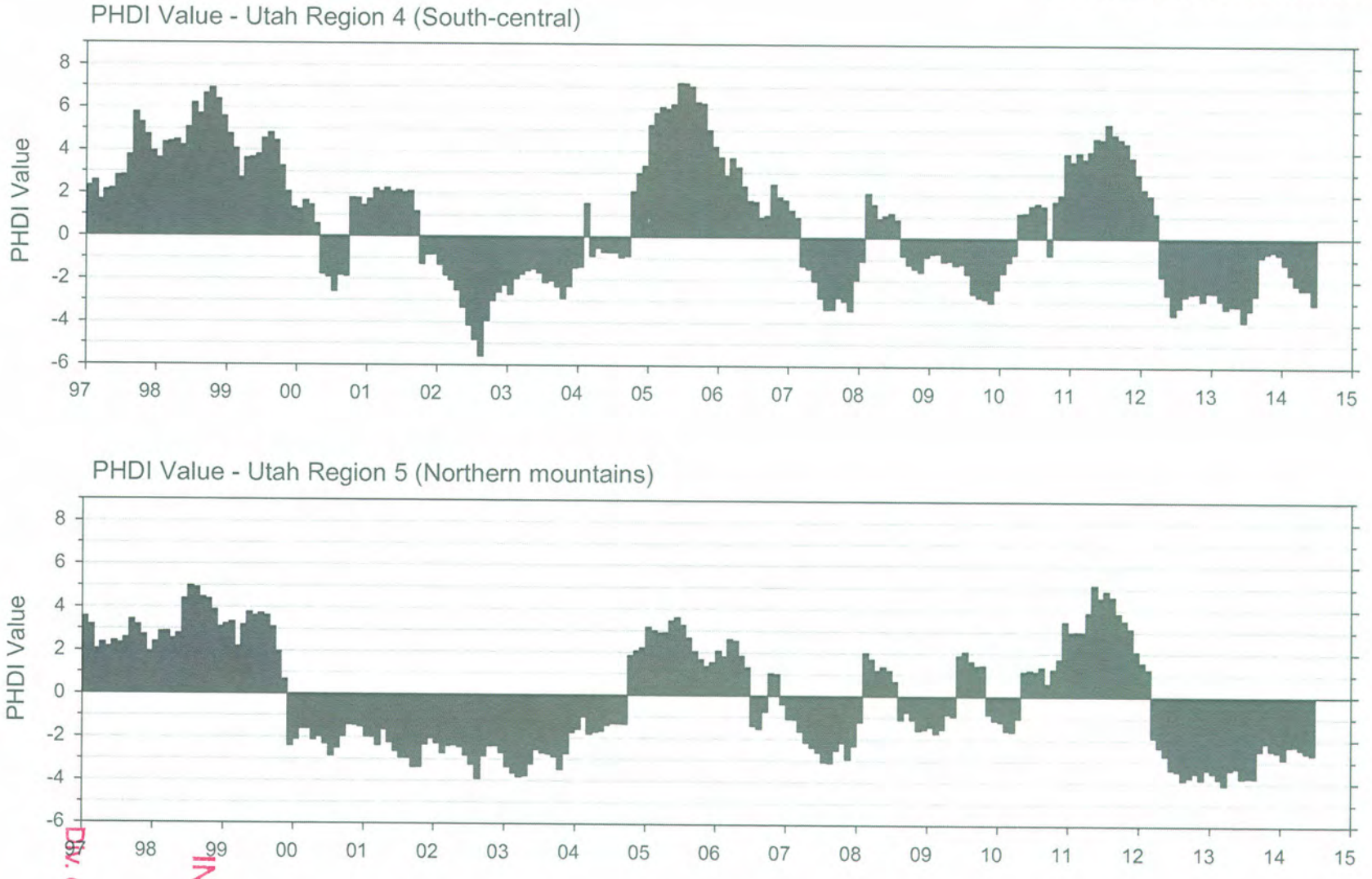

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Figure 3 Plots of Palmer Hydrologic Drought Index for Utah Regions 4 and 5.

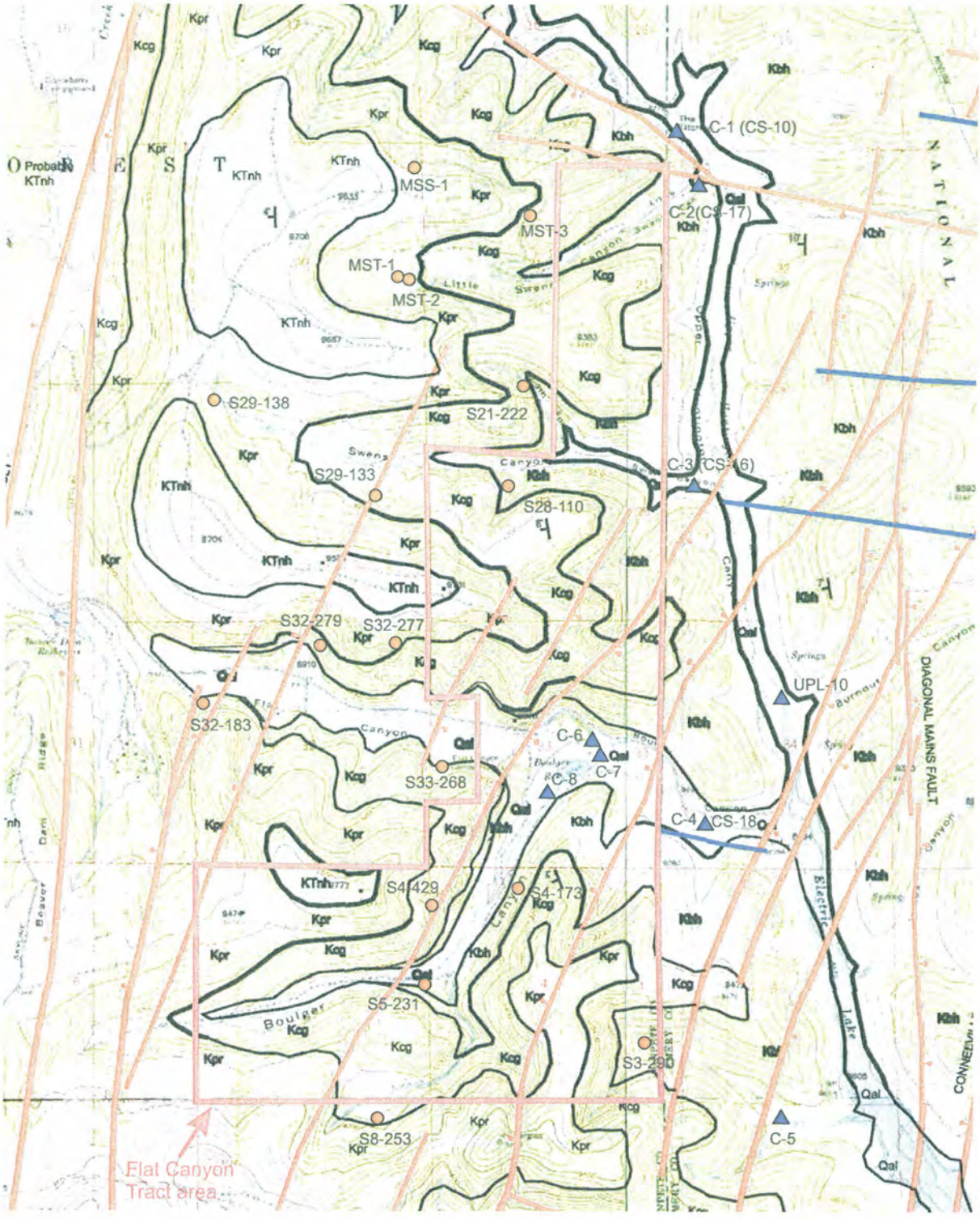

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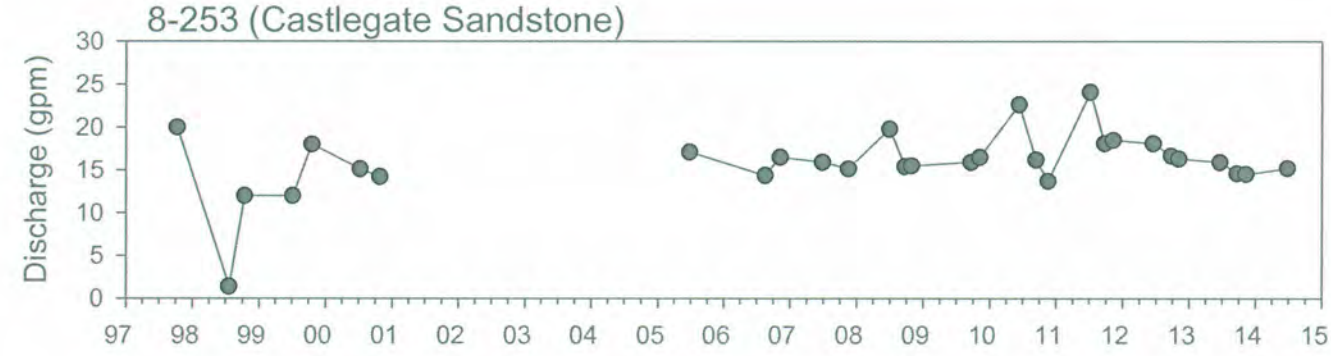
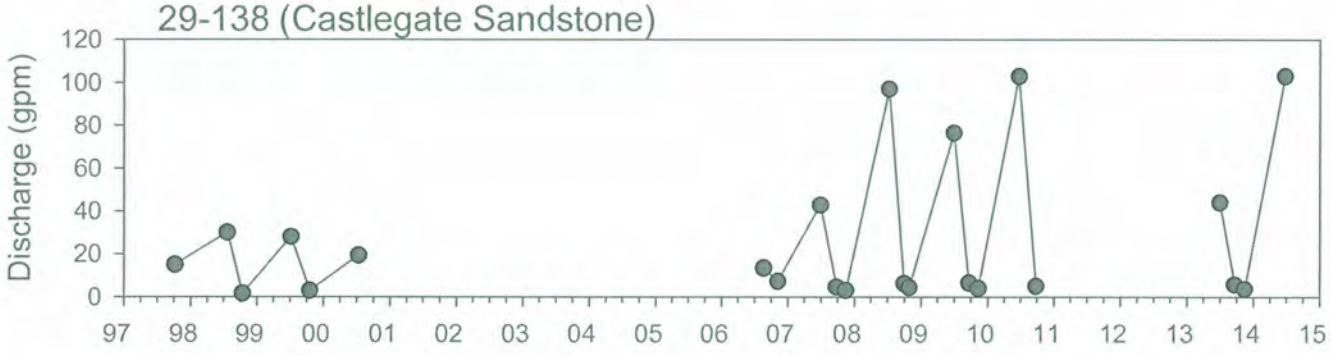
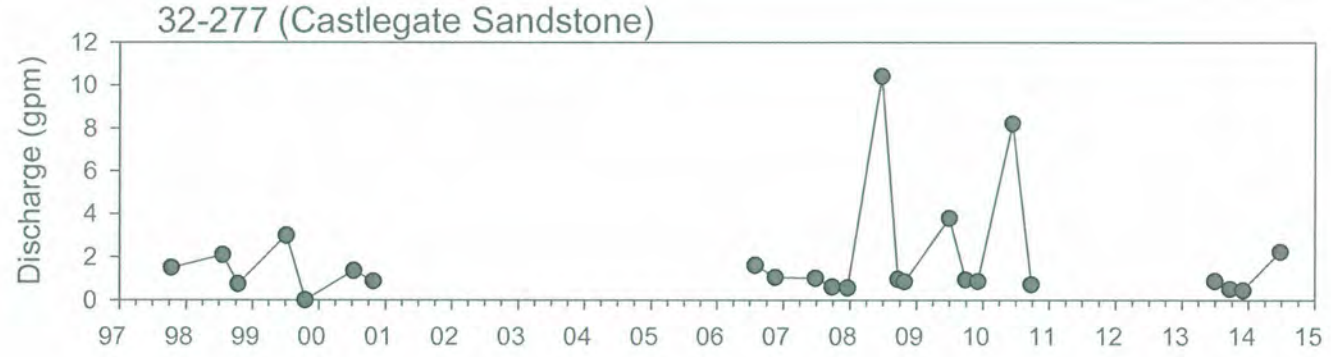
Figure 4 Generalized geologic map of the Flat Canyon area.







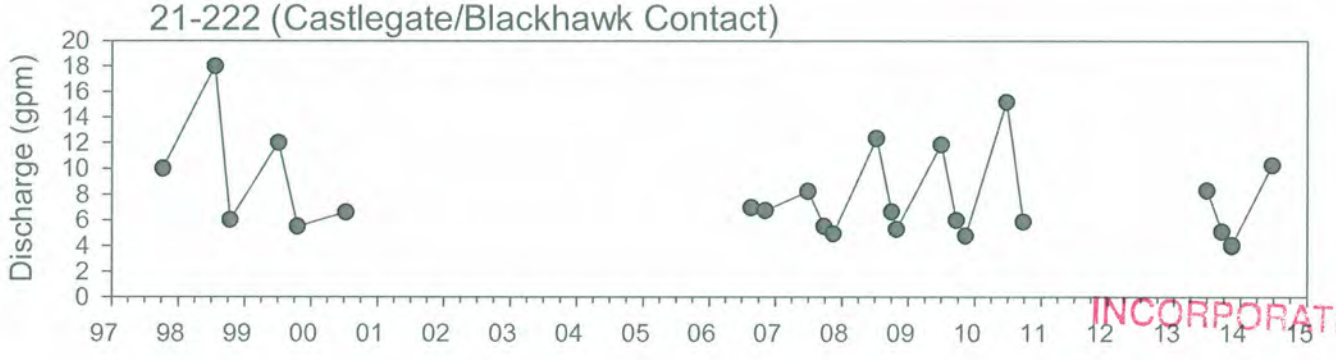


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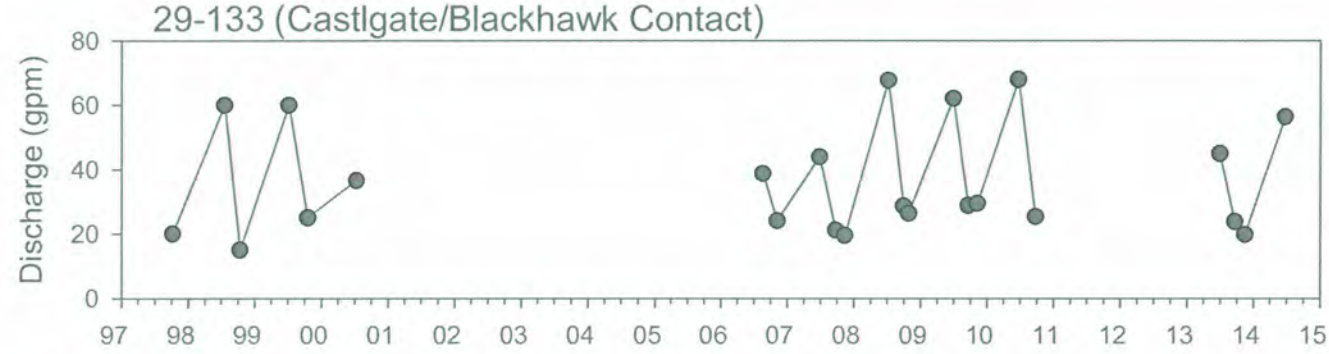
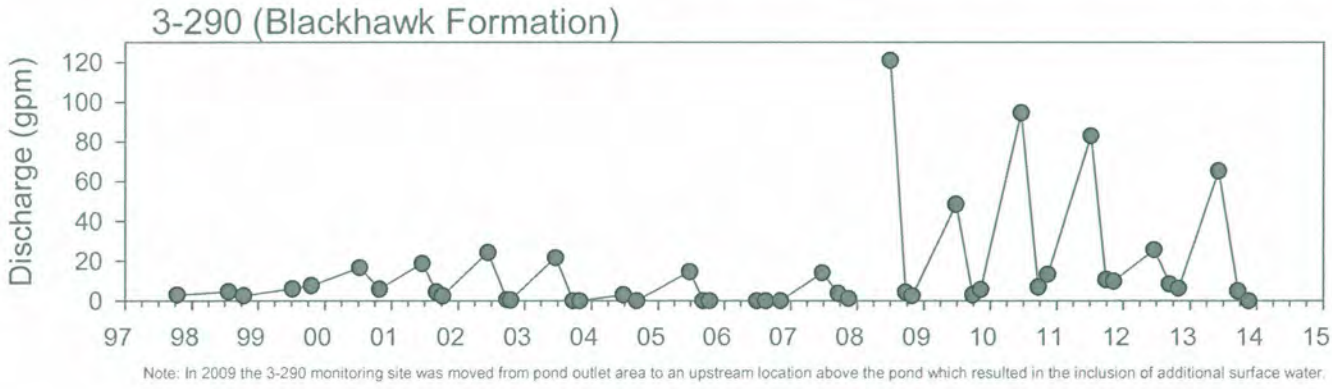
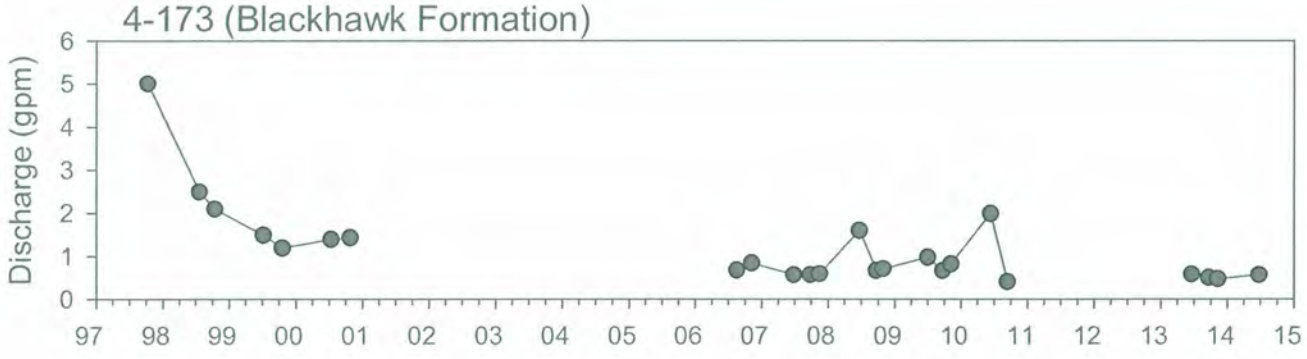
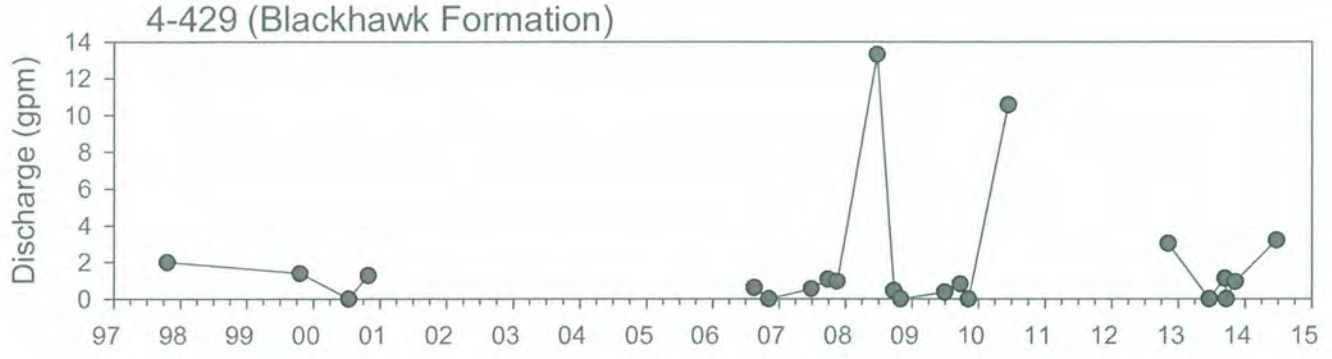
Figure 5 Discharge hydrographs for springs in the Flat Canyon area.





Note: In 2009 the 3-290 monitoring site was moved from pond outlet area to an upstream location above the pond which resulted in the inclusion of additional surface water.





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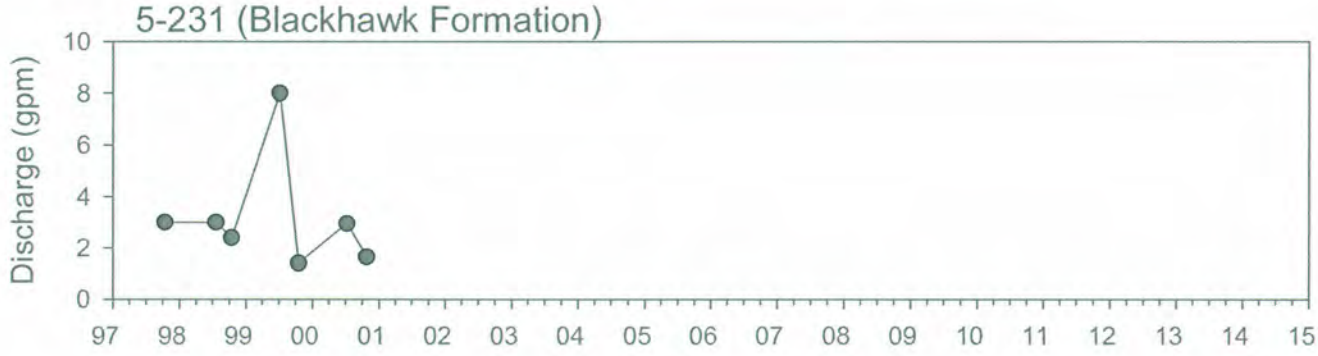

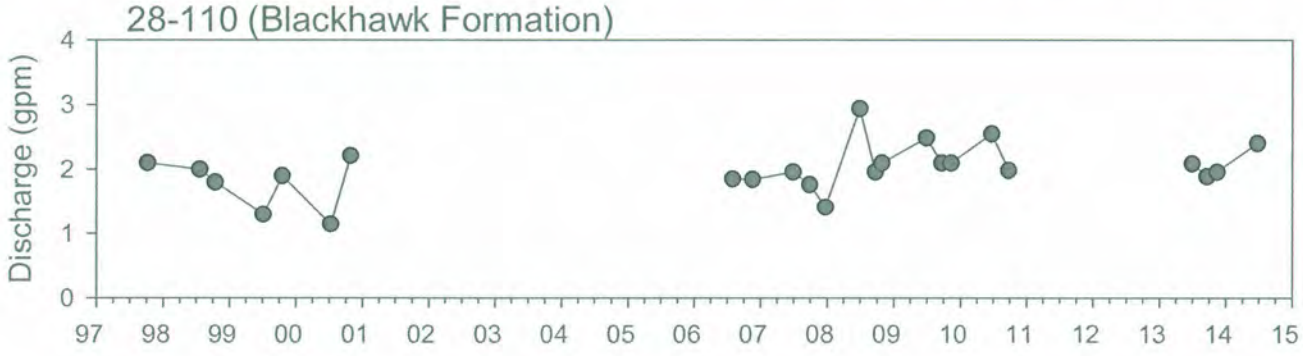

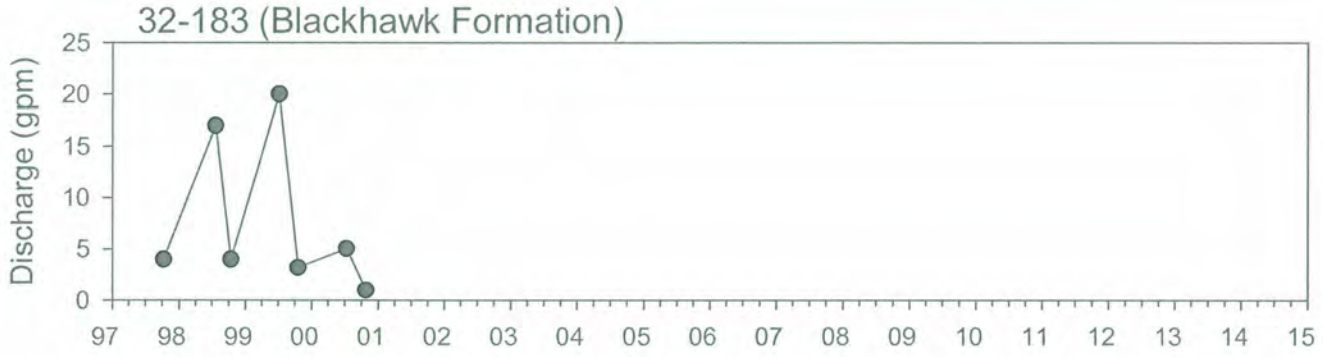

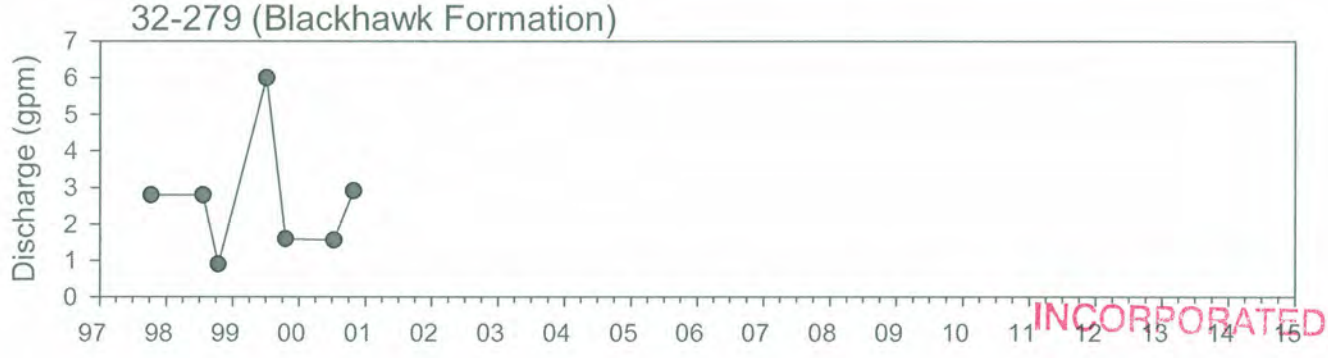

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Figure 5 (continued).

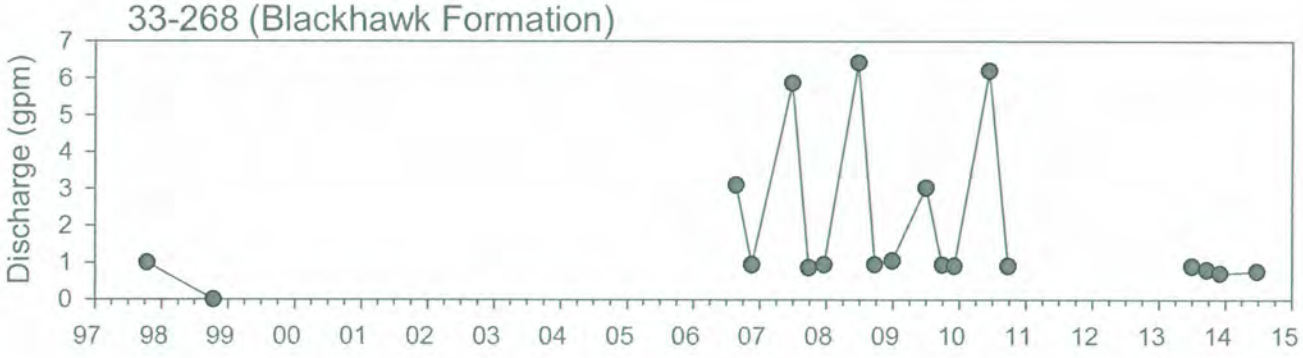

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Figure 5 (continued).

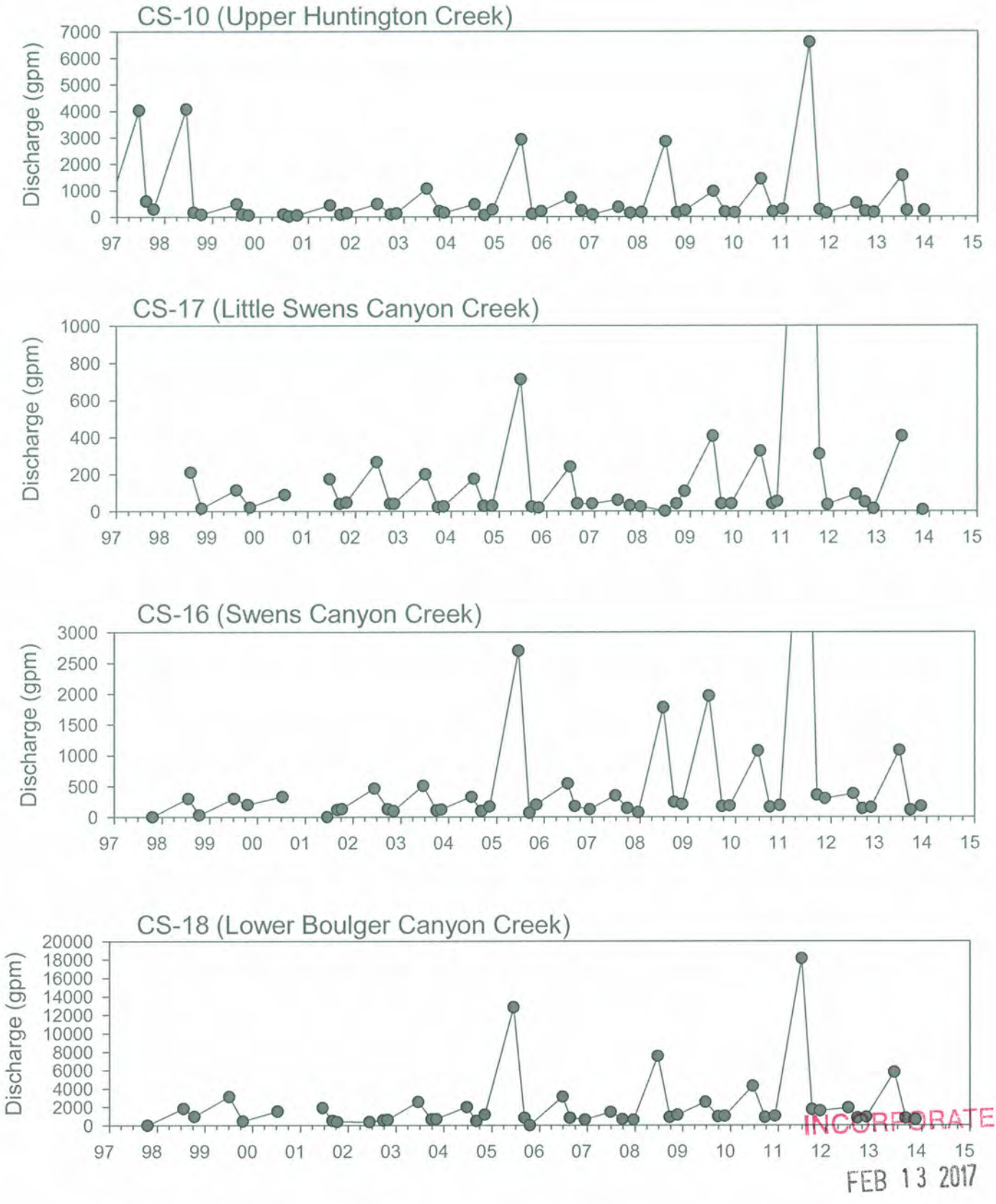

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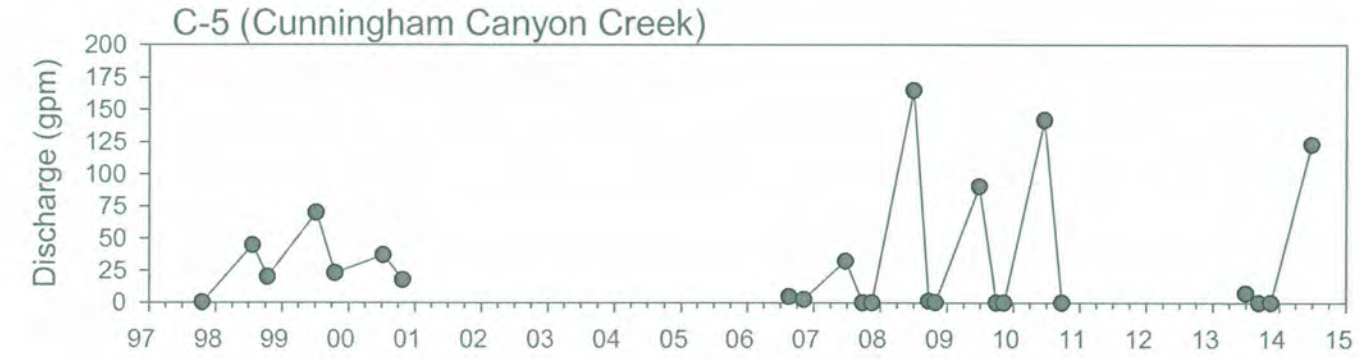
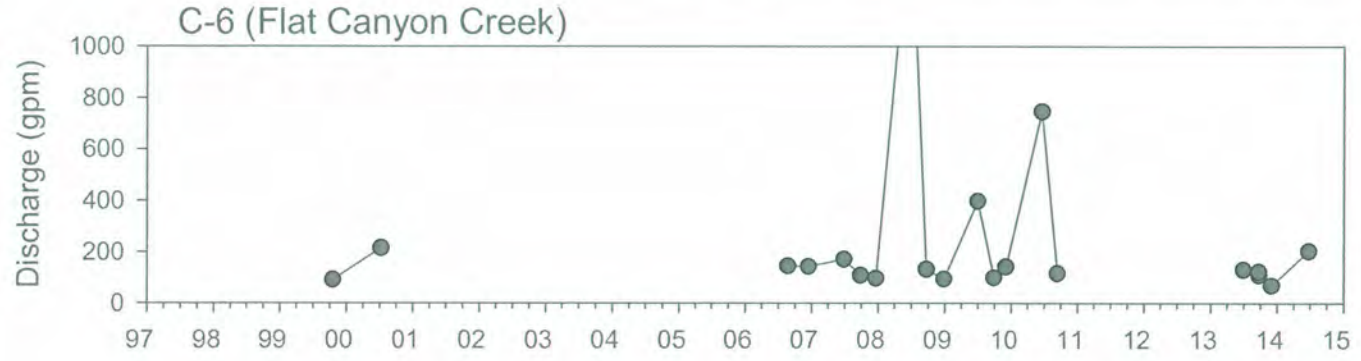
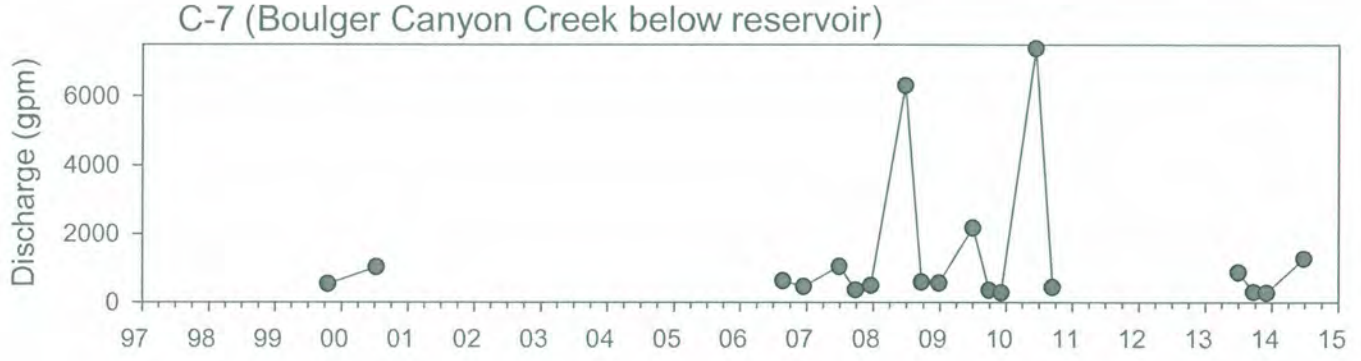
Figure 6 Discharge hydrographs for streams in the Flat Canyon area.







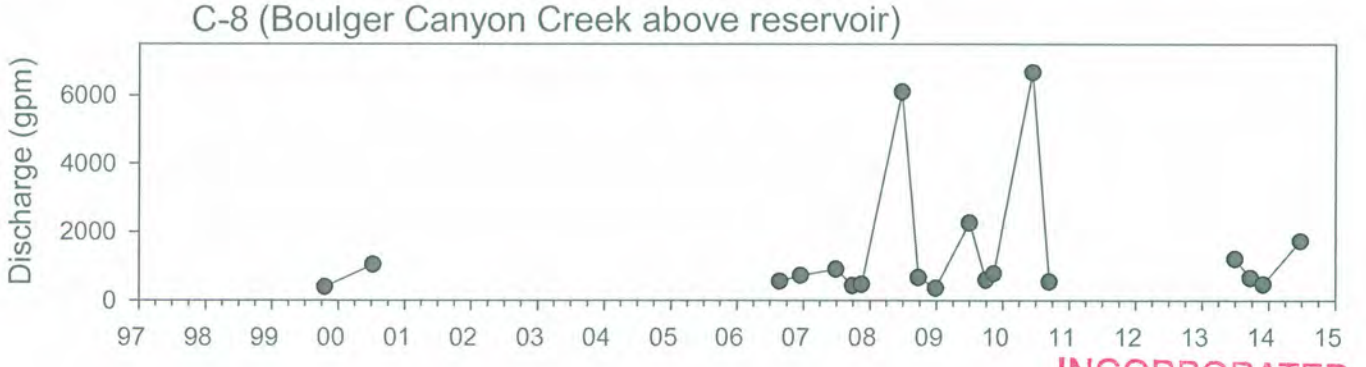


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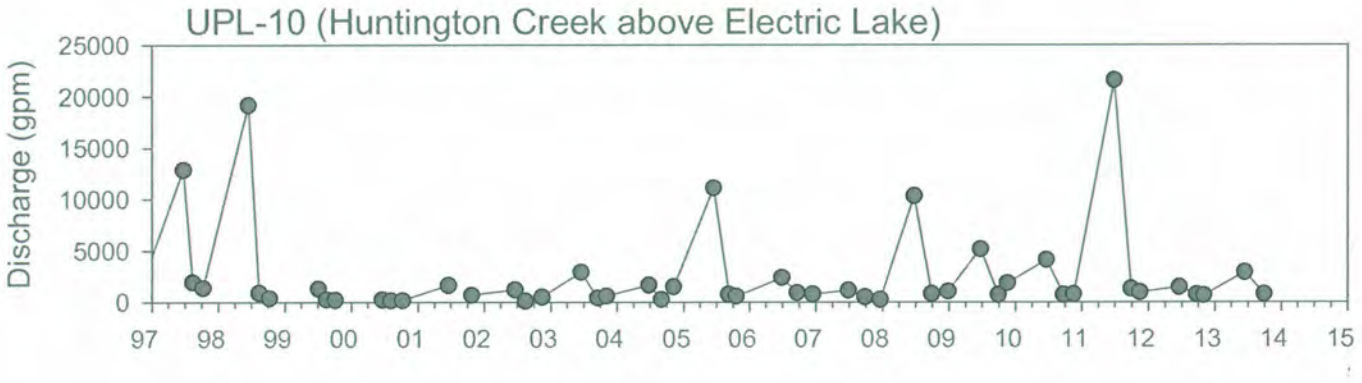
Figure 6 (continued).



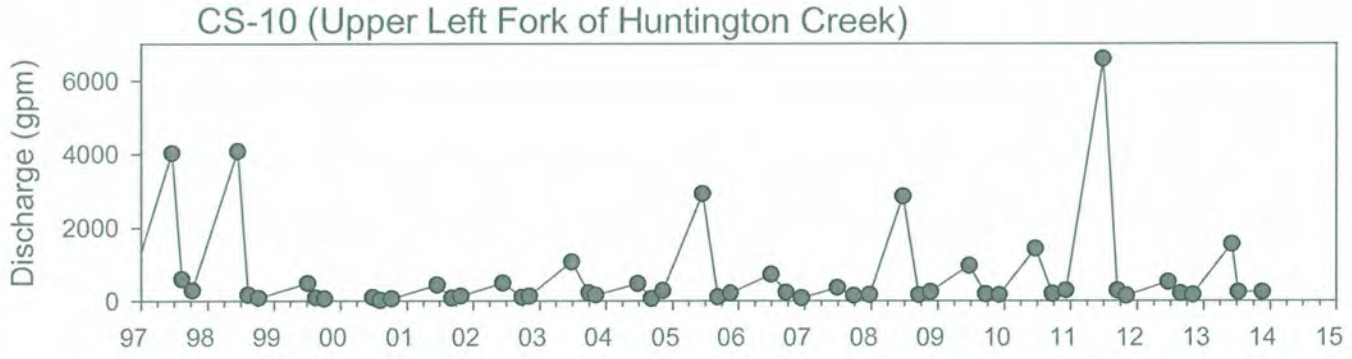


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Figure 6 (continued).

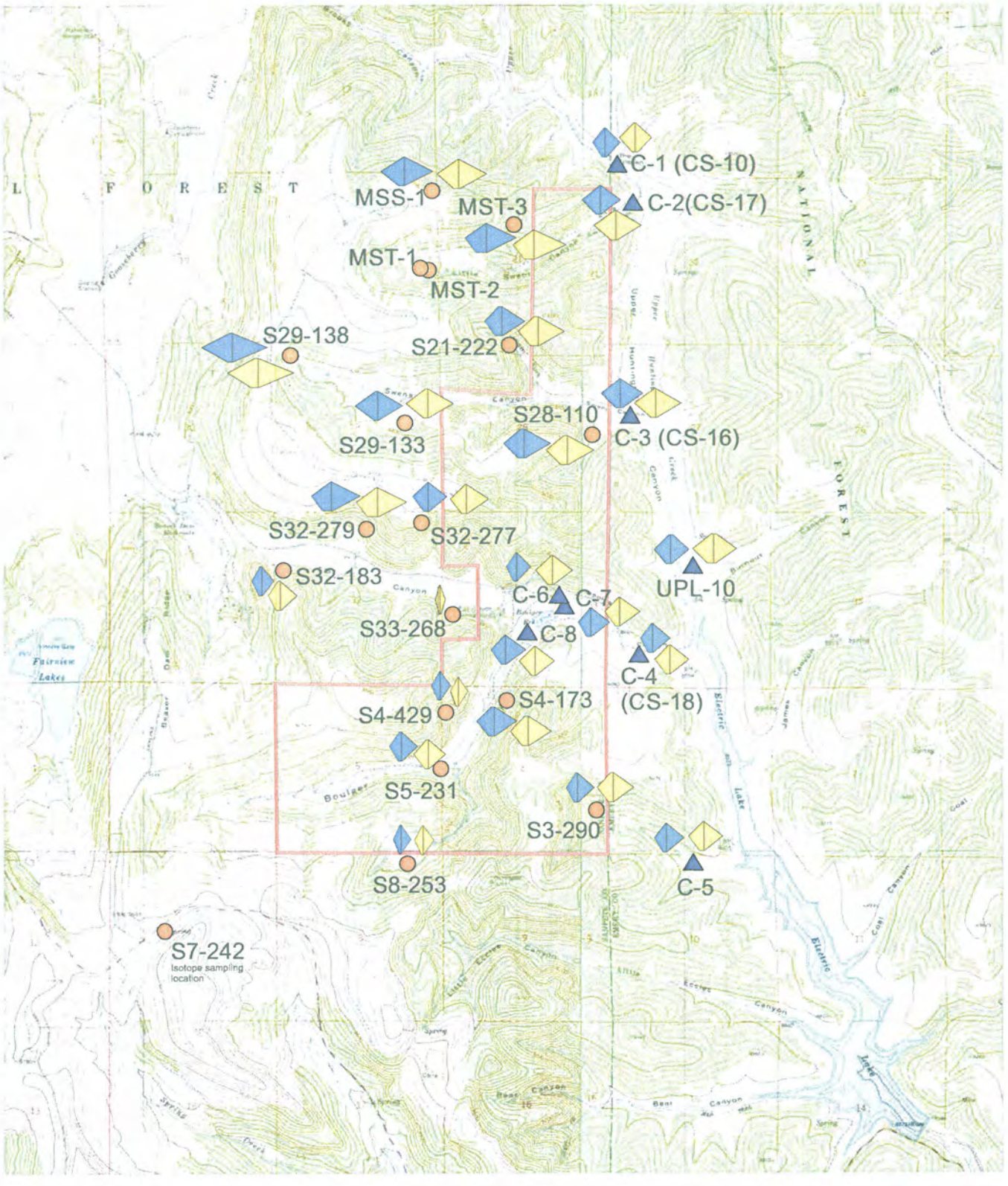

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Figure 7 Stiff diagrams for high-flow and low-flow conditions.

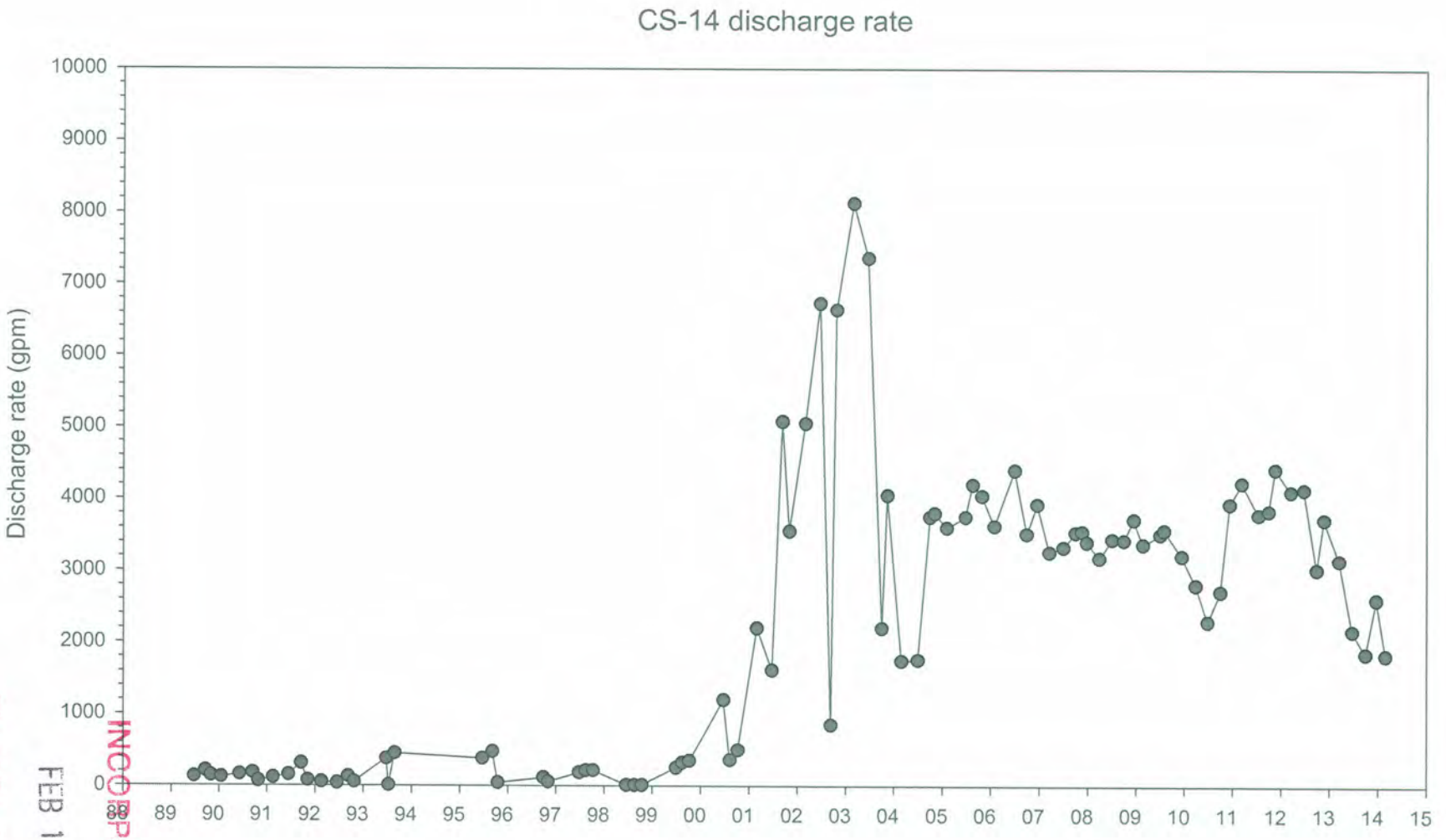

Figure 8 Discharge rates from CS-14 at the Skyline Mine.

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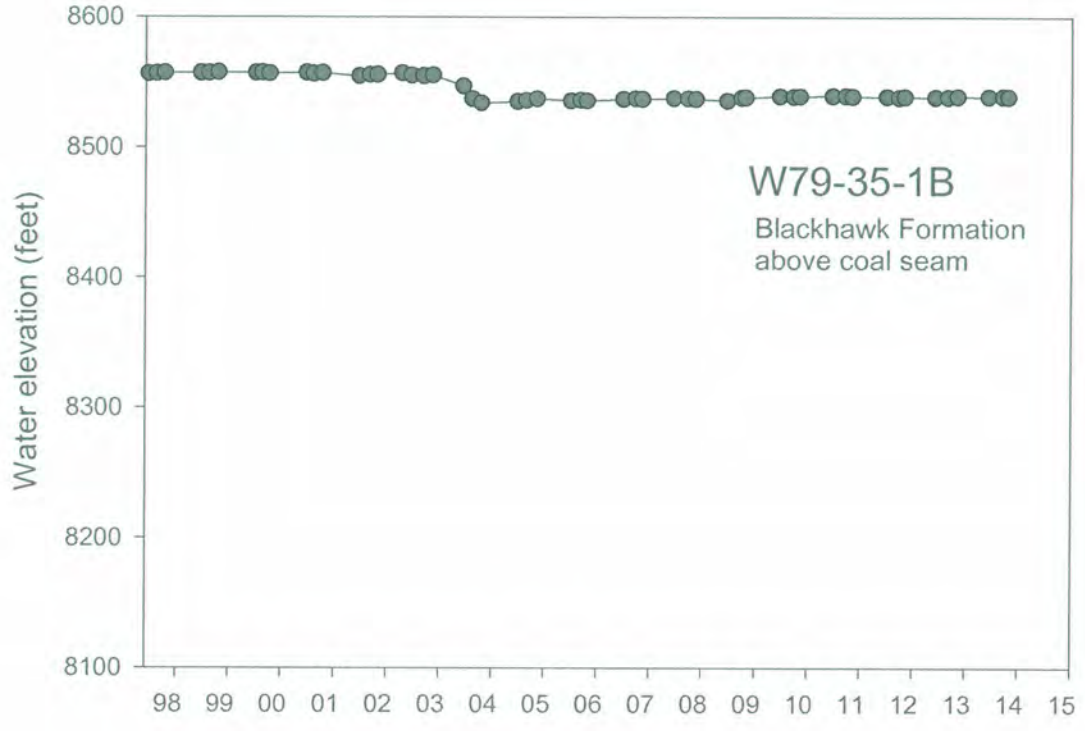

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Figure 9 Comparison of water level declines at the nested piezometers at W79-35-1.

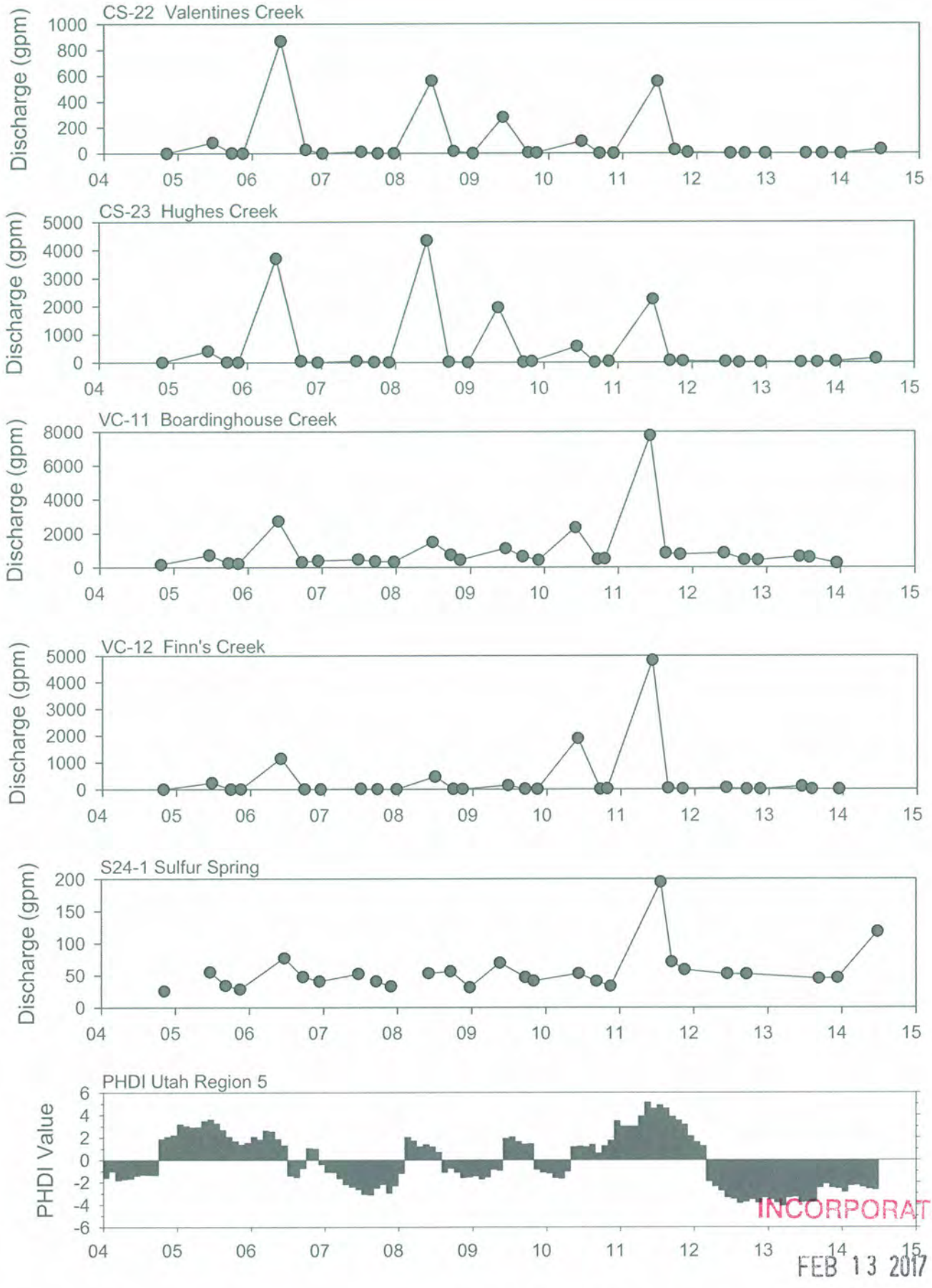

Figure 10 Discharge hydrographs for Star Point Sandstone monitoring locations.

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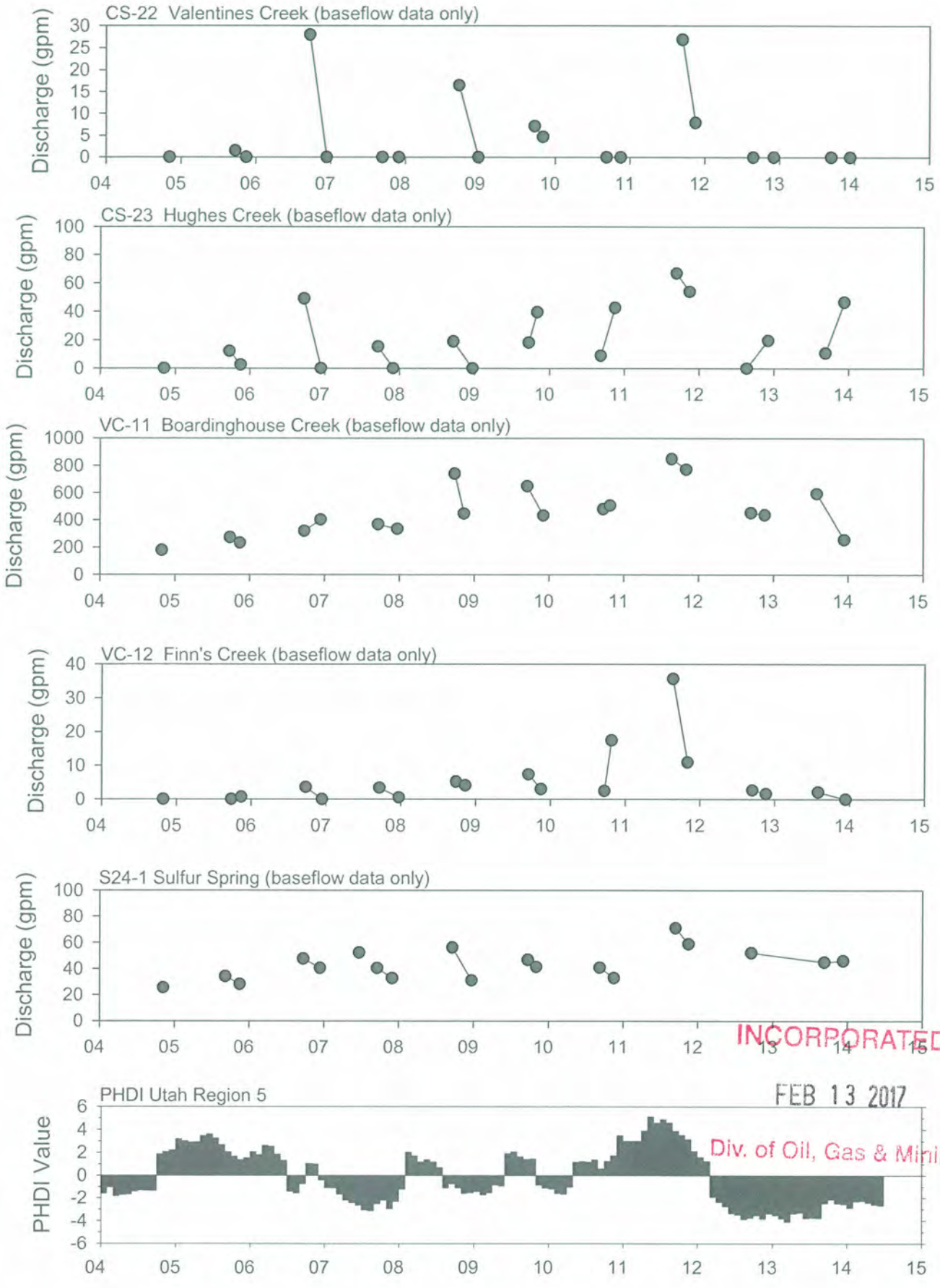

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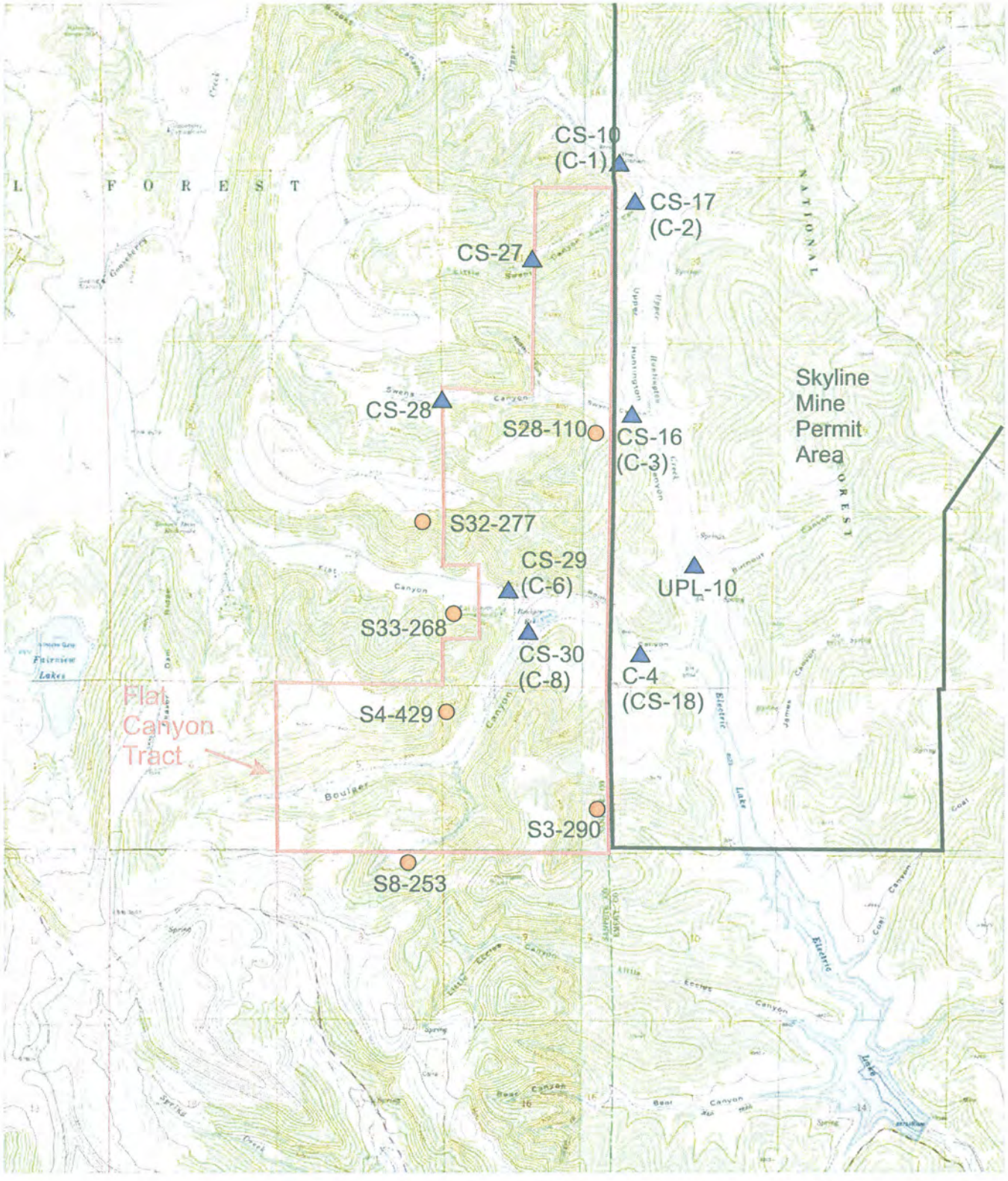
Figure 11 Discharge hydrographs for Star Point Sandstone monitoring locations under baseflow conditions..



1927 North American Datum, UTM grid zone 12
Generated by BigTopo7 (www.igage.com)
Map compiled from USGS Quads: Fairview Lakes, UT; Scofield, UT; Huntington Reservoir, UT; Candland Mountain, UT

0 ¼ ½ 1 2 Miles
1000 0 2000 4000 6000 8000 10,000 Feet
1,000 Meters 500 0 ½ 1 2 Kilometers

● Spring monitoring station
▲ Stream monitoring station

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Figure 12 Proposed groundwater and surface-water monitoring station locations

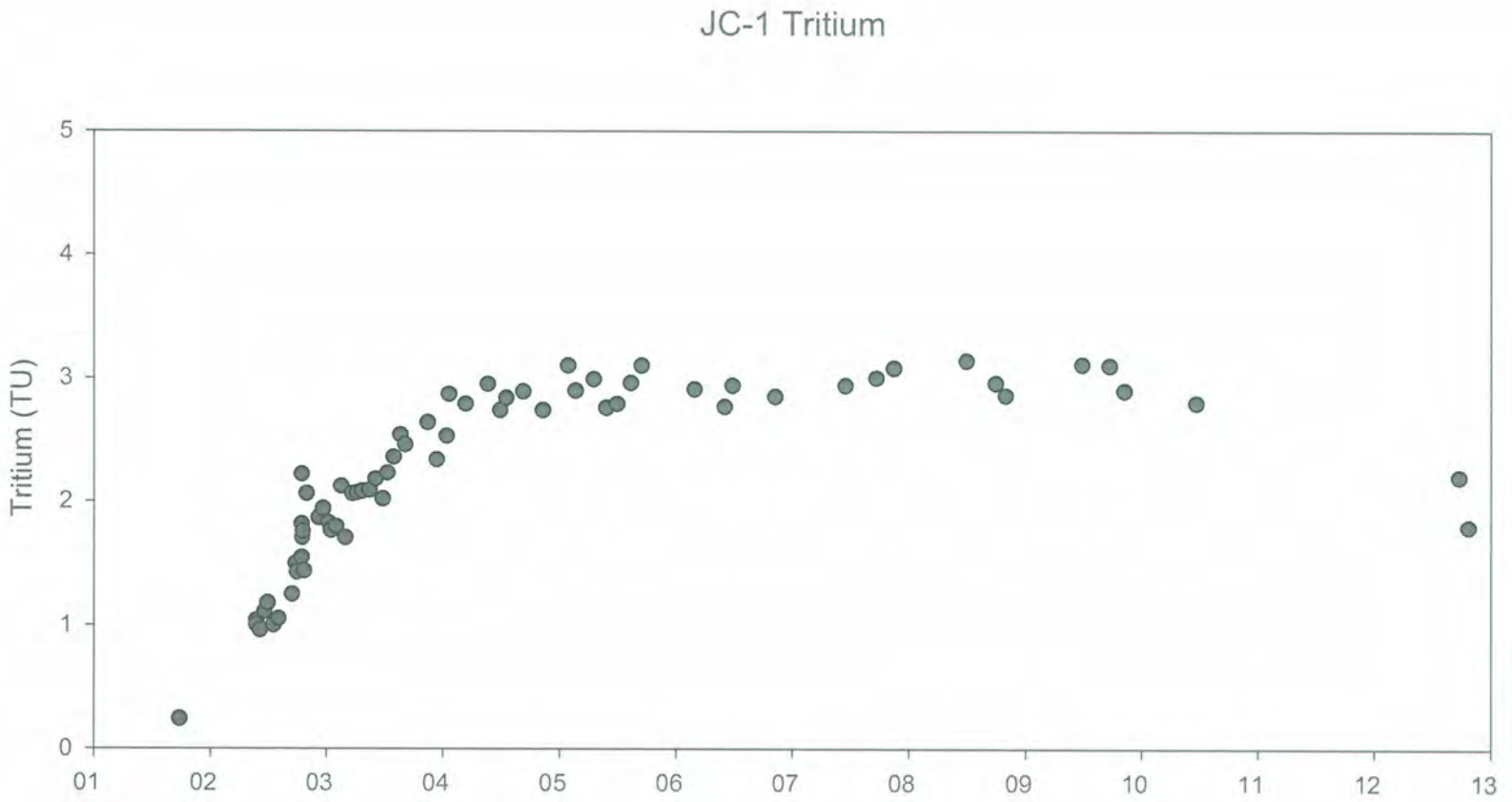

Figure 13 Plot of tritium concentrations in JC-1.

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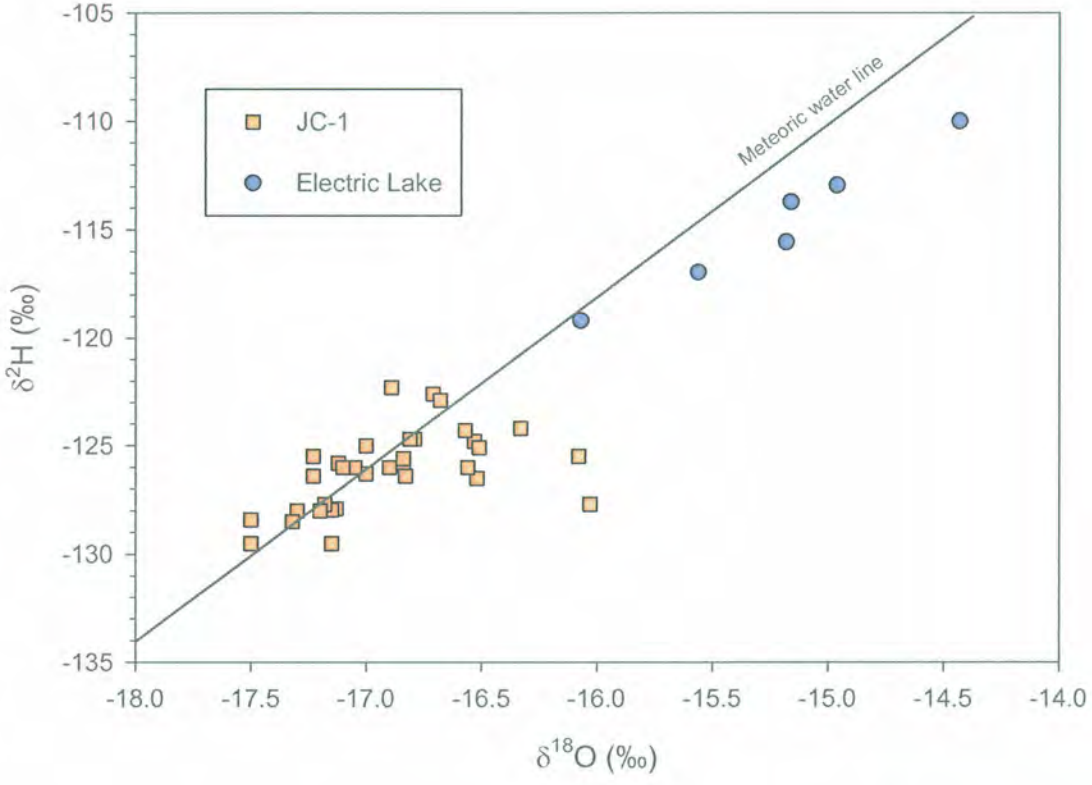

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Figure 14 Plot of deuterium and oxygen-18 in surface water and JC-1 groundwater.

Table 1 Baseline monitoring site details.

	Location UTM NAD 27		Geologic Formation	Area	Use
Springs					
29-138	475833	4390705	Price River Formation	Swens Canyon	Livestock
32-277	476939	4389144	Price River Formation (base)	Flat Canyon	Wildlife and cabin water
MSS-1	477099	4392306	Price River Formation	Brooks Canyon	Girls camp water
4-429	477315	4387145	Castlegate Sandstone	Boulger Canyon	Flat Cyn. Campground
8-253	476844	4386266	Castlegate Sandstone	Top of E. Fork Boulger Canyon	None apparent
29-133	476947	4390076	Castlegate Sandstone	Swens Canyon	Cabin water
33-268	477257	4388392	Castlegate Sandstone	Flat Canyon	Camp area water
21-222	477509	4391103	Castlegate/Blackhawk contact	N. Fork of Swens Canyon	None apparent
32-183	475689	4388665	Castlegate/Blackhawk contact	Flat Canyon	Cabin water
32-279	476320	4389122	Castlegate/Blackhawk contact	Flat Canyon	Cabin water
3-290	478802	4386572	Blackhawk Formation	Cunningham Cyn. in stream channel	None apparent
4-173	477778	4387169	Blackhawk Formation	Boulger Canyon	None apparent
5-231	476578	4386891	Blackhawk Formation	Boulger Canyon	None apparent
28-110	478715	4390076	Blackhawk Formation	Swens Canyon	None apparent
Spring-fed water tanks					
MST-1	477046	4391570	Composite water in tank	Little Swens Canyon	Girls camp water
MST-2	477121	439163	Composite water in tank	Little Swens Canyon	Girls camp water
MST-3	477840	4392441	Composite water in tank	Little Swens Canyon	Girls camp water
Creeks					
C-5	479649	4385815	---	Cunningham Canyon	None apparent
C-6	478450	4388370	---	Flat Canyon	None apparent
C-7	478473	4388336	---	Boulger Canyon (below reservoir)	None apparent
C-8	478052	4388019	---	Boulger Canyon (above reservoir)	None apparent
CS-10 (C1)	478922	4392550	---	Upper Left Fork Huntington Canyon	None apparent
CS-16 (C-3)	479211	4390178	---	Swens Canyon	None apparent
CS-17 (C-2)	479129	4392284	---	Little Swens Canyon	None apparent
CS-18 (C-4)	478941	4387913	---	Boulger Canyon below Flat Canyon	None apparent

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Table 2 Discharge and water quality data for springs and streams.

										Major Ions								Metals										Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
Springs																																
3-290	13-Oct-97	5.2	7.1	336	3			200		53	8	4	<1	215	<5	5	3	<0.01	0.1	<0.01	<0.1	1.6	<0.1	<0.1	<0.1	<0.2	<0.01	0.4	<0.03		0.05	
3-290	23-Jul-98	5.1	7.2	230	4.6			210		52	8	2	<1	205	<5	4	1	<0.01	0.1	<0.01	<0.1	0.3	<0.1	<0.1	<0.1	<0.2	<0.01	0.4	<0.03		<0.05	
3-290	13-Oct-98	5.5	7.9	250	2.7			209		57	8	2	<1	220	<5	4	2	<0.01	0.2	<0.01	<0.1	0.3	<0.1	<0.1	<0.1	<0.2	<0.01	0.5	<0.03		<0.05	
3-290	08-Jul-99	4.1	7.13	265	6			171		44	7	2	<1	180	<5	3	1	<0.01	0.1	<0.01	<0.1	0.3	<0.1	<0.1	<0.1	<0.2	<0.01	0.63	<0.03		0.06	
3-290	19-Oct-99	3.1	7.83	267	7.6			151		44	8	2	<1	176	<5	4	1	<0.01	0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	0.27	<0.03		<0.05	
3-290	10-Jul-00	11.3	7.95	231	16.7			121		31	6	3	<1	140	<5	4	<1	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	<0.03	0.27	
3-290	27-Oct-00	1.8	8.21	239	5.83																											
3-290	19-Jun-01	10.4	8.32	206	18.75			117	< 5.	32	5	1	< 1.			5	0.9								< .1						< .05	
3-290	04-Sep-01	9.9	7.74	337	4.44		6.03	151	14	43	7	2	< 1.	168	< 5.	4	0.8		0.06		< .1		< .1	0.09	0.13			< .03			< .05	
3-290	08-Oct-01	6	6.94	408	2.48			181	11	47	8	7	2	180		1.5	18.6								1.06			0.06			< .05	
3-290	13-Jun-02	13.9	8.39	219	24.2			111	5	25	4	3	< 1.	103	< 5.	3	< 1.								< .05						< .05	
3-290	25-Sep-02	7	7.01	399	0.649		7.33	200	17	48	9	4	1	180	< 5.	18	1		0.06		0.2		< .1	1.12	1.12				< .03		< .05	
3-290	16-Oct-02	4.6	6.93	381	0.402			201	< 5.	47	8	2	1	174	< 5.	11	< 1.								1						0.08	
3-290	19-Jun-03	11.3	8.62	146	21.6			104	< 5.	25.1	3.3	2.3	0.62	124	< 5.	3	1								0.01						< .05	
3-290	23-Sep-03				0																											
3-290	30-Oct-03				0																											
3-290	24-Jun-04	10.4	7.52	168	2.94			163	< 5.	24.2	3.59	1.36	0.95	72	< 5.	7	< 1.								0.21			0.08	< .05		< .05	
3-290	07-Sep-04				0																											
3-290	26-Jun-05	9.8	7.83	112	14.6			109	< 5.	21.1	2.84	2.25	0.47	71	<5	4	< 1.								0.02			0.14			< .05	
3-290	08-Sep-05				0																											
3-290	14-Oct-05				0																											
3-290	29-Jun-06				0																											
3-290	18-Aug-06				0																											
3-290	07-Nov-06				0																											
3-290	23-Jun-07	17	8.47	148	13.9																											
3-290	20-Sep-07	8.5	8.17	197	3.73																											
3-290	17-Nov-07	0.2	7.99	163	1.06																											
3-290	30-Jun-08	10.4	8.05	133	121																											
3-290	23-Sep-08	5.4	8.35	217	4.39																											
3-290	29-Oct-08	2	7.43	188	2.6																											
3-290	26-Jun-09	9.1	8.37	142	48.4																											
3-290	28-Sep-09	8.2	8.48	201	2.97																											
3-290	11-Nov-09	0.6	8.16	188	5.64																											
3-290	19-Jun-10	7.5	8.28	131	94.5																											
3-290	21-Sep-10	7.3	8.42	190	6.88			136	< 4.	32.9	4.8	1.9	0.8	121	1	5	2		< .05		< .02		< .02	< .005	< .005								
3-290	12-Nov-10	0.6	8.56	196.7	13.25																											
3-290	07-Jul-11	11.9	8.2	138	83																											
3-290	28-Sep-11	9	8.55	205	10.6																											
3-290	10-Nov-11	0.3	8.6	254	9.8																											
3-290	18-Jun-12	9.4	8.5	208	25.6																											
3-290	11-Sep-12	10.1	7.85	201	8.45																											
3-290	30-Oct-12	0.5	8.01	217	6.29																											
3-290	06-Jun-13	6.7	8.4	156	65.2																											
3-290	20-Sep-13	7.6	8.6	221	4.9																											
3-290	18-Nov-13				0																											
4-173	09-Oct-97	4.6	7.2	322	5			200		49	9	2	0	195	<5	5	2	<0.01	0.2	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<02	<0.01	0.9	<0.03		0.04	

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										Major Ions								Metals										Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
4-173	21-Jul-98	4.3	6.2	160	2.5			204		48	9	1	<1	191	<5	5	2	<0.01	0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<02	<0.01	0.9	<0.03		0.04	
4-173	13-Oct-98	4.5	7.6	230	2.1			188		49	9	2	<1	200	<5	5	2	<0.01	0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.9	<0.03		<0.05	
4-173	07-Jul-99	2.9	7.33	199	1.5			171		45	9	3	<1	192	<5	5	1	<0.01	0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	1.17	<0.03		<0.05	
4-173	19-Oct-99	3.3	7.8	303	1.2			163		49	10	2	<1	196	<5	5	1	<0.01	0.2	<0.01	<0.1	0.3	<0.1	<0.1	<0.1	<0.2	<0.01	1.18	<0.03		<0.05	
4-173	11-Jul-00	4	8.11	312	1.40			185		49	9	1	<1	193	<5	5	1	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	0.87	<0.05	
4-173	26-Oct-00	3.7	7.26	311	1.44																											
4-173	18-Aug-06	6.3	7.77	219	0.68																											
4-173	07-Nov-06	3.9	7.38	204	0.85																											
4-173	27-Jun-07	4.6	7.47	209	0.58																											
4-173	27-Sep-07	5.6	7.63	252	0.57																											
4-173	17-Nov-07	4	7.4	221	0.59																											
4-173	22-Jun-08	4	7.43	126	1.60																											
4-173	22-Sep-08	5.1	7.42	244	0.67																											
4-173	30-Oct-08	4.3	7.47	258	0.72																											
4-173	30-Jun-09	5	7.1	151	0.98																											
4-173	21-Sep-09	5.7	7.34	245	0.67																											
4-173	07-Nov-09	4.2	7.51	236	0.82																											
4-173	12-Jun-10	5.7	7.41	119	1.99																											
4-173	12-Sep-10	5.6	7.47	258	0.41																											
4-173	24-Sep-11	5.8	7.57	241	0.77																											
4-173	11-Nov-11	4.1	7.75	228	1.01																											
4-173	23-Sep-12	6.5	7.68	274	0.52																											
4-173	05-Nov-12	5	7.61	284	0.67																											
4-173	19-Jun-13	4.7	7.39	201	0.59																											
4-173	20-Sep-13	6.1	7.50	283	0.51																											
4-173	09-Nov-13	4.2	7.65	272	0.48																											
4-173	24-Jun-14	4	7.25	162	0.57																											
4-429	20-Oct-97	6	7.2	149	2			80		22	4	2	<1	84	<5	0	2	<0.01	0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0	<0.03		0.05	
4-429	19-Oct-99	5.8	7.3	133	1.4			76		21	4	1	<1	83	<5	3	<1	<0.01	0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	1.38	<0.03		0.08	
4-429	12-Jul-00	9.6	7.84	155	No overflow			104		24	4	<1	<1	86	<5	3	<1	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	1.91	<0.05	
4-429	27-Oct-00	5.9	7.52	144	1.28																											
4-429	18-Aug-06	7.9	7.06	140	0.61																											
4-429	07-Nov-06	—	—	—	Dry																											
4-429	27-Jun-07	7.8	6.91	139	0.55																											
4-429	27-Sep-07	8	7.69	136	1.07																											
4-429	17-Nov-07	6.3	7.42	124	0.95																											
4-429	22-Jun-08	4.5	7.37	114	13.3																											
4-429	22-Sep-08	7.5	7.49	141	0.45																											
4-429	30-Oct-08	—	—	—	Dry																											
4-429	30-Jun-09	6.5	7.12	137	0.37																											
4-429	21-Sep-09	7.8	7.29	141	0.82																											
4-429	07-Nov-09	—	—	—	Dry																											
4-429	12-Jun-10	6.4	7.46	118	10.6																											
4-429	12-Sep-10	7.8	7.22	149	1.12																											
4-429	24-Sep-11	7.2	7.42	165	1.62																											
4-429	11-Nov-11	5.4	7.84	129	0.78																											
4-429	23-Sep-12	8.4	7.46	137	1.19																											
4-429	05-Nov-12	—	—	—	Dry																											
4-429	19-Jun-13	—	—	—	No overflow																											

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											Major Ions								Metals										Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
4-429	20-Sep-13	---	---	---	Dry																											
4-429	09-Nov-13	6.6	7.79	160	0.94																											
4-429	24-Jun-14	4.6	7	136	3.21																											
5-231	13-Oct-97	3.4	7.1	244	3			140		38	5	1	<1	143	<5	17	2	<0.01	0.2	<0.01	<0.1	2.4	<0.1	<0.1	<0.1	<0.2	<0.01	1.2	<0.03		0.09	
5-231	21-Jul-98	2.8	6.2	120	3			161		38	3	1	<1	137	<5	5	1	<0.01	0.1	<0.01	<0.1	1.2	<0.1	<0.1	<0.1	<0.2	<0.01	<0.1	<0.03		<0.01	
5-231	13-Oct-98	3.5	7.8	170	2.4			148		40	4	2	<1	152	<5	6	2	<0.01	0.2	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	<0.1	<0.03		<0.05	
5-231	07-Jul-99	1.9	7.16	205	8			133		35	3	3	<1	132	<5	5	<1	<0.01	0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.34	<0.03		0.07	
5-231	19-Oct-99	2.7	7.3	231	1.4			130		40	6	2	<1	146	<5	6	<1	<0.01	0.2	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.44	<0.03		0.07	
5-231	10-Jul-00	2.9	7.42	227	2.96			117		33	5	2	<1	138	<5	5	<1	<0.01	<0.1	<0.01	<0.1	<0.1	<0.02	<0.1	<0.1	<0.2	<0.01		<0.03	<0.03	<0.05	
5-231	26-Oct-00	2.9	7.06	242	1.65																											
7-242	09-Oct-97	3.4	7.4	377	12			190		59	9	1	<1	232	<5	9	2	<0.01	0.1	<0.01	<0.1	0.6	<0.1	<0.1	<0.1	<0.2	<0.01	0.3	<0.03		0.03	
8-253	09-Oct-97	3.8	6.6	151	20+			70		24	2	1	<1	100	0	19	1	<0.01	0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.6	<0.03		0.02	
8-253	21-Jul-98	3.3	5.97	80	1.4			118		24	2	<1	<1	86	<5	2	<1	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.5	<0.03		<0.01	
8-253	13-Oct-98	4.1	7.8	100	12			91		24	3	1	<1	95	<5	2	1	<0.01	0.2	<0.01	<0.1	0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.5	<0.03		<0.05	
8-253	07-Jul-99	2.3	6.76	140	12			80		23	2	2	<1	87	<5	2	<1	<0.01	0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	2.43	<0.03		<0.05	
8-253	19-Oct-99	3.2	7	141	18			79		24	3	1	<1	90	<5	3	<1	<0.01	0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.89	<0.03		<0.05	
8-253	10-Jul-00	2.9	7.42	146	15.1			77		21	3	2	<1	86	<5	2	<1	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	<0.03	<0.05	
8-253	26-Oct-00	3.4	6.95	151	14.2																											
8-253	26-Jun-05	2.9	7.46	100	17.1																											
8-253	18-Aug-06	3.4	6.92	137	14.4																											
8-253	07-Nov-06	3.6	7.11	137	16.5																											
8-253	27-Jun-07	3.1	7.22	137	15.9																											
8-253	17-Nov-07	3.7	6.94	117	15.1																											
8-253	30-Jun-08	2.9	7.24	116	19.8																											
8-253	22-Sep-08	3.4	7.36	144	15.4																											
8-253	29-Oct-08	3.6	7.01	143	15.5																											
8-253	21-Sep-09	3.9	7.06	143	15.9																											
8-253	07-Nov-09	3.9	7.48	148	16.5																											
8-253	12-Jun-10	4.2	7.06	101	22.6																											
8-253	12-Sep-10	3.9	6.97	145	16.2																											
8-253	17-Nov-10	3.9	7.02	149	13.7																											
8-253	07-Jul-11	3.2	7.26	113	24.1																											
8-253	24-Sep-11	4	7.39	165	18.1																											
8-253	11-Nov-11	4	7.61	127	18.5																											
8-253	15-Jun-12	3.4	7.38	121	18.1																											
8-253	23-Sep-12	4.3	7.05	148	16.7																											
8-253	05-Nov-12	4.3	7.23	151	16.3																											
8-253	19-Jun-13	3.6	7.16	134	15.9																											
8-253	20-Sep-13	4.4	7.01	159	14.6																											
8-253	09-Nov-13	4.3	7.33	172	14.5																											
8-253	25-Jun-14	3.2	7.1	169	15.2																											
21-222	09-Oct-97	4.4	7.2	350	10			190		51	12	2	<1	208	<5	9	2	<0.01	0.1	<0.01	<0.1	0.8	<0.1	<0.1	<0.1	<0.2	<0.01	1	<0.03		0.02	
21-222	21-Jul-98	6.4	7.3	200	18			200		45	10	1	<1	190	<5	5	1	<0.01	<0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	1	<0.03		0.01	
21-222	13-Oct-98	4.1	7.7	280	6			196		52	12	2	<1	218	<5	7	1	<0.01	0.1	<0.01	<0.1	0.5	<0.1	<0.1	<0.1	<0.2	<0.01	1	<0.03		<0.05	
21-222	07-Jul-99	2.4	7.41	260	12			160		40	9	1	<1	178	<5	5	<1	<0.01	0.2	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	1.21	<0.03		<0.05	
21-222	19-Oct-99	3.5	7.5	339	5.5			204		55	13	2	<1	221	<5	7	<1	<0.01	0.1	<0.01	<0.1	0.1	<0.1	<0.1	<0.1	<0.2	<0.01	1.51	<0.03		<0.05	

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										Major Ions								Metals									Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
21-222	11-Jul-00	3.2	7.49	309	6.60			188		48	11	<1	<1	196	<5	6	<1	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	><0.01		<0.03	0.91	<0.05	
21-222	21-Aug-06	4.9	7.08	313	6.98																											
21-222	07-Nov-06	5	7.25	313	6.76																											
21-222	28-Jun-07	4.1	7.35	297	8.24																											
21-222	25-Sep-07	6	7.59	300	5.54																											
21-222	14-Nov-07	5.1	7.23	301	4.93																											
21-222	09-Jul-08	3.5	6.93	280	12.3																											
21-222	30-Sep-08	5.3	7.34	351	5.64																											
21-222	28-Oct-08	4.8	7.46	366	5.28																											
21-222	30-Jun-09	3.7	6.94	287	11.9																											
21-222	21-Sep-09	5.3	7.44	361	5.98																											
21-222	11-Nov-09	5.2	7.43	371	4.78																											
21-222	22-Jun-10	3.4	7.22	235	15.2																											
21-222	25-Sep-10	5.8	7.17	353	5.86																											
21-222	25-Sep-11	5.1	7.54	360	7.30																											
21-222	11-Nov-11	5	7.64	388	6.46																											
21-222	24-Sep-12	5.9	7.39	353	4.12																											
21-222	05-Nov-12	5.7	7.7	371	3.02																											
21-222	30-Jun-13	4.8	7.19	313	8.31																											
21-222	20-Sep-13	6.1	7.52	373	5.10																											
21-222	14-Nov-13	5.5	7.52	374	4.05																											
21-222	24-Jun-14	4.2	7.39	293	10.3																											
28-110	08-Oct-97	6.5	7.2	310	2.1			200		56	10	2	<1	219	0	7	2	<0.01	0.2	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0	<0.03		0.03	
28-110	21-Jul-98	5.9	7.4	250	2			226		56	9	2	<1	224	<5	7	2	<0.01	0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	0.3	<0.03		<0.01	
28-110	13-Oct-98	5.8	7.8	330	1.8			209		55	10	2	<1	238	<5	7	2	<0.01	0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.3	<0.03		<0.05	
28-110	07-Jul-99	4.8	7.48	327	1.3			194		53	9	2	<1	219	<5	7	1	<0.01	0.2	<0.01	<0.1	1.8	<0.1	<0.1	0.2	<0.2	<0.01	0.52	<0.03		<0.05	
28-110	19-Oct-99	5.5	7.42	343	1.9			204		58	11	3	<1	225	<5	7	1	<0.01	0.2	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	1.21	<0.03		<0.05	
28-110	11-Jul-00	5.6	7.37	348	1.15			216		57	10	1	<1	222	<5	7	1	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	0.31	<0.05	
28-110	27-Oct-00	5.8	7.22	339	2.21																											
28-110	31-Jul-06	7.5	7.46	335	1.85																											
28-110	18-Nov-06	5.1	7.57	333	1.85																											
28-110	28-Jun-07	6.1	7.78	339	1.96																											
28-110	27-Sep-07	7.2	7.76	309	1.76																											
28-110	22-Dec-07	4.6	7.74	303	1.42																											
28-110	28-Jun-08	5.2	7.08	345	2.94																											
28-110	22-Sep-08	6.1	7.49	340	1.96																											
28-110	28-Oct-08	6.7	7.49	347	2.10																											
28-110	29-Jun-09	5.4	7.45	341	2.49																											
28-110	21-Sep-09	6.9	7.47	348	2.10																											
28-110	11-Nov-09	5.6	7.52	350	2.10																											
28-110	22-Jun-10	5	7.51	343	2.55																											
28-110	25-Sep-10	7.5	7.35	356	1.99																											
28-110	24-Sep-11	6.3	7.73	373	2.53																											
28-110	11-Nov-11	5.5	7.68	375	2.44																											
28-110	24-Sep-12	7.1	7.57	342	2.04																											
28-110	04-Dec-12	5.4	7.45	350	1.91																											
28-110	30-Jun-13	6.2	7.52	364	2.09																											
28-110	20-Sep-13	7.5	7.52	361	1.89																											
28-110	14-Nov-13	5.5	7.61	360	1.96																											

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										Major Ions								Metals										Nutrients				
Site	Date	Temp °C	pH	Cond µS/cm	Flow gpm	Turb NTU	D O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
28-110	24-Jun-14	5	7 57	347	2 41																										
29-133	08-Oct-97	8 5	7 2	278	20			180		60	5	2	<1	205	<5	6	2	<0 01	0 3	<0 01	<0.1	<0 1	<0.1	<0 1	<0.1	<0 2	<0.01	0	<0 03		0.03	
29-133	21-Jul-98	3 4	6 9	230	60			212		60	4	1	<1	205	<5	6	1	<0 01	0 1	<0 01	<0.1	<0 1	<0.1	<0 1	<0.1	<0 2	<0.01	0.3	<0.03		0 02	
29-133	13-Oct-98	3.4	7 8	270	15			203		61	4	2	<1	224	<5	5	2	<0.01	0 1	<0.01	<0 1	<0 1	<0 1	<0 1	<0 1	<0 2	<0.01	0.4	<0 03		<0 05	
29-133	08-Jul-99	2 5	7 47	290	60			181		56	4	3	<1	205	<5	4	<1	<0 01	0.1	<0 01	<0.1	<0 1	<0 1	<0 1	<0 1	<0.2	<0 01	1 23	<0.03		<0.05	
29-133	19-Oct-99	2 9	7 5	322	25			195		60	7	2	<1	215	<5	6	1	<0 01	0.2	<0 01	<0 1	<0.1	<0 1	<0 1	<0.1	<0 2	<0.01	0.91	<0.03		<0 05	
29-133	12-Jul-00	3 3	7.49	331	36.6			188		62	5	<1	<1	214	<5	5	1	<0 01	<0 1	<0 01	<0.1	<0 1	<0 1	<0.1	<0 1	<0.2	<0.01		<0.03	0 4	<0 05	
29-133	21-Aug-06	3.4	7 07	332	38 7																										
29-133	07-Nov-06	3 5	7 06	327	24 0																										
29-133	28-Jun-07	3 6	7 47	331	43 9																										
29-133	25-Sep-07	3 7	7 06	270	21 1																										
29-133	14-Nov-07	3 7	7 33	273	19 5																										
29-133	09-Jul-08	3 7	7 08	341	67 7																										
29-133	30-Sep-08	3 9	7.22	342	28.6																										
29-133	28-Oct-08	3 7	7 27	345	26 3																										
29-133	30-Jun-09	3.9	7 10	335	62 1																										
29-133	21-Sep-09	3 9	7 25	341	28 8																										
29-133	11-Nov-09	3 9	7 48	349	29 5																										
29-133	22-Jun-10	3 6	7 28	309	67 9																										
29-133	25-Sep-10	4.3	7 19	334	25 4																										
29-133	25-Sep-11	4 1	7 46	363	42 1																										
29-133	11-Nov-11	4.2	7 64	364	34 1																										
29-133	24-Sep-12	4.3	7 41	326	22 2																										
29-133	05-Nov-12	4 2	7 28	343	15 4																										
29-133	30-Jun-13	4 3	7 12	338	45 0																										
29-133	20-Sep-13	4 4	7 75	347	23 8																										
29-133	14-Nov-13	4.3	7 46	349	19 7																										
29-133	24-Jun-14	4 1	7.44	357	56 4																										
29-138	08-Oct-97	6 4	7 0	478	15			280		79	7	2	<1	300	0	5	2	<0.01	0.2	<0 01	<0 1	<0 1	<0 1	<0 1	<0 1	<0.2	<0 01	0	<0 03		0.03	
29-138	21-Jul-98	4 8	7	350	30			293		85	7	2	<1	299	<5	3	13	<0 01	0.1	<0 01	<0.1	<0 1	<0.1	<0.1	<0.1	<0.2	<0.01	0.2	<0.03		<0 01	
29-138	13-Oct-98	5 9	7 6	390	1 7			270		85	8	2	<1	307	<5	4	2	<0 01	0 1	<0.01	<0 1	<0.1	<0.1	<0 1	<0.1	<0 2	<0.01	0.3	<0.03		<0 05	
29-138	08-Jul-99	3 9	7 34	420	28			251		78	7	3	<1	295	<5	3	<1	<0.01	0.2	<0.01	<0 1	<0.1	<0 1	<0 1	<0 1	<0.2	<0 01	0.65	<0.03		<0.05	
29-138	19-Oct-99	5.1	7 28	448	3.1			262		84	12	3	<1	300	<5	5	1	<0.01	0.1	<0 01	<0.1	<0 1	<0 1	<0.1	<0 1	<0 2	<0.01	0.71	<0.03		<0 05	
29-138	12-Jul-00	4.8	7 27	444	19 4			273		84	7	1	<1	296	<5	4	<1	<0 01	<0 1	<0.01	<0 1	<0.1	<0 1	<0 1	<0.1	<0.2	<0 01		<0.03	0 27	<0.05	
29-138	21-Aug-06	5 5	6.85	449	13 5																										
29-138	07-Nov-06	5 9	6 9	438	7 39																										
29-138	28-Jun-07	4.7	7 37	441	42 9																										
29-138	25-Sep-07	6 3	7 43	379	4 84																										
29-138	14-Nov-07	5 6	7 17	392	3 16																										
29-138	09-Jul-08	4 5	7 12	422	97 0																										
29-138	30-Sep-08	6 3	7 16	441	6 38																										
29-138	28-Oct-08	5 8	7 2	446	4 52																										
29-138	30-Jun-09	4 8	7 13	435	76 6																										
29-138	21-Sep-09	6 3	7 21	440	6 58																										
29-138	11-Nov-09	6	7 27	449	4 10																										
29-138	22-Jun-10	4 3	7 35	407	103																										
29-138	25-Sep-10	6 9	7 15	456	5 15																										
29-138	25-Sep-11	6	7.22	468	10 3																										

											Major Ions								Metals											Nutrients				
Site	Date	Temp °C	pH	Cond µS/cm	Flow gpm	Turb NTU	D O mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
29-138	11-Nov-11	6	7 58	480	5 44																												
29-138	24-Sep-12	6 6	7.34	445	3 81																												
29-138	05-Nov-12	6 2	7 53	459	2 60																												
29-138	30-Jun-13	5 2	7 33	444	44 0																												
29-138	20-Sep-13	6 6	7 36	473	5 86																												
29-138	14-Nov-13	5 9	7 48	474	3 73																												
29-138	24-Jun-14	4 7	7 29	476	103																												
32-183	09-Oct-97	4 2	6 9	230	4			140		32	5	2	<1	136	<5	6	2	<0 01	0 2	<0 01	<0 1	<0.1	<0.1	<0 1	<0 1	<0.2	<0.01	0.4	<0 03		0 02	
32-183	21-Jul-98	3 6	5 9	80	17			131		23	4	1	<1	95	<5	4	1	<0 01	<0 1	<0 01	<0 1	<0 1	<0 1	<0.1	<0 1	<0 2	<0 01	0 3	<0 03		<0.01	
32-183	13-Oct-98	3 8	7 5	160	4			134		32	6	2	<1	133	<5	6	1	<0 01	0 2	<0 01	<0 1	<0.1	<0.1	<0 1	<0 1	<0.2	<0 01	0 4	<0.03		<0 05	
32-183	07-Jul-99	2 5	7 03	134	20			91		22	4	1	<1	95	<5	4	<1	<0 01	0 2	<0 01	<0.1	0 1	<0.1	<0.1	<0 1	<0 2	<0.01	0.4	<0.03		<0 05	
32-183	19-Oct-99	1 9	7 88	193	3 2			117		33	7	2	<1	140	<5	6	<1	<0.01	0.1	<0.01	<0 1	<0 1	<0 1	<0 1	<0 1	<0 2	<0 01	0 64	<0 03		<0.05	
32-183	11-Jul-00	4 9	7 93	174	5 04			119		27	5	1	<1	102	<5	5	<1	<0 01	<0 1	<0 01	<0 1	<0 1	<0 1	<0 1	<0 1	<0 2	<0 01		<0 03	0 37	<0.05	
32-183	26-Oct-00	2 1	7 46	212	0 99																												
32-277	13-Oct-97	6 1	7 5	208	1 5			180		41	7	1	<1	163	<5	10	2	<0 01	0.2	<0 01	<0 1	<0 1	<0 1	<0 1	<0 1	<0 2	<0 01	0.9	<0 03		0.04	
32-277	21-Jul-98	5 2	6 1	150	2.1			176		40	6	2	<1	154	<5	7	1	<0.01	0 1	<0 01	<0 1	<0 1	<0 1	<0 1	<0 1	<0 2	<0 01	0 9	<0 03		<0 01	
32-277	13-Oct-98	5 9	7 9	240	0 75			181		44	8	2	1	189	<5	8	1	<0 01	0 2	<0 01	<0.1	0 9	<0.1	<0 1	<0.1	<0.2	<0 01	0 4	<0.03		<0 05	
32-277	07-Jul-99	4 2	7 33	228	3			137		36	6	1	<1	147	<5	6	<1	<0 01	0 2	<0 01	<0.1	1 8	<0 1	<0.1	<0.1	<0 2	<0.01	1.2	<0.03		<0 05	
32-277	19-Oct-99				Damp																												
32-277	11-Jul-00	5 6	7 64	268	1 36			177		43	7	<1	<1	160	<5	8	<1	<0.01	<0 1	<0 01	<0 1	<0.1	<0.1	<0 1	<0 1	<0 2	<0 01		<0 03	0 89	<0 05	
32-277	27-Oct-00	6 1	7 30	213	0 88																												
32-277	31-Jul-06	5 8	7 08	275	1 613																												
32-277	18-Nov-06	6 1	7 28	259	1 064																												
32-277	27-Jun-07	6 1	7 75	265	1 020																												
32-277	27-Sep-07	7 4	7 36	291	0 606																												
32-277	20-Dec-07	6	7 33	234	0.563																												
32-277	24-Jun-08	4 8	7 61	156	10 4																												
32-277	22-Sep-08	6 2	7 21	275	0 977																												
32-277	28-Oct-08	6 7	7 26	279	0 857																												
32-277	30-Jun-09	5 2	7 24	214	3 80																												
32-277	28-Sep-09	6.9	7.16	289	0 949																												
32-277	04-Dec-09	6 3	7 19	309	0 877																												
32-277	12-Jun-10	5 3	7 39	155	8 215																												
32-277	25-Sep-10	7 8	7 14	296	0.721																												
32-277	25-Sep-11	6 1	7 39	299	1 430																												
32-277	17-Nov-11	6 2	7 47	296	1 240																												
32-277	24-Sep-12	7 6	7 47	294	0 617																												
32-277	04-Dec-12	6 7	7.46	321	0 570																												
32-277	30-Jun-13	6 3	7 14	283	0 888																												
32-277	20-Sep-13	7 8	7 38	316	0 514																												
32-277	01-Dec-13	5 1	7 26	333	0 455																												
32-277	24-Jun-14	5 2	7 46	204	2 239																												
32-279	09-Oct-97	7 2	7 3	360	2.8			230		57	15	2	<1	247	<5	11	2	<0 01	0 1	<0.01	<0 1	<0.1	<0 1	<0 1	<0 1	<0 2	<0 01	1	<0 03		0.01	
32-279	21-Jul-98	5 6	7 2	210	2.8			234		52	14	1	<1	224	<5	5	1	<0 01	0 1	<0 01	<0.1	<0.1	<0 1	<0 1	<0 1	<0.2	<0 01	0 7	<0 03		<0 01	
32-279	13-Oct-98	5 9	7 4	310	0 9			240		57	17	2	<1	259	<5	10	2	<0 01	0 1	<0 01	<0 1	<0 1	<0.1	<0 1	<0.1	<0 2	<0 01	0 9	<0.03		<0 05	
32-279	07-Jul-99	4 3	7 44	283	6			190		47	12	1	<1	215	<5	6	<1	<0.01	0 2	<0 01	<0.1	<0.1	<0 1	<0 1	<0 1	<0 2	<0.01	1 49	<0 03		<0 05	
32-279	19-Oct-99	5 4	7.4	387	1 6			224		58	17	3	<1	250	<5	10	<1	<0.01	0.2	<0 01	<0.1	<0 1	<0 1	<0 1	<0 1	<0.2	<0 01	1.08	<0 03		<0.05	

										Major Ions								Metals										Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
32-279	11-Jul-00	5.1	7.65	316	1.56			231		55	15	1	<1	242	<5	9	<1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	0.76	<0.05	
32-279	27-Oct-00	4.8	7.09	382	2.91																											
33-268	13-Oct-97	3.4	6.6	114	1			70		14	3	1	<1	46	<5	9	2	<0.01	0.1	<0.01	<0.1	0	<0.1	<0.1	<0.1	<0.2	<0.01	0.9	<0.03		0.12	
33-268	13-Oct-98	3.9	8.1	60	0			73		13	1	2	<1	46	<5	5	2	<0.01	0.1	<0.01	<0.1	6.9	<0.1	<0.1	<0.1	<0.2	<0.01	0.9	<0.03		<0.05	
33-268	23-Aug-06	5.1	6.89	90	3.11																											
33-268	18-Nov-06	2.8	7.05	94	0.96																											
33-268	27-Jun-07	5.5	8.24	91	5.87																											
33-268	27-Sep-07	5.2	7.08	87	0.88																											
33-268	20-Dec-07	2.1	7.16	80	0.96																											
33-268	24-Jun-08	3.7	7.72	79	6.42																											
33-268	22-Sep-08	4.6	7.25	93	0.96																											
33-268	27-Dec-08	0.1	7.59	95	1.06																											
33-268	30-Jun-09	4.1	6.94	82	3.03																											
33-268	28-Sep-09	5.7	7.1	95	0.95																											
33-268	04-Dec-09	2.8	7.97	98	0.92																											
33-268	12-Jun-10	4.4	6.83	70	6.20																											
33-268	25-Sep-10	6	6.73	79	0.92																											
33-268	25-Sep-11	5.5	7.2	97	0.96																											
33-268	17-Nov-11	4	7.29	108	2.08																											
33-268	24-Sep-12	6.4	6.98	82	0.87																											
33-268	04-Dec-12	3.6	7.33	107	0.79																											
33-268	30-Jun-13	7	7.21	84	0.91																											
33-268	20-Sep-13	6.6	6.68	96	0.82																											
33-268	01-Dec-13	3.6	7.4	112	0.73																											
33-268	24-Jun-14	4.2	7.42	63	0.77																											
MSS-1	11-Sep-97	6	7.7	370				240		59	9	2	<1	236	<5	10	2	<0.01	<0.1	<0.01	<0.1	0.9	<0.1	<0.1	<0.1	<0.2	<0.01	0.4	<0.01		0.03	
MSS-1	12-Jul-00	3.8	7.71	378	1.05			216		65	9	<1	<1	243	<5		<1	<0.01	<0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	0.31	<0.05	
MST-1	11-Sep-97	9.6	7.8	369				200		62	8	1	<1	237	<5	0	1	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.3	<0.01		0.03	
MST-2	11-Sep-97	8	8.2	195.2				140		30	2	2	<1	112	<5	0	2	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.3	<0.01		0.03	
MST-3	11-Sep-97	7.9	7.8	423				250		57	16	2	<1	270	<5	6	2	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.2	<0.01		0.02	
MST-3	21-Jul-98	20	8.2	230	15																											
MST-3	12-Jul-00	7.9	7.56	405	1.66			222		58	17	<1	<1	257	<5	5	<1	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	1.15	<0.05	
Creeks																																
C-1	20-Oct-97	3.2	7.7	239	0.88		4.2	140	<5	34	4	4	<1	119	0	17	4	<0.01	0.1	<0.01	0.2	0.7	<0.1	<0.1	<0.1	<0.2	<0.01	0.1	<0.03		0.02	<2
C-1	21-Jul-98	13.5	7.9	200	325			170	<5	38	3	2	<1	132	<5	10	2	<0.01	0.1	<0.01	<0.1	0.6	<0.1	<0.1	<0.1	<0.2	<0.01	0.2	<0.01		0.01	<2
C-1	12-Oct-98	6.7	8.5	180	292			151	7	39	6	3	1	134	<5	18	4	<0.01	0.2	<0.01	0.1	0.7	<0.1	<0.1	<0.1	<0.2	<0.01	0.2	<0.03		<0.05	<2
C-1	08-Jul-99	12.7	8.14	195	628			137	<5	37	4	<1	<1	126	<5	9	2	<0.01	0.2	<0.01	0.1	0.6	<0.1	<0.1	<0.1	<0.2	<0.01	0.34	<0.03		<0.05	<2
C-1	19-Oct-99	-0.3	7.95	252	140		5.2	154	8	44	5	3	<1	140	<5	22	3	<0.01	0.2	<0.01	<0.1	0.6	<0.1	<0.1	<0.1	<0.2	<0.01	0.71	<0.03		<0.05	<2
C-1	10-Jul-00	14.7	8.29	253	295		10.3	145	<5	34	5	3	<1	129	<5	15	4	<0.01	0.1	<0.01	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.01		<0.03	<0.03	<0.05	<2
C-2	21-Jul-98	13.2	8.2	220	211			183	15	46	5	2	<1	145	11	6	2	<0.01	<0.1	<0.01	<0.1	0.3	<0.1	<0.1	<0.1	<0.2	<0.01	0.4	<0.03		0.02	<2
C-2	12-Oct-98	3.4	8.5	180	16			176	<5	47	7	2	1	181	<5	9	3	<0.01	0.2	<0.01	<0.1	0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.4	<0.03		<0.05	<2
C-2	07-Jul-99	13.4	8.4	244	115			151	<5	44	5	<1	<1	158	<5	4	<1	<0.01	0.1	<0.01	<0.1	0.1	<0.1	<0.1	<0.1	<0.2	<0.01	1.09	<0.03		<0.05	<2
C-2	19-Oct-99	-0.6	7.97	324	21		4.6	214	6	60	8	3	<1	216	<5	11	2	<0.01	0.2	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01	1	<0.03		<0.05	<2

Div. of Oil, Gas & Mining
FEB 13 2017
INCORPORATED

										Major Ions								Metals										Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
C-2	10-Jul-00	11.4	7.96	287	90		8.28	176	<5	50	7	<1	<1	174	<5	7	2	<0.01	0.2	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	<0.03	<0.05	2
C-3	20-Oct-97	2.8	8.3	322	1.54		5.4	180	<5	53	7	3	<1	210	<5	8	3	<0.01	0.1	<0.01	<0.1	0.3	<0.1	<0.1	<0.1	<0.2	<0.01	0.2	<0.03		0.01	<2
C-3	21-Jul-98	13.1	8.5	230	300			200	7	52	5	1	<1	172	12	4	<1	<0.01	<0.1	<0.01	<0.1	0.5	<0.1	<0.1	<0.1	<0.2	<0.01	0.1	0.14		0.02	3
C-3	12-Oct-98	6.7	8.3	220	32			178	<5	45	8	2	1	180	<5	7	2	<0.01	0.4	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	0.2	<0.03		<0.05	<2
C-3	07-Jul-99	13.4	8.5	218	300			177	9	52	5	<1	<1	182	7	4	<1	<0.01	0.1	<0.01	<0.1	0.3	<0.1	<0.1	<0.1	<0.2	<0.01	0.4	<0.03		<0.05	<2
C-3	19-Oct-99	-0.5	8.2	306	200		4.4	213	5	59	7	2	<1	215	<5	8	<1	<0.01	0.2	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	0.54	<0.03		<0.05	<2
C-3	10-Jul-00	11.3	8.39	304	329		9.28	163	<5	53	7	1	<1	190	<5	15	<1	<0.01	0.1	<0.01	<0.1	0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	<0.03	<0.05	<2
C-4	20-Oct-97	5.7	8.3	279	4.5		5.1	140	<5	39	6	4	<1	161	0	7	6	<0.01	0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	0.9	<0.03		0.02	<2
C-4	21-Jul-98	14.8	8.1	250	1828			190	<5	46	7	2	<1	148	14	5	3	<0.01	<0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	0.1	<0.03		<0.01	<2
C-4	12-Oct-98	10.1	8.3	200	964			144	5	38	7	2	<1	158	<5	5	4	<0.01	0.2	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	0.1	<0.03		<0.05	<2
C-4	08-Jul-99	14.4	8.51	270	3120			168	6	46	6	1	<1	171	<5	5	2	<0.01	0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	1.28	<0.03		<0.05	<2
C-4	19-Oct-99	5.2	8.25	255	450		4.2	161	<5	42	7	3	<1	160	<5	5	3	<0.01	0.1	<0.01	<0.1	0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.41	<0.03		<0.05	<2
C-4	10-Jul-00	17.9	8.48	254	1522		8.13	133	<5	33	7	3	<1	146	3	5	3	<0.01	<0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	<0.03	<0.05	<2
C-5	20-Oct-97	4.6	7.5	244	0.36		4.8	140	16	36	5	3	<1	148	<5	6	2	<0.01	0.1	<0.01	<0.1	0.3	<0.1	<0.1	<0.1	<0.2	<0.01	0.3	<0.03		0.03	<2
C-5	23-Jul-98	8.8	8	170	44.6			153	<5	33	5	2	<1	138	<5	4	1	<0.01	<0.1	<0.01	<0.1	0.1	<0.1	<0.1	0.1	<0.2	<0.01	0.3	<0.03		<0.05	<2
C-5	13-Oct-98	5.6	7.6	190	20			165	<5	42	7	3	<1	170	<5	5	2	<0.01	<0.1	<0.01	<0.1	0.3	<0.1	<0.1	<0.1	<0.2	<0.01	0.2	<0.03		<0.05	<2
C-5	08-Jul-99	9	8.07	192	70			118	5	31	5	2	<1	123	<5	4	1	<0.01	0.1	<0.01	<0.1	0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.45	<0.03		<0.05	<2
C-5	19-Oct-99	1.6	7.76	266	23		4.2	155	7	42	7	2	<1	161	<5	4	1	<0.01	0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	0.61	<0.03		<0.05	<2
C-5	10-Jul-00	12.1	7.86	244	37.0		7.88	117	<5	33	6	2	<1	148	<5	3	<1	<0.01	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	<0.03	<0.05	<2
C-5	27-Oct-00	3.7	7.84	259	17.7																											
C-5	18-Aug-06	9.6	7.57	202	4.98	0.78	7.28																									
C-5	07-Nov-06	5.4	7.33	160	2.61		6.59																									
C-5	23-Jun-07	9.8	8.33	145	32.4		7.2																									
C-5	27-Sep-07				Dry																											
C-5	17-Nov-07				Dry																											
C-5	30-Jun-08	13.3	8.23	136	165		7.49																									
C-5	23-Sep-08	5.5	7.53	219	1.53																											
C-5	29-Oct-08	3.4	7.26	238	0.151																											
C-5	26-Jun-09	9.8	7.96	140	90.4																											
C-5	28-Sep-09				Dry																											
C-5	11-Nov-09				Dry																											
C-5	19-Jun-10	9.4	8.28	129	142	5.04	8.82																									
C-5	25-Sep-10				Dry																											
C-5	17-Nov-11	0.9	8.19	192	5.73	5.10	9.60																									
C-5	23-Sep-12				Dry																											
C-5	04-Dec-12				Dry																											
C-5	30-Jun-13	9	8.06	166	7.46																											
C-5	10-Sep-13				Dry																											
C-5	14-Nov-13				Dry																											
C-5	14-Nov-13				Dry																											
C-5	25-Jun-14	14	8.01	162	123																											
C-6	19-Oct-99	1.2	8.23	268	91		5.1	169	6	46	7	4	<1	169	<5	7	5	<0.01	0.2	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	0.66	<0.03		<0.05	<2
C-6	10-Jul-00	9.9	8.69	201	215		11	105	7	28	5	2	<1	94	13	4	2	<0.01	<0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	<0.03	<0.05	<2
C-6	23-Aug-06	14.2	8.33	240	146	3.19	7.41																									
C-6	14-Dec-06	0.5	8.34	273	144		11.2																									
C-6	27-Jun-07	21.0	8.59	188	171	4.6	9.72																									

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											Major Ions								Metals										Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
C-6	27-Sep-07	10.9	8.6	229	109		9.95																									
C-6	20-Dec-07	0.1	8.15	238	98																											
C-6	23-Jun-08	16.2	8.16	135	1544		7.02																									
C-6	22-Sep-08	8.1	8.56	227	133																											
C-6	27-Dec-08	0.2	8.01	306	95																											
C-6	30-Jun-09	16.3	8.26	205	398																											
C-6	28-Sep-09	12.5	8.97	194	100																											
C-6	04-Dec-09	0.4	8.17	322	143																											
C-6	19-Jun-10	13.3	8.44	173	746	8.63	8.07																									
C-6	12-Sep-10	13.6	9.05	186	116																											
C-6	25-Sep-11	10.5	8.78	202	374																											
C-6	17-Nov-11	0.4	8.23	282	281	1.92	9.62																									
C-6	23-Sep-12	10.8	8.67	212	95																											
C-6	04-Dec-12	0.4	8.15	281	130																											
C-6	30-Jun-13	21.7	8.67	204	131																											
C-6	22-Sep-13	8.3	8.15	276	110																											
C-6	22-Sep-13	8.8	8.65	282	124																											
C-6	01-Dec-13	0.2	8.44	331	69.4	3.21	10.6																									
C-6	24-Jun-14	14.4	8.81	177	204																											
C-7	19-Oct-99	4.9	8.35	236	530		5.3	151	9	41	7	2	<1	172	<5	3	<1	<0.01	0.1	<0.01	<0.1	0.2	<0.1	<0.1	<0.1	<0.2	<0.01	0.34	<0.03		<0.05	<2
C-7	10-Jul-00	15.7	8.31	267	1021		9.06	126	<5	35	7	2	<1	150	5	5	2	<0.01	<0.1	<0.01	<0.1	0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	<0.03	<0.05	<2
C-7	23-Aug-06	17	8.26	239	627	5.20	7.45																									
C-7	14-Dec-06	0.5	8.3	259	455		8.84																									
C-7	28-Jun-07	17.9	8.57	286	1042																											
C-7	27-Sep-07	10.5	8.71	214	357		7.95																									
C-7	20-Dec-07	0.7	8.41	212	487																											
C-7	24-Jun-08	12.4	8.27	262	6306																											
C-7	22-Sep-08	11	8.87	206	588																											
C-7	27-Dec-08	0.1	8.04	280	562																											
C-7	30-Jun-09	15.8	8.28	295	2169																											
C-7	28-Sep-09	13.6	8.6	222	356																											
C-7	04-Dec-09	0.9	7.98	287	278																											
C-7	12-Jun-10	8.6	8.64	244	7392	9.11	8.3																									
C-7	12-Sep-10	11.6	8.56	230	441																											
C-7	25-Sep-11	11.7	8.89	245	890																											
C-7	17-Nov-11	1	8.18	313	693	3.38	9.56																									
C-7	24-Sep-12	12.7	8.7	211	346																											
C-7	04-Dec-12	1.4	8.21	313	332																											
C-7	30-Jun-13	18.4	8.39	306	875																											
C-7	22-Sep-13	11.9	8.88	245	306																											
C-7	01-Dec-13	1.1	8.27	324	281	2.66	10.3																									
C-7	25-Jun-14	16.2	8.74	316	1269																											
C-8	19-Oct-99	4.2	8.4	252	390		5.5	156	<5	44	6	2	<1	164	<5	4	1	<0.01	0.1	<0.01	<0.1	0.1	<0.1	<0.1	<0.1	<0.2	<0.01	0.76	<0.03		<0.05	<2
C-8	10-Jul-00	13.6	8.38	284	1039		9.89	143	<5	40	7	2	<1	162	6	5	2	<0.01	0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.01		<0.03	<0.03	<0.05	<2
C-8	23-Aug-06	15.4	8.03	274	557	1.97	8.57																									
C-8	14-Dec-06	0.5	8.55	259	725		11																									
C-8	27-Jun-07	13.3	8.41	284	910	14.5	7.57																									
C-8	27-Sep-07	10.5	8.72	231	428		8.15																									

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										Major Ions							Metals								Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
C-8	17-Nov-07	3.1	8.31	217	470	1.64	9.92																								
C-8	24-Jun-08	13.5	8.62	257	6097		8.95																								
C-8	22-Sep-08	9	8.69	254	670																										
C-8	27-Dec-08	0.1	8.34	252	357																										
C-8	30-Jun-09	15	8.41	295	2255																										
C-8	28-Sep-09	10.2	8.51	255	593																										
C-8	11-Nov-09	3.7	8.51	250	784																										
C-8	12-Jun-10	8.8	8.58	245	6662	11.3	8.25																								
C-8	12-Sep-10	12.5	8.7	247	543																										
C-8	25-Sep-11	9.2	8.36	274	962																										
C-8	17-Nov-11	1.4	8.41	301	798	1.83	10.3																								
C-8	24-Sep-12	10.5	8.59	230	429																										
C-8	04-Dec-12	0.9	8.26	290	585																										
C-8	30-Jun-13	13.8	8.42	306	1208																										
C-8	22-Sep-13	7.3	8.67	274	657																										
C-8	01-Dec-13	1	8.65	305	467	1.67	10.9																								
C-8	24-Jun-14	9.3	8.33	299	1730																										
CS-10	30-Jul-81	12			184		8.8	145	1					132		24	3.29								0.03						
CS-10	22-Oct-81	1			305		11.5	155	6.5					154		18	3.6								0.06						
CS-10	10-Nov-81	2			269		13.2	135	1					112		25.8	3	< .001	0.01	< .001	0.14		< .001		0.06	< .001	0.1				0.4
CS-10	08-Dec-81	0						150	3					115		31	2.6								0.05						
CS-10	28-Jun-82	10	7.4	273																											
CS-10	21-Jul-82	9	7.7	392	987																										
CS-10	18-Aug-82	11	8.3	213	368		8.2	160	5					130		14	14.7								0.05		0.11				0.6
CS-10	15-Sep-82	6	8.6	210	494																										
CS-10	15-Oct-82	2	8	198	1661																										
CS-10	28-Jun-83	12	7.8	125	6135																										
CS-10	19-Jul-83	15	7.6	152	2356																										
CS-10	24-Aug-83	9	6.8	250	588		6.8	136	16					139		10	2								0.09		< .02				< .2
CS-10	27-Sep-83	9	6.4	224	1091																										
CS-10	20-Oct-83	5	7.2	232	449																										
CS-10	24-May-84	7.1	7.1	111																											
CS-10	26-Jun-84	10	6.3	170	3896																										
CS-10	31-Jul-84	12	6.9	221	1131																										
CS-10	24-Aug-84	9	6.8	117	589		8.4	190	13	48	8.4	24	0.61	183		< 10.	20								0.11		0.06				< .1
CS-10	27-Sep-84	9	7.2	245	557																										
CS-10	13-Nov-84	0.5	7.4	175																											
CS-10	21-May-85	5	7.4	108	12746																										
CS-10	19-Jun-85	15	7.2	282	1418																										
CS-10	17-Jul-85	13	7.4	360	404																										
CS-10	28-Aug-85	10	7.5	246	229		7.	158	3	44.4	4.1	18	1.03	134		17	1.8								0.04		0.46				< .1
CS-10	24-Sep-85	8	7.4	254	404																										
CS-10	15-Oct-85	6	7.1	232	346																										
CS-10	27-May-86	7	6.9	74																											
CS-10	19-Jun-86	13	7.6	147	4142																										
CS-10	22-Jul-86	10	7.2	252	539																										
CS-10	19-Aug-86	14	7.6	266	301			144	< 1.					129		22	5.5								0.04		0.15				0.6
CS-10	24-Sep-86	5	7.6	244	337																										
CS-10	16-Oct-86	3	7.6	209	269																										

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Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
CS-10	13-Nov-86	0.5	7.5	218																												
CS-10	11-Dec-86				0																											
CS-10	22-Jan-87				0																											
CS-10	18-May-87	9	7.2	126	3442																											
CS-10	16-Jun-87	12	7.6	193	938																											
CS-10	28-Jul-87	12	7.5	211	215																											
CS-10	19-Aug-87	14	8.1	241	144		9	146	< 1.					160		16	1.6								0.04			0.59				< .1
CS-10	22-Sep-87	6	7.8	247	99																											
CS-10	19-Oct-87	4	8.1	250	144																											
CS-10	18-Aug-88	9.5	7	292	31		7.6	180	1					144		39	3								0.05			0.17				0.3
CS-10	21-Jun-89	13	7.4	262	745			114	1					124		10	1.6								0.05			0.16				
CS-10	06-Sep-89	12	6.8	660	126		8.9	135	< 1.					127		29	1.8	< .001		0.16		< .001	0.06		0.08			0.15				
CS-10	17-Oct-89	1	7.7	235	112			158	2	45.54	5.66	1.63	1.09	133		26	2.5								0.06			0.18				
CS-10	05-Jun-90	10	7.2	132	1894			80	8	24.18	2.24	3.6	< .5	84		7	1.3								< .01			0.08				
CS-10	11-Sep-90	14.7	7.5	291	151		9.5	152	2	42.18	6.11	1.7	1.07	144		20.2	2	< .005		0.02		< .001	0.02		0.04			0.24	< .02			
CS-10	24-Oct-90	7	7.4	281	242			162	4	43.28	5.19	1.79	1.46	143		23.8	2.8								0.06			0.11				
CS-10	12-Jun-91	8	7.48	123	5718			102	9	21.77	2.26	3.84	1.01	63		6.3	1.6								< .033			0.17				
CS-10	05-Sep-91	9.8	7.22	281	108		6.8	142	< 1.	51.51	5.83		0.88	142		19.3	1.8	< .05		0.11		< .003	< .018		0.02			0.19				
CS-10	16-Oct-91	6	7.84	284	126			156	< 1.	46.31	5.69	1.69	< .7	138		23.8	3								0.03			< .68				
CS-10	10-Jun-92	9	7.68	240	579			154	2					117	0.9	11.9	1.2								0.05			0.23				
CS-10	02-Sep-92	8.5	7.48	315	139		8.3	144	< .1					129	1.7	21.1	3.2	< .07		0.19		0.01	0.05		0.06			0.29				
CS-10	21-Oct-92	3.3	7.64	325				154	< 1.					143	2.1	25.3	2.9								0.05			0.34				
CS-10	28-Jun-93	15	7.83	201	1665			92	5					88.7	0.6	6.9	1.92								0.03			< .1				
CS-10	25-Aug-93	13	7.83	300			8	120	6					138	2.5	15.9	2.38	< .1		0.27		< .003	0.03		0.05			0.25				
CS-10	27-Oct-93	2	7.74	312				150	< 1.					125	1.3	24.8	2.94								0.06			0.12				
CS-10	19-Jun-95	13.35	8.3	161	10637		6.67	100	5					65	5	4	2								< .1						0.04	< 5.
CS-10	05-Sep-95	13.6	7.89	291	224		7.4	140	< 5.					150		13	2	< .1		0.3		< .1	< .1		< .1						0.02	
CS-10	18-Oct-95	3.12	7.72	312	211			150	< 5.					130		18	3								< .1						0.02	
CS-10	24-Jun-96	10.51	7.3	227	2038			111	7	32	3	2	< 1.	112		6	2								< .1						< .01	
CS-10	11-Sep-96	10.6	8.36	308	115			162	22					146	< 5.	16	6	0.1		0.2		< .1	< .1		< .1						0.01	
CS-10	28-Oct-96	1.5	8.04	149	314			126	< 5.	41	6	2	1	338			4								< .1						0.02	
CS-10	19-Jun-97	11.1	7.88	206	4030			100	6	32	3	2	< 1.	93			2								< .1						0.03	
CS-10	12-Aug-97	13.19	7.62	265	597			130	20	38	4	3	< 1.	120	< 5.	15	2	< .1		0.3		< .1	< .1		< .1						0.01	
CS-10	09-Oct-97	7.19	6.12	265	292			140	7	39	5	2	< 1.	121			3								< .1						0.02	
CS-10	15-Jun-98	6.13	7.93	182	4075			93	7	23	2	1	< 1.	90			< 1.								< .1						< .01	
CS-10	11-Aug-98	13.57	7.04	282	170			146	7	42	4	2	< 1.	148	< 5.	13	< 1.	0.2		0.2		< .1	< .1		< .1						< .05	
CS-10	07-Oct-98	10.2	7.91	291	90			171	21	41	5	2	1	149			2								< .1						< .05	
CS-10	06-Jul-99	14.58	7.79	264	489			124	10	35	4	1	< 1.	125			< 1.								< .1						< .05	
CS-10	18-Aug-99	10.75	7.71	311	99			149	< 5.	39	5	< 1.	< 1.	139	< 5.	14	< 1.	< .1		< .1		< .1	< .1		< .1						< .05	
CS-10	06-Oct-99	6.44	7.97	320	66		8.9																									
CS-10	06-Oct-99							139	< 5.	41	6	2	< .1	134			< 1.								< .1						< .05	
CS-10	27-Jun-00	11.02	7.79	283	102			138	< 5.	39	4	2	< 1.	126	< 5.	11	1								< .1						< .05	
CS-10	08-Aug-00	10	7.3	331	24		5.69	142	< 5.	44	6	1	< 1.	146	< 5.	26.3	1	< .1		< .1		< .1	< .1		< .1						< .05	
CS-10	09-Oct-00	-14.4	7.69	346	62			200	< 5.	43	6	2	1	135		24	1								< .1						< .05	
CS-10	18-Jun-01	16.3	7.8	284	439			126	5	35	4	2	< 1.	119		12	1								< .1						< .05	
CS-10	05-Sep-01	11.5	8.04	336	80.8		8.43	162	< 5.	44	6	2	< 1.	120	< 5.	21	1.2	< .06		< .1		< .1	< .05		< .05						< .05	
CS-10	25-Oct-01	2.1	7.53	255	137			167	< 5.	46	6	2	< 1.	154		25.1	1.8								< .05			0.18			< .05	
CS-10	13-Jun-02	12.3	7.7	284	491			133	12	38	5	4	< 1.	106	< 5.	11	< 1.								< .05						< .05	
CS-10	25-Sep-02	7.9	8.05	349	102		7.97	203	< 5.	44	6	3	< 1.	144		27	2	0.07		< .1		< .1	< .05		< .05			0.09			0.15	
CS-10	05-Nov-02	0.4	8.28	270	136			180	5	47	7	2	< 1.	135	< 5.	33	3								< .05				< .03		< .05	

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Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
CS-10	25-Jun-03	10.4	8.09	209	1073			105	6	35.8	4.37	1.02	< .5	109		11	5								0.04						< .05	
CS-10	29-Sep-03	8.1	7.26	269	225		6.73	160	10	47.5	6.19	1.7	1.07	145	< 5.	26	2	< .005		0.04		< .005	0.02	0.03							< .05	
CS-10	06-Nov-03	0.6	8.32	273	163			149	< 5.	44.7	6.37	1.59	1.41	114	< 5.	29	6								0.03			0.17			< .05	
CS-10	24-Jun-04	12.1	8.24	227	476			121	5	38	4.16	1.29	0.57	103	< 5.	13	2								0.03			0.15	< .05		< .05	
CS-10	08-Sep-04	7.2	8.36	284	66		5.77	158	< 5.	47	5.74	1.59	1.04			23	2	< .01		0.11		< .01	0.02	0.02				0.15			< .05	
CS-10	09-Nov-04	1	7.9	253	280			172	< 5.	39.4	5.71	1.57	0.95			23	17								0.09			0.11			< .05	
CS-10	16-Jun-05	11.2	8.21	134	2920		7.44	80	< 5.	26.3	2.7	1.22	0.55			5	< 1.			0.06			0.02	0.03				0.08			< .05	
CS-10	08-Sep-05	9.1	8.05	245	109		6.96																									
CS-10	17-Nov-05	0.6	8.17	200	215																											
CS-10	30-Jun-06	11.3	7.89	229	731																											
CS-10	20-Sep-06	5	8.28	232	235																											
CS-10	14-Dec-06	1.5	8.26	220	82.6																											
CS-10	28-Jun-07	14.2	8.32	231	366																											
CS-10	27-Sep-07	6.4	8.35	220	147																											
CS-10	22-Dec-07	0.4	8.18	167	170																											
CS-10	24-Jun-08	14	8.35	140	2850																											
CS-10	19-Sep-08	6.4	8.01	224	166																											
CS-10	21-Nov-08	1.1	8.11	225	252																											
CS-10	22-Jun-09	7.3	7.56	188	966																											
CS-10	21-Sep-09	7.6	8.04	269	188.3																											
CS-10	04-Dec-09	0.4	8.17	283	165																											
CS-10	22-Jun-10	12.9	8.05	175	1436																											
CS-10	23-Sep-10	7	8.12	265	200			172	< 4.	42.5	5.2	1.9	1.2			22	3	< .05		0.17		< .02	0.02	0.02								
CS-10	07-Dec-10	1.7	7.7	243	286.3																											
CS-10	28-Jun-11	8.7	8.14	125	6592																											
CS-10	15-Sep-11	6.7	7.37	234	282.5																											
CS-10	03-Nov-11	1.6	8.17	345	145.4																											
CS-10	18-Jun-12	11.7	8.2	264	516.8																											
CS-10	27-Aug-12	9.4	7.82	267	211																											
CS-10	02-Nov-12	2	7.8	259	170																											
CS-10	06-Jun-13	12	8.1	191	1558																											
CS-10	11-Jul-13	11.9	8.2	295	246																											
CS-10	18-Nov-13			244																												
CS-10	19-Nov-13	-0.3	8.03	244	247																											
CS-16	18-Jun-01	18.3	8.67	270	0.94			170	< 5.	47	6	2	< 1.			5	0.7				0.2				< .1						< .05	
CS-16	04-Sep-01	15.8	8.35	324	117.4		7.14	234	< 5.	42	7	2	< 1.	157	< 5.	7	0.8	< .06		< .1	0.1	< .1	< .05	< .05				< .03			< .05	
CS-16	08-Oct-01	7.4	8.2	378	131			159	< 5.	52	8	2	< 1.	195		8	1.4				0.1			< .05				0.12			< .05	
CS-16	12-Jun-02	17.7	8.19	341	467			172	10	49	6	3	< 1.	169	6	4	< 1.				0.2			< .05							< .05	
CS-16	24-Sep-02	12.1	8.41	365	127		7.28	163	< 5.	49	8	3	< 1.	180	< 5.	8	1	0.06		< .1	0.2	< .1	< .05	< .05					< .03		< .05	
CS-16	05-Nov-02	0	8.19	329	95.7			196	5	58	9	2	< 1.	216	< 5.	11	1				<0.1			< .05					< .03		< .05	
CS-16	19-Jun-03	10.5	8.46	267	510			253	< 5.	68	16.4	3.98	1.66	279	< 5.	11	2				0.12			0.01							< .05	
CS-16	29-Sep-03	9.6	8.81	296	107		9.48	161	< 5.	54	7.82	1.47	0.76	189	< 5.	8	1	< .005		0.08	0.22	< .005	0.01	0.01				0.05			< .05	
CS-16	06-Nov-03	0.4	8.43	341	122			181	< 5.	59.8	8.31	1.48	1.02	207	< 5.	14	2				0.13			0.01				0.45			< .05	
CS-16	23-Jun-04	15.7	8.55	286	328			176	6	52.1	5.85	1.31	0.61	155	< 5.	5	1				0.34			0.02				0.09	< .05		< .05	
CS-16	07-Sep-04	12.4	8.47	297	95.7		8.31	178	< 5.	54.4	7.48	1.48	0.81			7	2	< .01		0.1	0.27	0.01	0.01	0.01				0.06			< .05	
CS-16	09-Nov-04	0	8.25	287	170			174	< 5.	53.4	6.94	1.4	0.9			8	2				0.24			0.02				0.25			< .05	
CS-16	16-Jun-05	11.4	8.25	214	2700		7.52	133	< 5.	48.5	4.51	1.21	0.67			3	< 1.				0.29			0.02				0.17			< .05	
CS-16	08-Sep-05	9.8	8.41	278	66		6.78																									
CS-16	01-Nov-05	0	8.46	272	201																											

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										Major Ions								Metals									Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
CS-16	29-Jun-06	15.7	8.58	301	543																											
CS-16	23-Aug-06	14	8.41	286	174																											
CS-16	14-Dec-06	0.4	8.47	298	125																											
CS-16	28-Jun-07	17.5	8.66	278	348																											
CS-16	27-Sep-07	8	8.65	264	142																											
CS-16	20-Dec-07	0.6	8.39	219	75																											
CS-16	28-Jun-08	15.2	8.66	241	1780																											
CS-16	19-Sep-08	4.6	8.26	290	241																											
CS-16	19-Nov-08	0.6	8.31	296	207																											
CS-16	11-Jun-09	9.3	8.3	253	1966																											
CS-16	21-Sep-09	8.2	8.3	327	172																											
CS-16	18-Nov-09	0.2	8.38	333	180																											
CS-16	22-Jun-10	15	8.26	275	1073																											
CS-16	21-Sep-10	7.5	8.53	323	162			192	< 4.	53.7	7	1.6	0.7			10	2	< .05		0.03	0.18	< .02	0.01	0.01								
CS-16	07-Dec-10	0.7	8.26	332	187																											
CS-16	28-Jun-11	6.5	7.91	205	6721																											
CS-16	15-Sep-11	7.2	8.02	304	354																											
CS-16	16-Nov-11	0.3	8.2	376	301																											
CS-16	18-Jun-12	11.2	8.7	342	380																											
CS-16	27-Aug-12	10.9	8.3	332	135																											
CS-16	02-Nov-12	1	8.25	335	152																											
CS-16	06-Jun-13	11	8.7	279	1086																											
CS-16	30-Aug-13	8.5	8.6	363	112																											
CS-16	19-Nov-13	-0.3	8.2	340	175																											
CS-17	18-Jun-01	17.6	8.65	226	175			147	< 5.	40	5	2	< 1.			5	0.8				<0.01			< .1								
CS-17	04-Sep-01	13.1	8.61	261	40.7		6.86	158	< 5.	43	7	1	< 1.	157	< 5.	9	1.7	< .06		< .1	0.1	< .1	< .05	< .05			< .03			< .05	
CS-17	23-Oct-01	2.7	8.26	381	47.7			185	5	51	9	2	< 1.	180		11.5	1.6				<0.1			< .05			0.13			< .05	
CS-17	12-Jun-02	17.9	8.27	282	267			128	6	39	5	3	< 1.	148	< 5.	4	< 1.				0.1			< .05						< .05	
CS-17	23-Sep-02	9.5	7.98	377	40.7		7.31	176	< 5.	49	9	3	< 1.	183	< 5.	11	2	< .06		< .1	0.1	< .1	< .05	< .05				< .03		< .05	
CS-17	23-Oct-02	0.6	8.71	296	40.7			195	< 5.	54	9	3	< 1.	196	< 5.	14	2				<0.1			< .05						< .05	
CS-17	18-Jun-03	15.1	8.79	214	200			156	9	40.6	4.54	1.26	0.67	129	5	4	1				0.06			0.01						< .05	
CS-17	22-Sep-03	8.8	8.66	286	23.1		6.32	211	< 5.	55.8	8.89	1.97	0.96	185	< 5.	9	1	< .005		0.04	0.08	< .005	0.01	0.01						< .05	
CS-17	06-Nov-03	0.1	8.4	342	26.2			184	< 5.	58.7	9.34	1.62	1.22	201	< 5.	14	2				0.03			< .005			0.42			< .05	
CS-17	23-Jun-04	10.3	8.47	264	176			169	< 5.	45.8	5.46	1.54	0.69	134	< 5.	6	2				0.21			0.02			0.61	< .05		< .05	
CS-17	07-Sep-04	9.4	8.43	309	29.5		8.62	184	< 5.	54.3	7.45	1.59	0.86			8	2	< .01		0.03	0.07	< .01	0.01	0.01			0.17			< .05	
CS-17	09-Nov-04	0	8.36	285	30			180	< 5.	50.5	7.33	1.81	0.94			10	2				0.05			0.01			0.28			< .05	
CS-17	16-Jun-05	12.2	8.12	179	713			109	< 5.	36.5	3.65	1.38	0.71			3	< 1.				0.53			0.02			< .05			< .05	
CS-17	08-Sep-05	9.6	8.48	269	24.6		6.92																									
CS-17	01-Nov-05	0.4	8.49	261	19.9																											
CS-17	29-Jun-06	15.7	8.49	267	241																											
CS-17	23-Aug-06	12	8.66	284	41.5																											
CS-17	14-Dec-06	0.6	8.47	280	40.7																											
CS-17	28-Jun-07	16.9	8.66	261	60.8																											
CS-17	27-Sep-07	5.4	8.62	246	30.8																											
CS-17	20-Dec-07	1.1	8.39	244	25																											
CS-17	23-Jun-08	13.9	8.23	170	0.93																											
CS-17	19-Sep-08	5.4	8.35	266	40.7																											
CS-17	19-Nov-08	0.5	8.17	294	109																											
CS-17	22-Jun-09	8.9	8.31	252	406																											

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										Major Ions							Metals									Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
CS-17	28-Aug-09	7.2	7.33	324	40.7																										
CS-17	11-Nov-09	0.2	7.89	333	40.7																										
CS-17	21-Jun-10	11.5	8.41	214	326																										
CS-17	21-Sep-10	5.5	8.56	318	40.7			182	< 4.	47.8	7	1.7	0.7			10	2		< .05		0.03	0.1	< .02	< .005	0.01							
CS-17	27-Oct-10	0.6	8.47	321	53.8			198	< 4.	45.6	6.9	1.8	0.8			10	2				0.03				0.01			0.7	< .1			
CS-17	28-Jun-11	9.8	7.96	180	3315																										
CS-17	15-Sep-11	9	7.98	270	309.5																										
CS-17	16-Nov-11	0.4	8.6	345	36.2																										
CS-17	18-Jun-12	14.8	8.8	293	91.6																										
CS-17	27-Aug-12	9.9	8.29	320	50.8																										
CS-17	02-Nov-12	1.1	8.24	337	14.1																										
CS-17	06-Jun-13	15.6	8.9	222	406.1																										
CS-17	30-Aug-13			381																											
CS-17	12-Nov-13	-0.3	8.26	344	8.21																										
CS-18	19-Jun-01	17.3	8.27	327	1910			143	< 5.	39	7	2	< .01			6	4					0.2			< .1						< .05
CS-18	04-Sep-01	18.9	8.32	303	506		6.54	127	< 5.	37	7	2	< 1.	143	< 5.	5	4		0.07		< .1	0.1	< .1	< .05	< .05			< .03			< .05
CS-18	08-Oct-01	10.2	8.64	239	396			136	< 5.	38	7	2	< 1.	152		4.7	3.4					0.1			< .05			0.03			< .05
CS-18	12-Jun-02	15.2	8.13	332	383			154	7	44	8	4	< 1.	165	< 5.	5	3					0.1			< .05						< .05
CS-18	25-Sep-02	10.5	8.27	310	557		7.09	161	< 5.	36	8	5	< 1.	142	< 5.	5	4		< .06		< .1	2.2	< .1	< .05	< .05				< .03		< .05
CS-18	29-Oct-02	3.6	8.41	261	597			151	< 5.	44	8	4	< 1.	155	< 5.	9	6					0.1			< .05						< .05
CS-18	19-Jun-03	11.1	8.61	280	2549			178	5	49	6.62	3.26	0.56	171	< 5.	42	5					0.15			0.03						< .05
CS-18	29-Sep-03	11.5	8.13	242	637		8.37	129	< 5.	40	7.57	2.48	0.61	151	< 5.	5	4		< .005		0.06	0.12	< .005	0.01	0.01			< .03			< .05
CS-18	06-Nov-03	0.2	8.41	309	705			152	< 5.	46.6	7.33	4.65	1.02	174	< 5.	7	9					0.12			0.02			0.24			< .05
CS-18	24-Jun-04	11.1	8.63	282	1990			138	8	45.2	6.92	2.49	0.46	140	< 5.	5	4					0.2			0.04			0.1	< .05		< .05
CS-18	07-Sep-04	15.1	8.52	226	489		7.38	132	< 5.	36.1	6.83	2.38	0.53			5	4		< .01		0.08	0.2	< .01	0.01	0.03			< .05			< .05
CS-18	08-Nov-04	2.2	8.14	339	1165			206	< 5.	51.1	7.08	16	0.93			7	31					0.25			0.02			0.31			< .05
CS-18	16-Jun-05	8.8	8.46	219	12835		8.05	101	< 5.	46	5.4	2.06	0.52			3	3					0.34			0.02			0.22			< .05
CS-18	08-Sep-05	14.4	8.47	256	818		7.22																								
CS-18	20-Oct-05	8.9	8.58	210	8.9																										
CS-18	29-Jun-06	16.1	8.46	287	3110																										
CS-18	23-Aug-06	18	8.52	249	795																										
CS-18	14-Dec-06	0.4	8.56	278	613																										
CS-18	28-Jun-07	19.1	8.53	273	1440																										
CS-18	27-Sep-07	11.7	8.55	229	666																										
CS-18	20-Dec-07	1.3	8.37	226	585																										
CS-18	23-Jun-08	13.8	8.56	238	7530																										
CS-18	22-Sep-08	10.5	8.64	226	874																										
CS-18	21-Nov-08	4.2	8.59	259	1132																										
CS-18	22-Jun-09	12.4	8.43	263	2516																										
CS-18	28-Sep-09	13.8	8.56	263	951																										
CS-18	18-Nov-09	1.4	8.54	297	1001																										
CS-18	19-Jun-10	11.7	8.56	266	4274																										
CS-18	21-Sep-10	14	8.87	232	875			148	< 4.	35.3	6.5	2.8	0.4			5	5		< .05		0.04	0.13	< .02	0.01	0.01							
CS-18	07-Dec-10	1.2	8.39	325	1009																										
CS-18	28-Jun-11	5.4	7.87	208	18114																										
CS-18	16-Sep-11	8.4	8.62	254	1722																										
CS-18	16-Nov-11	0.3	8.9	357	1580																										
CS-18	18-Jun-12	13.7	8.8	303	1901																										
CS-18	27-Aug-12	14.9	8.32	269	807																										

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											Major Ions							Metals									Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
CS-18	03-Nov-12	5.7	8.42	277	884																											
CS-18	06-Jun-13	12.2	8.8	291	5778																											
CS-18	30-Aug-13	12.7	8.7	292	787																											
CS-18	14-Nov-13	3.8	8.7	344	624																											
UPL-10	30-Jul-81	13					9.9	167	1					171		18	2.81					0.28		0.02							
UPL-10	22-Oct-81	0					10.2	195	3.1					221		6	3.8					0.55		0.05							
UPL-10	10-Nov-81	3			494		12.8	196	4					162		38	3	< .001	0.01	< .001	0.16	0.58	< .001	0.05		< .001	0.11				23.8
UPL-10	08-Dec-81	0						212	2					189		33	2.7					0.37		0.04							
UPL-10	28-Jun-82	13	8.2	332	5790																											
UPL-10	21-Jul-82	13	7.9	339	2715																											
UPL-10	17-Aug-82	14	8.2	246	1158		8.6	187	17					208		< 3.	11.2					0.63		0.04			0.23				0.4
UPL-10	15-Sep-82	8	8	320	1436																											
UPL-10	15-Oct-82	4	8.6	247	1616																											
UPL-10	28-Jun-83	13	8	126	28319																											
UPL-10	19-Jul-83	12	8	270	5094																											
UPL-10	24-Aug-83	9	7.6	315	2383		7.4	176	41					188		13	< .1					0.72		0.05			< .02				< .2
UPL-10	27-Sep-83	10	6.6	263	3478																											
UPL-10	20-Oct-83	6	7.7	283	2289																											
UPL-10	24-May-84	8.4	7.3	142																												
UPL-10	26-Jun-84	11	6.8	227	14003																											
UPL-10	31-Jul-84	12	7.5	291	2401																											
UPL-10	24-Aug-84	10	7.7	353	1391		9.4	225	17	60	21.6	9.5	0.63	220		< 10.	20					0.16		0.07			0.13				< .1
UPL-10	27-Sep-84	3.5	7.6	311	1293																											
UPL-10	13-Nov-84	0	7.5	243																												
UPL-10	30-Jan-85	0	8.1	545				442	1.2	96	37.4	3	2.24	334		107	7					0.09		< .01							
UPL-10	21-May-85	6	7.4	154	35455																											
UPL-10	19-Jun-85	17	7.8	317	3680																											
UPL-10	17-Jul-85	15	7.9	406	1279																											
UPL-10	28-Aug-85	14	7.9	291	803		6.6		2					181			1.9					0.15		0.02			0.33				1
UPL-10	24-Sep-85	10	7.9	301	776																											
UPL-10	15-Oct-85	6	7.7	290	965																											
UPL-10	27-May-86	7	7.3	120																												
UPL-10	19-Jun-86	14	7.8	191	14003																											
UPL-10	22-Jul-86	11	7.4	315	1521																											
UPL-10	19-Aug-86	15	7.7	311	830		8.4	155	< 1.					176		9	1.9					0.33		0.03			0.24				0.4
UPL-10	24-Sep-86	5	7.6	297	1055																											
UPL-10	16-Oct-86	0.5	7.8	267	925																											
UPL-10	19-May-87	8	7.9	170	7544																											
UPL-10	16-Jun-87	16	8	233	1310																											
UPL-10	28-Jul-87	14	8.1	265	898																											
UPL-10	20-Aug-87	17	8.4	265	269		8.4	162	< 1.					196		8	1.4					0.37		0.02			0.28				< .1
UPL-10	22-Sep-87	7	8	294	489																											
UPL-10	19-Oct-87	6	8.4	289	615																											
UPL-10	17-Aug-88	10	7.2	341	750		7.4	185	3					198		10	1.9					0.33		0.04			0.18				0.2
UPL-10	21-Jun-89	16	7.6	287	1840			198	2					177		7	11.4					0.3		0.03			0.17				
UPL-10	07-Sep-89	7.5	6.8	383	426		8.7	188	< 1.					178		24	2.6		< .001		0.05	0.36	< .001	< .01			< .01				
UPL-10	17-Oct-89	6	8.15	280	606			179	< 1.	52.87	8.5	1.97	0.87	176		20	3.3					0.32		0.02			0.24				
UPL-10	05-Jun-90	8	7.3	183				104	10	33.78	3.61	4.57	< .5	124		6	2.9					0.56		0.05			0.13				
UPL-10	11-Sep-90	17.8	8.4	329	494		8.7	172	< 1.	46.92	9.03	2.65	0.9	194		10.5	3.9		< .005		0.06	0.31	< .001	< .01			0.07	< .02			

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										Major Ions								Metals												Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
UPL-10	24-Oct-90	9	7.3	342	570			186	< 1.	51.29	7.79	2.18	0.68	184		13.7	4.8					0.31			0.03			0.15				
UPL-10	19-Jun-91	13.5	8.33	210	3379			116	8					108		8.2	4.6					0.42			< .033			0.11				
UPL-10	05-Sep-91	14	8.26	325	678		6.9	174	< 1.	58.26	8.82	1.04	0.79	180		10.4	4.8	< .05		0.03		0.13	< .003	< .018	0.02			0.12				
UPL-10	15-Oct-91	11.8	8.03	322	467			204	< 1.	53.01	8.69	2.48	< .7	177		12.8	5.4					0.29			< .02			< .68				
UPL-10	09-Jun-92	17.1	8.32	288	1230			194	< 1.					143	1.3	8.1	6.5					0.31			0.03			0.18				
UPL-10	02-Sep-92	12.3	7.83	311	364		7.6	172	< .1					167	2.7	12	7.2	< .07		0.05	0.34	0	0.02	0.03			< .1				
UPL-10	21-Oct-92	2.5	7.93	389				186	< 1.					198	2.2	15.1	6.3					0.28			< .01			0.32				
UPL-10	28-Jun-93	16.7	8.8	206	2343			112	2					118	3.2	5.9	4.6					0.25			0.02			< .1				
UPL-10	26-Aug-93	11	8.23	387			8.6	182	8					183	4.2	10	6.85	< .1		0.07			< .02		0.04			0.26				
UPL-10	27-Oct-93	2.9	8.16	382	619			188	< 1.					181	2	14.8	8.27					0.27			0.02			0.15				
UPL-10	19-Jun-95	13.5	8.12	216	13958		6.4	80	5					95	10	1	4					0.4			< .1					0.1	0.06	
UPL-10	04-Sep-95	16	8.57	343	1355		7.1	130	5					175		9	9	< .1		< .1		0.3	< .1	< .1	< .1					< .1	0.02	
UPL-10	18-Oct-95	9.67	8.26	384	718			190	< 5.					170		11	9					0.2			< .1					0.1	0.02	
UPL-10	24-Jun-96	13.21	8.54	307	8222			140	7	44	5	3	< 1.	129		5	1					0.3			< .1					< .01	0.01	
UPL-10	11-Sep-96	10.8	8.43	375	1176		7.2	210	< 5.					191	< 5.	11	10	0.1		< .1		0.3	< .1	< .1	< .1					< .1	< .01	
UPL-10	28-Oct-96	1.5	8.06	232	1257			216	8	54	9	6	1	395			11					0.6			< .1					0.3	0.02	
UPL-10	23-Jun-97	9.25	7.63	315	12876			150	6	49	6	3	< 1.	153			7					0.3			< .1					0.2	0.03	
UPL-10	12-Aug-97	15.66	8.27	368	1957	11.8		190	11	53	8	5	< 1.	183	< 5.	10	9	< .1		0.1		0.6	< .1	< .1	< .1					0.2	0.01	
UPL-10	09-Oct-97	9.01	8.56	336	1391	8.28		180	< 5.	53	8	5	1	177			13					0.5			< .1					0.1	0.02	
UPL-10	15-Jun-98	8.58	8.26	249	19173	9.03		142	12	36	4	3	< 1.	115			6					0.4			< .1					< .1	0.01	
UPL-10	13-Aug-98	10.38	7.49	382	911	6.85		198	7	56	7	4	< 1.	208	< 5.	9	10	0.2		< .1		0.4	< .1	< .1	< .1					0.3		
UPL-10	08-Oct-98	10.22	8.18	392	386	5.81		222	< 5.	54	8	4	1	214			12					0.3			< .1					0.2	< .05	
UPL-10	24-Mar-99	o Access																														
UPL-10	05-Jul-99	20.02	8.27	342	1337	5.21		166	5	45	6	4	< 1.	164			8					0.3			< .1					0.18	< .05	
UPL-10	18-Aug-99	18.15	8.28	391	283	5		181	9	50	8	2	< 1.	178	< 5.	9	10	< .1		< .1		0.3	< .1	< .1	< .1					0.16	< .05	
UPL-10	06-Oct-99	8.59	8.24	416	217	8	9.48																									
UPL-10	06-Oct-99							210	6	56	8	< 1.	< 1.	193			10					0.3			< .1					0.25	< .05	
UPL-10	20-Jun-00	18.64	8.32	349	270	17		197	< 5.	45	7	5	< 1.	142	6	8	13					0.3			< .1				< .03	0.11	< .05	
UPL-10	07-Aug-00	12	8.29	392	197	3	6.21	233	6	49	9	4	< 1.	177	< 5.	11	13	0.1		< .1		0.3	< .1	< .1	< .1				< .03	0.04	< .05	
UPL-10	09-Oct-00	9	8.17	432	196	6		259	< 5.	54	9	5	< 1.	184	< 5.	14	12					0.3			< .1					0.11	< .05	
UPL-10	19-Jun-01	18.7	8.84	274	1641	5		165	< 5.	41	7	5	< 1.	149		10	16					0.2			< .1					0.07	< .05	
UPL-10	03-Sep-01	16.1	8.11	411			6.83	215	< 5.	50	9	6	< 1.	132	9	12	16.4	< .06		< .1		0.2	< .1	< .05	< .05					< .03	< .05	
UPL-10	25-Oct-01	0.2	7.61	443	711	5		216	< 5.	58	10	6	1	196		15.9	14.6					0.2			< .05			0.2		0.2	< .05	
UPL-10	19-Jun-02	18.9	8.12	365	1213	7		159	< 5.	46	8	7	< 1.	149	< 5.	9	15					0.2			< .05					< .03	< .05	
UPL-10	15-Aug-02	22.2	8.5	325	144	4	5.96	173	< 5.	48	10	8	< 1.	159	< 5.	14	19	0.1		< .1		0.2	< .1	< .05	< .05					< .03	< .05	
UPL-10	14-Nov-02	0.5	7.97	384	494	11.7		236	< 5.	62	11	12	2	184	< 5.	19	23			< .1		0.2		< .05	< .05				< .03	0.23	< .05	
UPL-10	17-Jun-03	11.2	8.61	278	2935	5.1		159	< 5.	46.6	6.34	5.8	0.7	137	< 5.	8	16					0.24			0.02					0.24	< .05	
UPL-10	18-Sep-03	9.9	8.52	304	415	5.6	7.7	194	< 5.	49.7	8.72	4.1	0.7	172	< 5.	9	13	0.01		0.11		0.29	< .005	0.01	0.01					< .03	< .05	
UPL-10	06-Nov-03	0.1	8.36	422	615	2		214	< 5.	59.9	10.3	9.2	1.36	198	< 5.	19	28					0.2			0.01			0.21		0.21	< .05	
UPL-10	24-Jun-04	15.4	8.6	343	1665	5		177	< 5.	49.9	7.52	5.9	0.7	137	< 5.	10	17					0.27			0.02			0.15	< .05	0.15	< .05	
UPL-10	02-Sep-04	14.5	8.61	361	282	4	7.67	200	< 5.	54.1	9.84	6.3	1.07	172	3.6	13	18	0.01		0.14		0.27	< .01	< .002	0.01			< .05			< .05	
UPL-10	08-Nov-04	0.01	7.79	354	1510	12		217	< 5.	50.2	7.86	14.5	1.17	151		15	37					0.41			0.02			0.16			< .05	
UPL-10	16-Jun-05	10.2	8.51	214	11085	11	7.58	119	< 5.	40.7	4.68	3.6	0.62	112	3.6	5	7					0.25			0.02			0.09			< .05	
UPL-10	08-Sep-05	13.5	8.49	322	744	7.6	7.9	224	< 5.	55.5	9.23	7.3	0.9	173	6.6	12	20	0.02		< .03		0.26	< .01	0.01	0.01			0.09			< .05	
UPL-10	20-Oct-05	7.9	8.72	303	387	5.18		224	< 5.	55.1	8.65	6.0	1.01	173	3.6	16	20					0.31			0.01			0.07			< .05	
UPL-10	28-Jun-06	13.6	8.48	315	2390			206	< 5.	51.4	7.1	5.4	0.68	162	< 5.	10	13					0.23			0.02					0.19		
UPL-10	20-Sep-06	5	8.07	344	920			211	5	61.39	8.95	7.5	1.03	191	< 5.	13	18					0.9			0.05					0.2		
UPL-10	14-Dec-06	0.2	8.42	383	726			216	< 5.	60.16	8.94	10.0	0.87	180	< 5.	16	24					0.19			0.01					0.39		
UPL-10	28-Jun-07	17.7	8.43	342	1155			178	6	54.7	8.09	5.7	0.52	169	< 5.	10	15					0.32			0.03					0.34		
UPL-10	27-Sep-07	10.8	8.52	339	513			240	< 5.	57.8	9.94	7.8	1.12	180	3	17	20					0.34			0.01					2.29		

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										Major Ions								Metals									Nutrients				
Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L	As (D) mg/L	B (D) mg/L	Cd (D) mg/L	Fe (D) mg/L	Fe (T) mg/L	Pb (D) mg/L	Mn (D) mg/L	Mn (T) mg/L	Hg (D) ug/L	Se mg/L	NO3 mg/L	NO2 mg/L	NO3+NO2 mg/L	PO4 mg/L	O&G mg/L
UPL-10	20-Dec-07	0.2	8.31	272	260			260	< 5.	59.41	9.91	8.4	1.17	190	< 5.	18	21					0.16			0.02					0.82		
UPL-10	24-Jun-08	14.4	8.84	225	10310			143	< 5.	40.34	4.89	3.9	0.57	109	6.6	6	8					0.19			0.02					0.94		
UPL-10	28-Sep-08	9.6	8.41	364	817			228	< 5.	61.43	10.56	6.8	0.89	189	< 5.	14	18					0.24			0.01					0.36		
UPL-10	27-Dec-08	0.4	8.31	3.06	1055			219	6	60.32	9.28	6.3	1.4	176	< 5.	18	16					12.2			0.12					3.53		
UPL-10	22-Jun-09	14.4	6.19	286	5149			189	< 5.	48.06	6.04	5.4	0.72	143	< 5.	8	12					0.36			0.02					1.15		
UPL-10	28-Sep-09	12.5	8.49	363	729			196	7	54.38	9.62	6.9	1.07	166	7.2	14	18					0.24			0.01					0.23		
UPL-10	18-Nov-09	0.5	8.56	366	1862			211	< 5.	57.93	9.78	6.8	1.14	187	< 5.	18	17					0.15			0.01					0.5		
UPL-10	21-Jun-10	10.1	8.42	291	4110			180	5	46.39	5.77	5.4	0.61	144	< 5.	7	11					0.28			0.02					0.87		
UPL-10	23-Sep-10	9.2	8.62	387	734			242	5	55.2	8.8	7.8	0.9	233	1.8	15	19	< .05		0.06		0.28	< .02	0.01	0.01					0.3		
UPL-10	17-Nov-10	0.8	8.3	400	780			244	< 4.	54	8.1	9.1	1	218	< 1.	18	25			0.2		0.02			0.02					0.5		
UPL-10	28-Jun-11	5.7	8.03	203	21576			560	14	35.8	4	3.1	0.7	143	0.6	6	5					0.24			0.03					0.7		
UPL-10	28-Sep-11	11.5	8.59	364	1315			204	< 4.	53	8.4	6.7	0.9	190	1.8	12	16					0.25			0.01					0.5		
UPL-10	16-Nov-11	0.3	8.4	429	978			200	< 4.	56.9	8.6	7.0	1.1	194	< 1.	16	17					0.16			0.02					0.8		
UPL-10	18-Jun-12	11.3	8.6	391	1474			188	4	52.3	7.4	6.3	0.6	188	3	11	15					0.27			0.03					0.7		
UPL-10	24-Sep-12	10.6	8.7	404	770			304	< 4.	52.2	8.9	6.5	1	230	1.2	15	17					0.3			0.01					0.2		
UPL-10	02-Nov-12	4.4	8.31	367	673			232	< 4.	54.7	8.9	6.7	1.1	191	1.8	17	16					0.27			0.01					0.5		
UPL-10	14-Jun-13	9.7	8.6	344	2902			148	6	48.2	6.3	5.7	0.6	177	7.8	9	13					0.31			0.03					1.7		
UPL-10	28-Sep-13	-0.3	8.04	372	799			204	< 4.	60.4	9.5	10.9	1.1	199	1.8	15	25					0.38			0.02					0.4		

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Table 3 Average discharge rates and solute geochemical compositions for springs and streams.

Site	Temp. °C	pH	Cond. µS/cm	Flow gpm	TDS mg/L	Major Ions Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	CO3 mg/L	SO4 mg/L	Cl mg/L
Springs													
Price River springs													
29-138	5.6	7.26	439	24.1	272	83	8.0	2.2	0.0	300	0.0	4.0	3.0
32-277	6.1	7.33	257	1.8	170	41	6.8	1.2	0.2	163	0.0	7.8	0.8
MSS-1	4.9	7.71	374	1.05	228	62	8.5	1.0	0.0	240	0.0	10.0	1.0
Average	***5.5***	***7.4***	***357***	***9.0***	***223***	***61.8***	***7.8***	***1.5***	***0.1***	***234***	***0.0***	***7.3***	***1.6***
Price River/Castlegate contact springs													
29-133	4.0	7.33	324	35.5	193	60	4.8	1.7	0.0	211	0.0	5.3	1.2
Average	**4.0**	**7.3**	**324**	**35.5**	**193**	**60**	**5**	**1.7**	**0.0**	**211**	**0.0**	**5.3**	**1.2**
Castlegate Sandstone springs													
33-268	4.4	7.25	89	1.8	72	14	2.0	1.5	0.0	46	0.0	7.0	2.0
4-429	6.8	7.39	139	1.7	87	22	4.0	1.0	0.0	85	0.0	2.0	0.7
8-253	3.6	7.13	136	16.0	86	23	2.5	1.2	0.0	91	0.0	5.0	0.3
Average	***4.9***	***7.3***	***122***	***6.5***	***81***	***19.7***	***2.8***	***1.2***	***0.0***	***73.9***	***0.0***	***4.7***	***1.0***
Castlegate/Blackhawk contact springs													
21-222	4.8	7.37	322	7.7	190	49	11.2	1.3	0.0	202	0.0	6.5	0.7
32-183	3.3	7.23	169	7.7	122	28	5.2	1.5	0.0	117	0.0	5.2	0.7
32-279	5.5	7.35	321	2.7	225	54	15.0	1.7	0.0	240	0.0	8.5	0.8
Average	***4.5***	***7.3***	***271***	***6.0***	***179***	***43.7***	***10.4***	***1.5***	***0.0***	***186***	***0.0***	***6.7***	***0.7***
Blackhawk Formation springs													
28-110	6.0	7.51	340	2.0	208	56	9.8	2.0	0.0	225	0.0	7.0	1.5
3-290	7.0	8.00	219	14.9	158	39	6.3	2.6	0.43	155	0.07	5.3	2.0
4-173	4.7	7.45	233	1.1	185	48	9.2	1.8	0.0	195	0.0	5.2	1.5
5-231	2.9	7.15	206	3.2	138	37	4.3	1.8	0.0	141	0.0	7.3	0.8
Average	**5.1**	**7.5**	**249**	**5.3**	**172**	**45.1**	**7.4**	**2.1**	**0.1**	**179**	**0.0**	**6.2**	**1.5**
Groundwater storate tanks													
MST-1	9.6	7.80	369	---	200	62	8.0	1.0	0.0	237	0.0	0.0	1.0
MST-2	8.0	8.20	195	---	140	30	2.0	2.0	0.0	112	0.0	0.0	2.0
MST-3	11.9	7.85	353	8.3	236	58	16.5	1.0	0.0	264	0.0	5.5	1.0
Creeks													
C-5	7.5	7.85	192	28	141	36	5.8	2.3	0.0	148	0.0	4.3	1.2
C-6	8.9	8.46	235	240	137	37	6.0	3.0	0.0	132	6.5	5.5	3.5
C-7	9.4	8.45	261	1,200	139	38	7.0	2.0	0.0	161	2.5	4.0	1.0
C-8	8.1	8.47	267	1,275	150	42	6.5	2.0	0.0	163	3.0	4.5	1.5
CS-10	7.9	7.72	241	984	143	39	4.9	2.9	0.4	131	0.6	17.9	3.0
CS-16	8.0	8.39	296	515	183	53	7.4	1.8	0.4	193	1.8	7.8	1.1
CS-17	7.8	8.37	278	187	173	48	6.8	1.8	0.4	171	1.2	8.3	1.6
CS-18	10.1	8.47	270	2,067	150	42	7.0	3.5	0.3	156	1.2	7.3	5.5
UPL-10	9.7	8.07	313	3,120	198	53	8.7	5.7	0.7	177	1.9	13.4	11.7

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Table 4 Groundwater mean residence times in the Flat Canyon area.

Site	Date	$\delta^{13}C$ (‰)	^{14}C (pmC)	Tritium (TU)	Mean residence time
7-242	10/9/1997	-13.1	73.52	10.5	modern
29-138	10/8/1997	-12.3	88.58	12.9	modern
	7/21/1998	-13.5	90.96	14	modern
8-253	10/9/1997	-16.0	84.39	29.7	modern
	7/21/1998	-16.1	79.06	30	modern
32-279	10/9/1997	-12.3	68.62	14	modern
	7/21/1998	-12.5	71.67	15	modern
MST-3	9/11/1997			13.1	modern

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Tables 5, 6, 7, and 8

Are included in Section 9.0 of this report.

(pages 43-46)

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Appendix A

Analytical Services, Inc.

Williston, Vermont

Microscopic Particulate Analysis

Laboratory Reports

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ANALYTICAL SERVICES, INC.
Microbiological Testing, Research and Consulting

130 Allen Brook Ln., PO Box 515, Williston, VT 05495 USA
1.800.723.4432 / 802.878.5138 Fax: 802.878.6765
www.analyticalservices.com

February 3, 2003

Erik Petersen
Petersen Hydrologic
2695 North 600 East
Lehi, UT 84043

Dear Erik:

Enclosed please find the results of the Microscopic Particulate Analysis (MPA) performed on the sample received in our laboratory on January 16, 2003.

Thank you for using Analytical Services Inc. for your testing needs. If you have any questions or if we may be of service in the future, please do not hesitate to contact us at (800) 723-4432.

Sincerely,

ANALYTICAL SERVICES, INC.

Jessica Howlett
Staff Microbiologist

JH/lll

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Div. of Oil, Gas & Mining

Project No.: 2003-0116-009

Microscopic Particulate Analysis

Section I.

One sample from Petersen Hydrologic was analyzed using the Environmental Protection Agency's Consensus Method for Determining Ground Waters Under the Direct Influence (GWUDI) of Surface Water Using Microscopic Particulate Analysis (MPA). MPA is one parameter used to determine if a ground water source is under the direct influence of surface water. As indicated in the Guidance Manual for compliance with the Surface Water Treatment Rule, other factors, including a sanitary survey, well construction logs, hydrological criteria, distance from nearest surface water source and water quality are considered when making a GWUDI determination. Recent data indicate that factors effecting particulate movement in soil need to be taken into account in GWUDI determinations. These include the degree of hydraulic communication (timing and amount of surface water mixed with ground water), time of travel in the ground, and natural filtration.

An MPA filter is processed by first cutting the fibers from the filter core then washing them repeatedly with a stomacher. The resulting sediment is centrifuged into a pellet. Then, depending on the volume of the pellet recovered from a filter, the sediment is either purified by a gradient flotation procedure using Percoll sucrose as the levitant, or is analyzed directly. A portion of the pellet is examined for surface water "bioindicators", such as plant debris, algae, diatoms, insects, protozoa, rotifers, and other particulates that are characteristic of surface waters. The number and type of bioindicators are tabulated and used to calculate a risk rating score, which indicates the risk of surface water contamination. The MPA risk-rating table can be found in Section III of this report.

Results from the MPA indicate this sample is characteristic of ground water. There was a minimal amount of sediment recovered from the filter (0.05 mL in 458 gallons), and only a minimal amount remained after the flotation process. Low numbers of particulates and biological organisms were detected in this sample. Data from the MPA are included in Section II of the Analytical Results.

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ANALYTICAL SERVICES, INC.

Client: Petersen Hydrologic
Address: 2695 North 600 East
Lehi, UT 84043

Sampling Date: January 14, 2003
Date Received: January 16, 2003
Analyst: jh

Section II.

Analytical Results

Sample No.: 2003-0116-009

I. SAMPLE DATA		
Sample ID:	JC-1	
Sample Site:	JC-1	
Water Type:	raw/well	
Turbidity, NTU's:	S: 3.4	E: 1.1
pH:	S: 7.72	E: 7.79
Treatment:	none	
Distance From Surface Water:	100 feet	
Volume Filtered:	458 gallons	
Filter:	Commercial Honeycomb 1 µm	
Filter Color:	off-white	
Sediment Volume:	0.05 mL	
Volume Floated:	0.05 mL	
Pellet Volume After Float:	trace	
Levitant –		
type:	Percoll sucrose	
specific gravity:	1.15	

S = Start of Sampling; E = End of Sampling

II. MPA			
Numbers reported are per 100 gallons			
Detection Limit = 6.67			
Amorphous Debris:	Confluent	Crustaceans:	BDL
Vegetative Debris -		Crustacean Parts:	BDL
with chlorophyll:	BDL	Crustacean Eggs:	BDL
without chlorophyll:	BDL	Water Mites:	BDL
Diatoms -		Gastrotrichs:	BDL
with chlorophyll:	BDL	Tardigrades:	BDL
without chlorophyll:	BDL	Nematodes:	BDL
Other Algae*:	BDL	Nematode Eggs:	BDL
Rotifers:	BDL	Invertebrate Eggs:	BDL
Rotifer Eggs:	BDL	Annelids:	BDL
Fungal Spores:	BDL	Amoebae:	BDL
Pollen:	BDL	Protozoa:	BDL
Iron Bacteria**:	BDL	Insects/Larvae:	BDL

BDL = Below Detection Limit

*Algae Identifications:	NA
**Iron Bacteria:	NA
Comments:	

NA = Not Applicable

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Project No.: 2003-0116-009

INCORPORATED

Client: Petersen Hydrologic
Address: 2695 North 600 East
Lehi, UT 84043

Sampling Date: January 14, 2003
Date Received: January 16, 2003

Section III.

MPA Risk Rating Table

The risk rating for surface water influence as calculated according to the EPA Consensus Method for Microscopic Particulate Analysis is as follows:

Lab ID	Sample ID	Table 1	Table 2	Total	Risk Rating
2003-0116-009	JC-1	None Detected	NA	0	Low*

NA = Not Applicable

The tables of relative risk factors used to calculate surface water influence in the EPA Consensus Method for Microscopic Particulate Analysis are based on a limited set of data. These data are not representative of all aquifer types or well designs. Therefore, the relative risk values calculated from these tables are of limited value in determining health risks associated with surface water indicators.

*This EPA Risk Rating table classifies each sample according to the number of surface water indicating organisms per 100 gallons; however, only 15 gallons of this sample could be analyzed for MPA. The relatively small volume analyzed does not affect the validity of the results; however, the risk rating should be interpreted with caution.

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MPA References

Berk, Sharon G., John H. Gunderson. Wastewater Organisms: A Color Atlas. Lewis Publishers. Boca Raton, Florida. 1993.

Fox, J. Carl, Paul R. Fitzgerald and Cecil Lue-Hing. Sewage Organisms: A Color Atlas. Lewis Publishers. Chelsea, Michigan. 1981.

Needham, James G., Paul R. Needham. A Guide to the Study of Fresh-water Biology. McGraw-Hill, Inc. New York. 1962.

Patterson, D.J., S. Hedley. Free-Living Freshwater Protozoa. CRC Press, Inc. Boca Raton, Florida. 1992.

Pennak, Robert W. Fresh-water Invertebrates of the United States. John Wiley and Sons, Inc. New York. 1989.

Prescott, G.W. How to Know the Freshwater Algae. Wm. C. Brown Company Publishers. Dubuque, Iowa. 1978.

Smith, E. Grant. Sampling and Identifying Allergenic Pollens and Molds. Blewstone Press. San Antonio, Texas. 1990.

Standard Methods for the Examination of Water and Wastewater. APHA, AWWA, and WEF, 20th Edition. American Public Health Association, Washington, D.C. 1998.

Thorp, James H., Alan P. Couich. Ecology and classification of North American Freshwater Invertebrates. Academic Press, Inc. San Diego, California. 1991.

USEPA. Consensus Method for Determining Groundwaters Under Direct Influence of Surface Water Using Microscopic Particulate Analysis. October, 1992.

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ANALYTICAL SERVICES, INC. (ASI)
Microbiological Testing, Research and Consulting

130 Allen Brook Ln., PO Box 515, Williston, VT 05495 USA
1.800.723.4432 / 802.878.5138 Fax: 802.878.6765
www.analyticalservices.com

August 16, 2006

Erik Petersen
Petersen Hydrologic
2695 North 600 East
Lehi, UT 84043

Dear Erik:

Enclosed please find the results of the Microscopic Particulate Analysis (MPA) performed on the sample received in our laboratory on August 1, 2006.

Thank you for using Analytical Services Inc. for your testing needs. If you have any questions or if we may be of service in the future, please do not hesitate to contact us at (800) 723-4432.

Sincerely,

ANALYTICAL SERVICES, INC.

Jessica Howlett
Aquatic Biologist/Staff Microbiologist

JH/lll

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ASI Project No.: 2006-0801-001

ANALYTICAL SERVICES, INC.
Microbiological Testing, Research and Consulting

Client:	Petersen Hydrologic	**Sampling Date:**	July 31, 2006
Address:	2695 North 600 East	**Date Received:**	August 1, 2006
	Lehi, UT 84043	**Analyst:**	jh
Client Sample ID:	JC-1	**ASI Sample No.:**	2006-0801-001

Section I.

Microscopic Particulate Analysis

This sample was analyzed using the Environmental Protection Agency's Consensus Method for Determining Ground Waters Under the Direct Influence (GWUDI) of Surface Water Using Microscopic Particulate Analysis (MPA). MPA is one parameter used to determine if a ground water source is under the direct influence of surface water. As indicated in the Guidance Manual for compliance with the Surface Water Treatment Rule, other factors, including a sanitary survey, well construction logs, hydrological criteria, distance from nearest surface water source and water quality are considered when making a GWUDI determination. Recent data indicate that factors effecting particulate movement in soil need to be taken into account in GWUDI determinations. These include the degree of hydraulic communication (timing and amount of surface water mixed with ground water), time of travel in the ground, and natural filtration.

An MPA filter is processed by first cutting the fibers from the filter core then washing them repeatedly with a stomacher. The resulting sediment is centrifuged into a pellet. Then, depending on the volume of the pellet recovered from a filter, the sediment is either purified by a gradient flotation procedure using Percoll sucrose as the levitant, or is analyzed directly. A portion of the pellet is examined for surface water "bioindicators", such as plant debris, algae, diatoms, insects, protozoa, rotifers, and other particulates that are characteristic of surface waters. The number and type of bioindicators are tabulated and used to calculate a risk rating score, which indicates the risk of surface water contamination. The MPA risk-rating table can be found in Section III of this report.

There was a minimal amount of sediment recovered from the filter (0.1 mL in 701.8 gallons), and the sediment was analyzed directly without flotation. Biological particulates that contribute to the EPA Risk Rating score were not detected in this sample. Data from the MPA are included in Section II of the Analytical Results.

Iron bacteria were detected in this sample, and were identified as *Gallionella* spp. Although iron bacteria can be a nuisance, they are not uncommon in certain wells, and do not represent a risk to public health. However, a high concentration of iron bacteria sediment can interfere with analysis.

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ANALYTICAL SERVICES, INC.
Microbiological Testing, Research and Consulting

Client:	Petersen Hydrologic	**Sampling Date:**	July 31, 2006
Address:	2695 North 600 East Lehi, UT 84043	**Date Received:**	August 1, 2006
		Analyst:	jh
Client Sample ID:	JC-1	**ASI Sample No.:**	2006-0801-001

Section II.

Analytical Results

I. SAMPLE DATA		
Sample Site:	JC-1 Sampling port at well head	
Water Type:	raw/well	
Turbidity, NTU's:	S: 0.38	E: 0.30
pH:	S: 7.4	E: 7.4
Treatment:	none	
Distance From Surface Water:	75 feet	
Volume Filtered:	701.8 gallons	
Filter:	Commercial Honeycomb 1 µm	
Filter Color:	off-white	
Sediment Volume:	0.1 mL	

INP = Information Not Provided
S = Start of Sampling;
E = End of Sampling

II. MPA			
Numbers reported are per 100 gallons			
Amorphous Debris:	Uniformly distributed	**Crustaceans:**	$<4.0 \times 10^0$
Vegetative Debris -		**Crustacean Parts:**	$<4.0 \times 10^0$
with chlorophyll:	$<4.0 \times 10^0$	**Crustacean Eggs:**	$<4.0 \times 10^0$
without chlorophyll:	$<4.0 \times 10^0$	**Water Mites:**	$<4.0 \times 10^0$
Diatoms -		**Gastrotrichs:**	$<4.0 \times 10^0$
with chlorophyll:	$<6.9 \times 10^1$	**Tardigrades:**	$<4.0 \times 10^0$
without chlorophyll:	$<6.9 \times 10^1$	**Nematodes:**	$<4.0 \times 10^0$
Other Algae*:	$<6.9 \times 10^1$	**Nematode Eggs:**	$<4.0 \times 10^0$
Rotifers:	$<4.0 \times 10^0$	**Invertebrate Eggs:**	$<4.0 \times 10^0$
Rotifer Eggs:	$<4.0 \times 10^0$	**Annelids:**	$<4.0 \times 10^0$
Spores:	$<4.0 \times 10^0$	**Amoebae:**	$<4.0 \times 10^0$
Pollen:	4.0×10^0	**Protozoa:**	$<6.9 \times 10^1$
Iron Bacteria:**	Present	**Insects/Larvae:**	$<4.0 \times 10^0$

***Algae Identifications:**	ND
****Iron Bacteria:**	*Gallionella* spp.
Comments:	NA

NA = Not Applicable ND = None Detected

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ANALYTICAL SERVICES, INC.
Microbiological Testing, Research and Consulting

Client:	Petersen Hydrologic	**Sampling Date:**	July 31, 2006
Address:	2695 North 600 East Lehi, UT 84043	**Date Received:**	August 1, 2006
		Analyst:	jh
Client Sample ID:	JC-1	**ASI Sample No.:**	2006-0801-001

Section III.

MPA Risk Rating Table

The risk rating for surface water influence as calculated according to the EPA Consensus Method for Microscopic Particulate Analysis is as follows:

Table 1	Table 2	Total	Risk Rating*
None Detected	NA	0	Low**

NA = Not Applicable

The tables of relative risk factors used to calculate surface water influence in the EPA Consensus Method for Microscopic Particulate Analysis are based on a limited set of data. These data are not representative of all aquifer types or well designs. Therefore, the relative risk values calculated from these tables are of limited value in determining health risks associated with surface water indicators.

*ASI advises that the risk rating be interpreted with caution, as it was developed by the US EPA from a relatively small set of data that may not be representative of conditions throughout the U.S.

**This EPA Risk Rating table classifies each sample according to the number of surface water indicating organisms per 100 gallons; however, it was possible to read only 25 gallons of this sample at a magnification of 100X, and 1.45 gallons at 400X. The relatively small volumes analyzed do not affect the validity of the results; however, decreased volume does decrease the sensitivity of the assay.

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ANALYTICAL SERVICES, INC.
Microbiological Testing, Research and Consulting

MPA References

Berk, Sharon G., John H. Gunderson. Wastewater Organisms: A Color Atlas. Lewis Publishers. Boca Raton, Florida. 1993.

Fox, J. Carl, Paul R. Fitzgerald and Cecil Lue-Hing. Sewage Organisms: A Color Atlas. Lewis Publishers. Chelsea, Michigan. 1981.

Needham, James G., Paul R. Needham. A Guide to the Study of Fresh-water Biology. McGraw-Hill, Inc. New York. 1962.

Patterson, D.J., S. Hedley. Free-Living Freshwater Protozoa. CRC Press, Inc. Boca Raton, Florida. 1992.

Pennak, Robert W. Fresh-water Invertebrates of the United States. John Wiley and Sons, Inc. New York. 1989.

Prescott, G.W. How to Know the Freshwater Algae. Wm. C. Brown Company Publishers. Dubuque, Iowa. 1978.

Smith, E. Grant. Sampling and Identifying Allergenic Pollens and Molds. Blewstone Press. San Antonio, Texas. 1990.

Standard Methods for the Examination of Water and Wastewater. APHA, AWWA, and WEF, 20th Edition. American Public Health Association, Washington, D.C. 1998.

Thorp, James H., Alan P. Couich. Ecology and classification of North American Freshwater Invertebrates. Academic Press, Inc. San Diego, California. 1991.

USEPA. Consensus Method for Determining Groundwaters Under Direct Influence of Surface Water Using Microscopic Particulate Analysis. October, 1992.

ASI Project No.: 2006-0801-001

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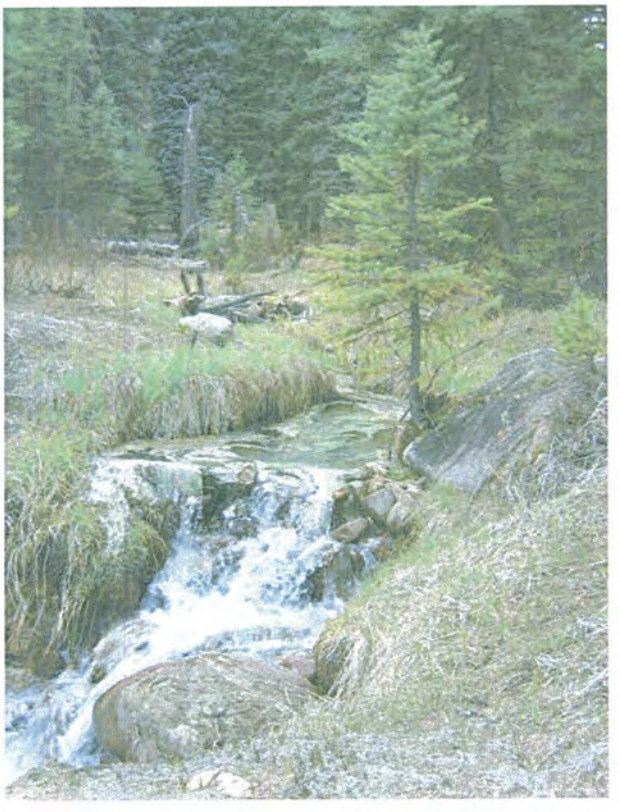
PHC Addendum Vol. 2

Appendix O

Groundwater Conditions in The Star Point Sandstone In the Vicinity of the Skyline Mine, 2014

18 August 2014

Canyon Fuel Company, LLC
Skyline Mine
Helper, Utah



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PETERSEN HYDROLOGIC
CONSULTANTS IN HYDROGEOLOGY

Groundwater Conditions in The Star Point Sandstone In the Vicinity of the Skyline Mine, 2014

18 August 2014

Canyon Fuel Company, LLC
Skyline Mine
Helper, Utah

Prepared by:

Erik C. Petersen, P.G.

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PETERSEN HYDROLOGIC
CONSULTANTS IN HYDROGEOLOGY

2695 N. 600 E.
LEHI, UTAH 84043
(801) 766-4006

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Table 1 Potentiometric data from Star point Sandstone monitoring wells

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1.0 Introduction

The Canyon Fuel Company, LLC, Skyline Mine is located in the northern Wasatch Plateau coal mining district, approximately 3.5 miles southwest of the town of Scofield, Utah (Figure 1). Operations at the Skyline Mine commenced in 1981 and continue at the present time.

Prior to 1999, modest quantities of groundwater were intercepted during underground mining operations at the Skyline Mine. Typically, the total discharge from the mine was on the order of a few hundred gallons per minute or less (UDOGM, 2014). Beginning in 1999, as coal mining operations progressed in the southwestern portion of the mine permit area, appreciably more groundwater began to be intercepted. The great majority of the intercepted groundwater upwelled from the Star Point Sandstone through the mine floor through fault and fracture systems. The intercepted Star Point Sandstone groundwater (which pooled in down-dip areas) was pumped from the southwest portion of the Skyline Mine to surface discharge points in Eccles Canyon (CS-14). Mining in the southwest area was mostly completed by 2003. The inflow of Star Point Sandstone groundwater into the mined out areas has continued and, consequently, the pumping of groundwater from this area has been essentially continuous from 1999 to the present time.

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Canyon Fuel Company plans to conduct mining operations in the Flat Canyon Tract, which is located to the west of the existing Skyline Mine permit area (Figure 1). The purpose of this investigation is to evaluate the current potentiometric conditions in Star Point Sandstone groundwater systems subsequent to the more than 14 years that have elapsed since these systems were first intercepted in the Skyline Mine.

2.0 Methods of Study

Existing hydrogeologic maps and reports were obtained and reviewed. These included previous hydrogeologic investigations of the Skyline Mine area (Mayo and Associates, 1996), the Flat Canyon Tract Final Environmental Impact Statement conducted by the United States Forest Service and Bureau of Land Management (USFS, 2002), and reports of Star Point Sandstone groundwater systems that were intercepted previously by the Skyline Mine (Petersen Hydrologic, 2002; HCI, 2001, 2002, 2003, 2004).

Potentiometric information from monitoring wells in the Skyline Mine area was obtained from the Utah Division of Oil, Gas and Mining on-line Utah Coal Mining Water Quality Database (UDOGM, 2014) and compiled for analysis.

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Mine-water discharge rate data from the southwest portion of the Skyline Mine (at monitoring site CS-14) as well as pumping rate data from Skyline well JC-1 were also obtained from the Utah Coal Mining Water Quality Database (UDOGM, 2014) and compiled for analysis.

Regional Palmer Hydrologic Drought Index (PHDI) data for the Skyline Mine area (Utah Region 5) were obtained from the National Climatic Data Center (NCDC, 2014) for analysis. The PHDI is a monthly value generated by the National Climatic Data Center using a variety of hydrologic parameters that indicates wet and dry spells. The PHDI is calculated from several hydrologic parameters including precipitation, temperature, evapotranspiration, soil water recharge, soil water loss, and runoff. Consequently, it is a useful tool for evaluating the relationship between climate and groundwater and surface-water discharge data.

Potentiometric data from each of the Star Point Sandstone wells were plotted together with plots of CS-14 discharge, JC-1 pumping rates, and the PHDI for analysis. These data were plotted using SigmaPlot version 12 software.

3.0 Presentation of Data

The locations of water wells utilized in this analysis are shown on Figure 1. Groundwater potentiometric data from wells are presented as groundwater elevations (above sea level) and also as depths below the surface in Table 1. A generalized geologic map of the Skyline Mine and adjacent area is presented in Figure 2. A plot of the PHDI for Utah Region 5 is presented in Figure 3. Water level hydrographs for each of the wells utilized in this investigation are presented in Figure 4.

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4.0 Overview of Mine Operations at the Skyline Mine

The Skyline Mine began operations in 1981. Prior to 1999, generally only modest quantities of groundwater were intercepted during underground mining operations in the Skyline Mine. Most commonly, groundwater was intercepted in Blackhawk Formation sandstone paleochannels in the mine roof in newly opened mining areas. These groundwater inflows were commonly short lived. During this time, the total discharge from the Skyline Mine was usually on the order of a few hundred gallons per minute or less. Beginning in 1999, larger inflows began to be encountered as mining operations progressed into the southwest portion of the Skyline Mine. These larger inflows originated from the mine floor as warm water upwelled through faults and fractures in the underling Star Point Sandstone. Unlike discharges from the overlying sandstone paleochannels, discharges from the underlying Star Point Sandstone encountered from 1999 have been more persistent. In response to the groundwater intercepted in the Star Point Sandstone, discharge rates at CS-14 peaked during early 2003 at rates exceeding 8,000 gpm (UDOGM, 2014). Much of the peak discharge was in response to a large groundwater inflow that occurred while mining in the 10-left development entries (Figure 1). It has been necessary to pump the accumulating Star Point Sandstone groundwater from the southwest portion of the Skyline Mine underground workings to surface discharge points in Eccles Canyon. The mine water pumped from the southwest portion of the mine is monitored at Skyline Mine monitoring point CS-14. Mine water from CS-14 is discharged to the surface into Eccles Creek in Eccles Canyon near the mine surface facilities (Figure 1). Mining in the various mining districts in the southwest portion of the Skyline Mine were completed during 2002 and 2003. After mining in these regions was completed, water levels in the underground mine pool were allowed to rise as pumping was

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stopped and the mined-out southwest area mine workings filled with groundwater. Groundwater inflows from Star Point Sandstone have continued, and the pumping of groundwater from the now flooded southwest portion of the mine has been essentially continuous from 1999 to the present time. By September of 2004 the water levels in the southwest mine pool had risen to the 8,300 foot level. Currently, the pool is maintained at an elevation of approximately 8,300 feet by pumping from the pool to CS-14.

In the summer of 2001, a groundwater pumping well (JC-1) was drilled and completed, apparently in a fracture system related to the fracture system from which the 10-Left groundwater inflow into the mine workings originated. Over the period of its existence, pumping rates at JC-1 have varied from about 2,000 gpm to more than 4,000 gpm. Intermittently, pumping from JC-1 has stopped (typically to allow for well repairs). Groundwater pumped from JC-1 is discharged to Electric Lake.

5.0 Previous Investigations

Previous investigations of Star Point Sandstone groundwater systems in the vicinity of the Skyline Mine have been performed by Mayo and Associates, (1996), Petersen Hydrologic, LLC (2002), and Hydrologic Colorado Consultants, Inc. (HCI 2001, 2002, 2003, 2004). Mayo and Associates (1996) performed a comprehensive investigation of groundwater and surface-water systems in the vicinity of the Skyline Mine. Petersen Hydrologic (2002) investigated fault-related groundwater systems in the Star Point Sandstone, including the likely origins of the

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groundwater inflows and the likely impacts to the hydrologic balance resulting from these Star Point Sandstone inflows. HCI has performed a series of hydrologic investigations in the Skyline Mine and surrounding areas that have focused on numeric modeling of the groundwater and surface-water systems. Initially, in 2001 HCI created a numerical flow model for the purpose of predicting dewatering requirements for proposed coal mining in the Flat Canyon Tract. An updated and more comprehensive version of the model was later created that incorporated data on surface-water hydrology, additional groundwater level data, and more information on stratigraphy and structures from a sub-regional geologic mapping program (HCI, 2004).

6.0 Geologic Setting

A map showing the general geology of the Skyline Mine and adjacent areas is presented in Figure 2.

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The Star Point Sandstone consists of massive, fine- to medium-grained sandstone that is moderately well consolidated. Individual massive sandstone units are separated by partings of low-permeability siltstone or mudstone. The Storrs Tongue of the Star Point Sandstone interfingers with the basal portion of the overlying Blackhawk Formation in the Skyline Mine area. The Storrs Tongue of the Star Point Sandstone, which exists beneath the current Skyline Mine permit area, pinches out to the west in the Flat Canyon area. The Panther Tongue of the Star Point Sandstone underlies the Storrs Tongue in the existing permit area and the adjacent Flat Canyon area. The Panther Tongue is in most locations separated from the overlying Storrs

Tongue by several tens of feet of relatively impermeable shaley deposits. Regional studies indicate that the individual sandstone bodies of the Star Point Sandstone are elongate in a north-south direction, parallel to the ancient shoreline. These units interfinger seaward (to the east) with the Mancos Shale and landward (to the west) with the Blackhawk Sediments (HCI, 2003). Together, the stacked sequence of sandstones and siltstones of the Star Point are approximately 1,500 feet in thickness (HCI, 2003).

Numerous faults have been mapped in the current Skyline Mine permit area and the adjacent Flat Canyon area (Figure 2). The Skyline Mine area lies between two major north-south trending faults. The Pleasant Valley Fault is located in the Mud Creek area to the east and the Gooseberry Fault is located in the Gooseberry Creek area to the west. The Pleasant Valley Fault system juxtaposes rocks of the Star Point Sandstone against the shale, mudstone, and sandstone rocks of the Blackhawk Formation. The Gooseberry Creek Fault system juxtaposes rocks of the Star Point Sandstone against the predominantly shale bedrock of the North Horn Formation.

Several north- to northeast-trending faults with displacements up to a few tens of feet have been mapped in the existing Skyline Mine permit area and in the Flat Canyon area. The fault-related Star Point Sandstone groundwater inflows at the Skyline Mine have been associated with these structures.

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It is noteworthy that the rock strata in the southern portion of the Skyline Mine area are in a tensional stress regime (Personal communication, Mark Bunnell, 2002). Consequently, rock fractures in the region (particularly the brittle sandstones of the Star Point Sandstone beneath the

coal seams) can remain open (i.e. have a measurable aperture). Groundwater can be readily conveyed through such fractures. The rock strata in the northern portion of the mine area do not appear to be in a tensional stress regime (Personal communication, Mark Bunnell, 2002). Regions north of the 6 Left through 12 Left longwall panels are separated from the southern portion of the mine by an east-west trending fault system that structurally isolate these two regions. A significant igneous dike in the same region likely also partitions groundwater systems in these two regions.

The Blackhawk Formation overlies the Star Point Sandstone in the Skyline Mine area. The Blackhawk Formation consists of lenticular, discontinuous beds of sandstone, claystone, mudstone, shale, and coal. Sandstone paleochannels, which are sinusoidal fluvial sandstones encased in the surrounding low permeability, fine-grained rocks are present throughout the formation.

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7.0 Potentiometric Conditions in the Star Point Sandstone

For detailed information regarding the hydrogeology and groundwater and surface-water systems in the region, the reader is referred to previous reports from the Skyline Mine area (Mayo and Associates, 1996; Petersen Hydrologic, 2002; HCI,2001, 2002, 2003, 2004).

Water level hydrographs for each of the 10 Star Point Sandstone monitoring wells evaluated in this investigation are presented in Figure 4. Also plotted in Figure 4 are plots of historic CS-14

discharge rates and also plots of historic pumping rates from well JC-1 (plotted on the same x-axis time scale as the well water level hydrographs). The CS-14 and JC-1 information is plotted together with the well water level information to facilitate an analysis of potential relationships between these parameters. PHDI information is also plotted in Figure 4 to assist in determining whether climatic variability influences potentiometric levels in the Star Point Sandstone.

It is apparent in Figure 4 that water levels in all of the wells screened in the Star Point Sandstone in the southwest portion of the Skyline Mine area responded to the underground interception of fracture-related Star Point Sandstone groundwater at the Skyline Mine that began in 1999. Relative to pre-1999 levels, water levels in monitoring well W79-35-1A had declined by more than 350 feet by mid-2003. Water levels located in areas more distant from the largest in-mine groundwater inflow areas responded with lesser water level declines. Water levels in monitoring wells W98-2-1, W20-4-2, 20-4-1, and 99-28-1 declined by 100 feet or more in response to the in-mine Star Point Sandstone inflows. Water levels in monitoring wells 20-28-1 and W99-21-1 declined by about 30 feet or more (Figure 4).

As anticipated, water levels in monitoring wells W91-26-1 and W91-35-1 (located in the northern Skyline Mine area) did not respond appreciably to the Star Point Sandstone groundwater inflows in the southwest portions of the Skyline Mine. This is likely because 1) as discussed in Section 6 above, the northern portions of the Skyline Mine are likely not in good hydraulic communication with mining areas to the southwest due to the different geologic/structural conditions and possibly also to the presence of a low-permeability igneous

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dike between the two areas, and 2) because the two areas are separated by a considerable distance of several miles (Figure 1). It is noted that marked water level declines in both W91-26-1 and W91-35-1 were observed beginning in about 2011 and 2012 (Figure 4). However, these water level declines correspond with the occurrence of mining in the nearby vicinity of the two wells in the northern area and are likely not associated with dewatering/depressurization of the Star Point Sandstone in the southwest portion of the Skyline Mine.

As apparent in Figure 4, beginning in about mid-2003, water levels in the Star Point Sandstone in the southwest portion of the mine area began to recover from their maximum drawdown levels. During 2003, mining in most of the southwest portion of the mine was completed. Subsequently, pumping of mine water from these areas ceased and water levels were allowed to rise and eventually fill the mined-out areas. After the southwest mining region had filled with groundwater to an elevation of approximately 8,300 feet, pumping was resumed (to the CS-14 discharge location) so as to maintain the mine-water pool at approximately that elevation. The beginning of the water-level recovery noted in the monitoring wells in mid-2003 is likely a response to this occurrence. During the 10 years that have elapsed since that time, water levels have generally been recovering gradually (Figure 4).

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Water level responses that are likely related to the pumping conditions at well JC-1 are apparent in most of the Star Point Sandstone monitoring wells (Figure 4). During times when JC-1 pumping rates decreased, or when the well was not operating, water levels generally increased in the surrounding Star Point Sandstone monitoring wells in response to these conditions. Notably, after a several-year period during which JC-1 pumped at an average rate exceeding 4,000 gpm,

during the period from late 2010 through mid-1012, JC-1 pumped only intermittently at a rate nearer 2,000 gpm with prolonged periods of no discharge from the well. Water levels in most of the monitoring wells in the southwest portion of the mine area reflect this trend with more rapid water level recovery during this period. Increases in mine-water discharge rates at CS-14 were also noted during the period of lowered groundwater production from JC-1. When the 4,000 gpm pumping regime was resumed in mid-2012, water levels in the surrounding monitoring wells decreased in response to the increased groundwater withdrawal rates from the Star Pont Sandstone (Figure 4).

Water level responses that might suggest the influence of climatic variability on water levels in the Star Point Sandstone groundwater system are not apparent (Figure 4).

In Figure 5, water levels at monitoring wells W79-35-1A and W79-35-1B (a nested well pair) are plotted together. W79-35-1A is screened in the Star Point Sandstone, while W79-35-1B is screened in the more shallow overlying Blackhawk Formation groundwater system. As depicted in Figure 5, water levels in the Blackhawk Formation groundwater system at the W79-35-1B well location have not decreased significantly as a result of the interception of the deep Star Point Sandstone groundwater systems at the Skyline Mine. It is noteworthy that there is such an obvious lack of hydraulic communication between the Blackhawk Formation groundwater system and the deep Star Point Sandstone system at this location, even though the borehole of the deep well (W79-35-1A) physically intersected a significant fault (Vaughn Hansen Associates, 1979) that is likely in good hydraulic communication with the "Diagonal Fault" (Figure 2) and groundwater discharge from the Star Point Sandstone in this vicinity has been

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ongoing for more than 10 years. The "Diagonal Fault" system is likely the conduit through which the large 10-L inflow entered the mine workings. (The modest drop in the water level at W79-35-1B that occurred in early 2003 took place as the longwall mining face passed within a few hundred feet of W79-35-1B also in early 2003. The one-time water level drop at W79-35-1B likely reflects the effects of subsidence near the well and is not believed to be related to drainage of water from the Star Point Sandstone).

8.0 Observations and Conclusions

- Substantial drawdowns of potentiometric levels in Star Point Sandstone monitoring wells in the Skyline Mine area (up to several hundred feet) occurred in response to the interception of large in-mine groundwater inflows that began in 1999 (and to groundwater pumping at well JC-1). The large drawdowns are consistent with the removal of substantial quantities of groundwater from storage in the Star Point Sandstone.

- There are no indications that climatic variability has significantly influenced water levels in the Star Point Sandstone groundwater system.

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- Water levels in the northern portions of the Skyline Mine area have not responded to the Star Point Sandstone groundwater inflows or to ongoing pumping of water from the southwest portion of the Skyline Mine. This is likely attributable to the different

geologic/structural conditions in these two areas and possibly to the presence of a low-permeability igneous dike. The considerable distance between the northern mining area and southwest area (several miles) may also be in part responsible for the lack of a response in water levels in the Star Point Sandstone groundwaters in the northern area.

- Potentiometric levels in the Star Point Sandstone groundwater system began to recover appreciably in mid-2003 after mining was completed in the southwest portion of the mine and mined-out areas were allowed to fill with groundwater. The current mine pool elevation is maintained at about 8,300 feet by pumping to CS-14.

- Water levels in the Star Point Sandstone groundwater system in the southwest portion of the mine area have generally not recovered to their maximum pre-2003 levels. (Pre-1999 water level data are not available for most wells).

- Water levels in wells in the Star Point Sandstone respond to pumping-rate variability at JC-1, demonstrating the hydraulic interconnectedness of the Star Point Sandstone groundwater systems in which the monitoring wells are screened.

- Observations of CS-14 and JC-1 pumping rate data suggest that pumping at JC-1 has an influence on the CS-14 pumping rate required to maintain the pool level in the southwest portion of the mine. (When JC-1 is not operating, pumping rates from the mine pool to CS-14 need to increase). However, the increase in the rate at which groundwater needs to be pumped to CS-14 to maintain the pool elevation does not increase in an amount equal to the previous JC-1 pumping rate before the well was turned off.

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- Over the past 11 years, mine-water discharge rates from the southwest portion of the existing Skyline Mine workings (CS-14) have declined substantially, from more than 8,000 gpm in early 2003 to less than 2,000 gpm in early 2014 (while pumping at JC-1 has continued more or less continuously). The apparent long-term declines in the CS-14 discharge rate likely reflect a local lowering of the hydraulic head in the Star Point Sandstone groundwater system in response to the long term outflow of groundwater from the formation.

- The fact that the water levels have recovered substantially in most monitoring wells (even as groundwater continues to flow from the Star Point Sandstone into the southwestern mine area and JC-1 continues to pump at substantial rates) suggests that there is still a large quantity of groundwater in the system (i.e. the groundwater system is likely large and it has not been drained or greatly depressurized).

- It is anticipated that where mining in the proposed Flat Canyon Tract intercepts water-bearing faults or fractures, considerable inflows into the mine workings would be anticipated.

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- It is anticipated that Star Point Sandstone inflows encountered during mining in the Flat Canyon Tract could be of similar duration to those encountered previously at the Skyline Mine (i.e. the Star Point system has probably not been dewatered or depressurized

sufficiently to expect appreciably reduced inflow rates or inflow durations relative to those that occurred during previous mining operations in the southwest portion of the Skyline Mine).

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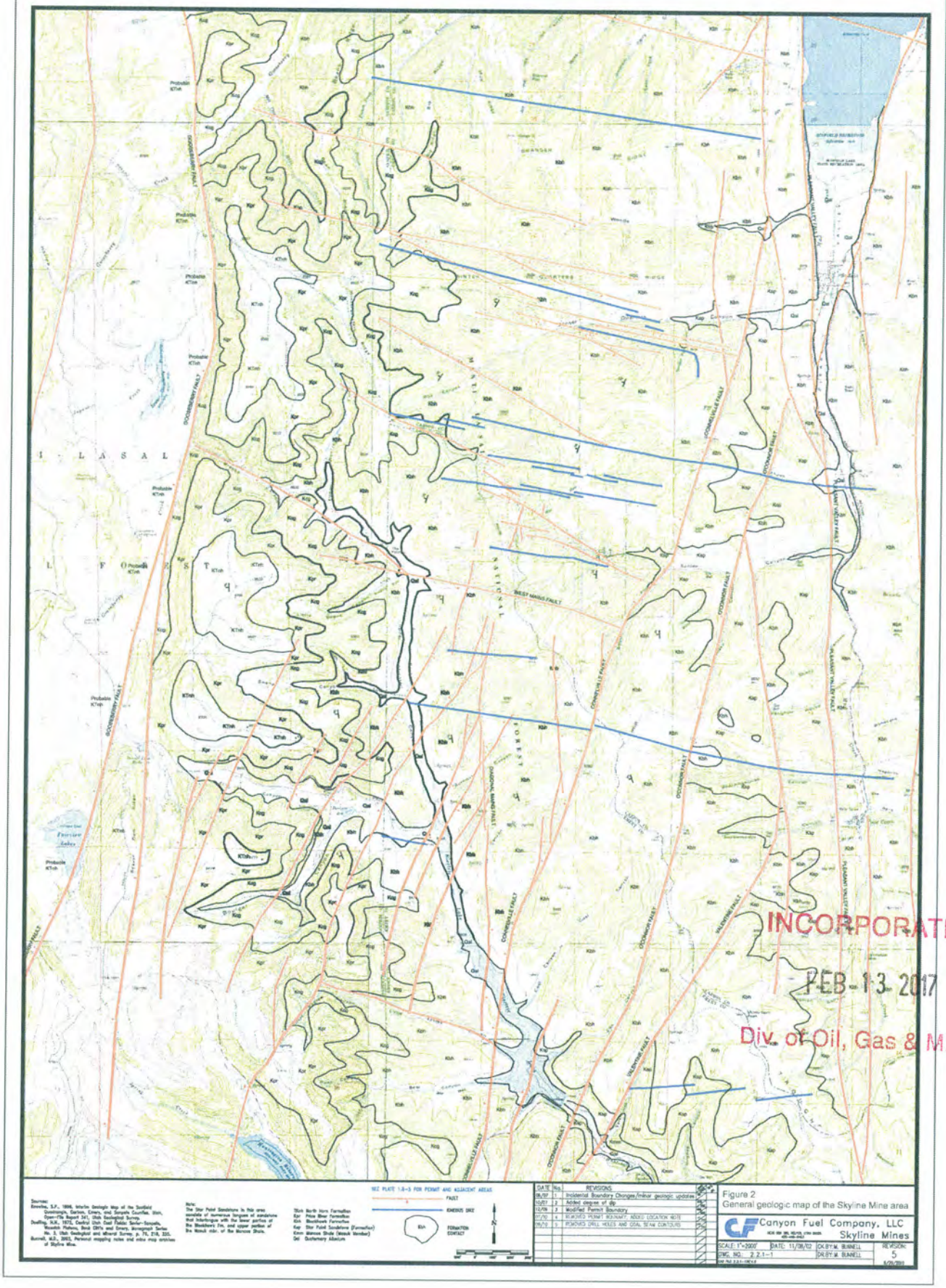
Figure 1 Locations of monitoring wells at the Skyline Mine area.



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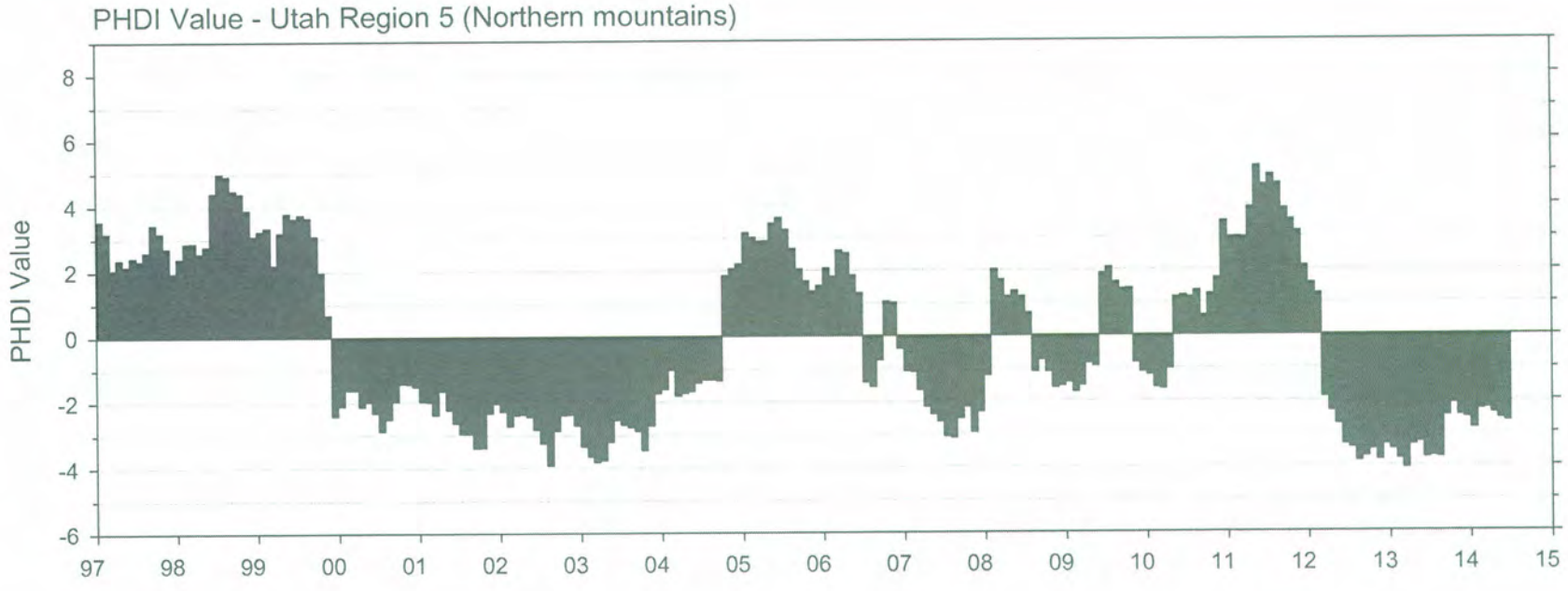

-1 to -2	Mild Drought	1 to 2	Mild Wet Spell
-2 to -3	Moderate Drought	2 to 3	Moderate Wet Spell
-3 to -4	Severe Drought	3 to 4	Severe Wet Spell
-4 to -5	Extreme Drought	4 to 5	Extreme Wet Spell

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Figure 3 Plot of Palmer Hydrologic Drought Index for Utah Region 5.

Figure 4 Water level hydrographs for monitoring wells:

W79-35-1A

W91-26-1

W91-35-1

W98-2-1

W99-4-1

W99-21-1

W99-28-1

W20-4-1

W20-4-2

W20-28-1

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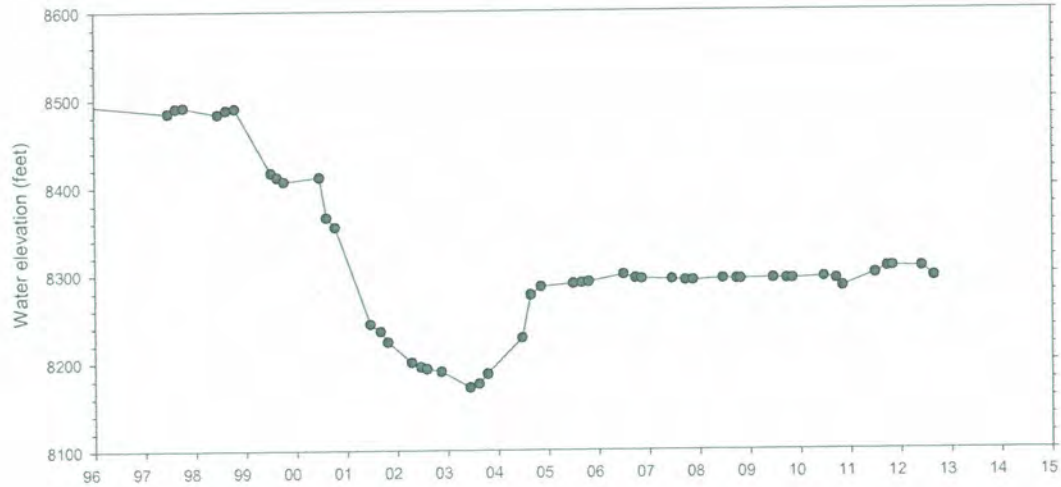
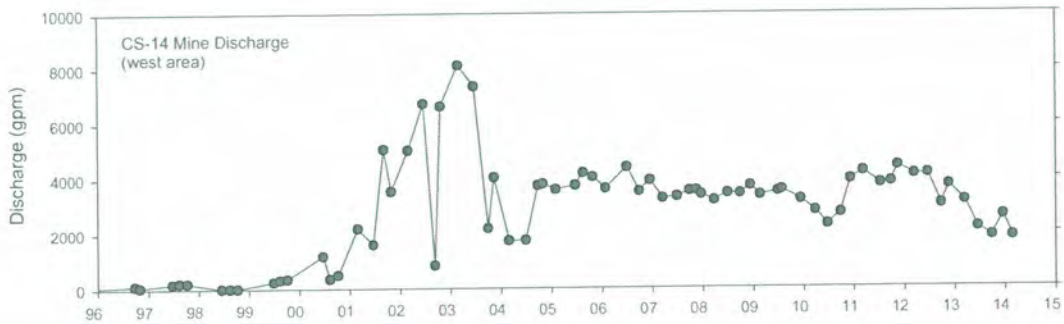
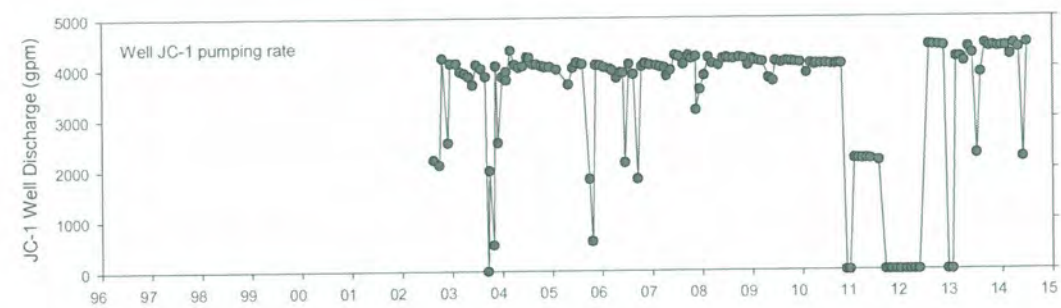
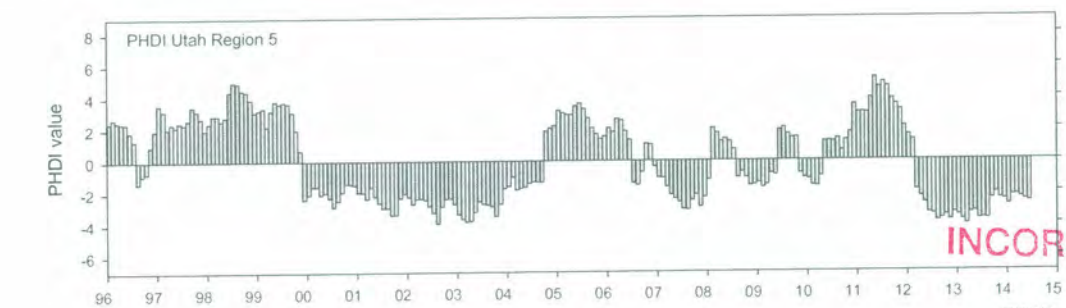
W79-35-1A









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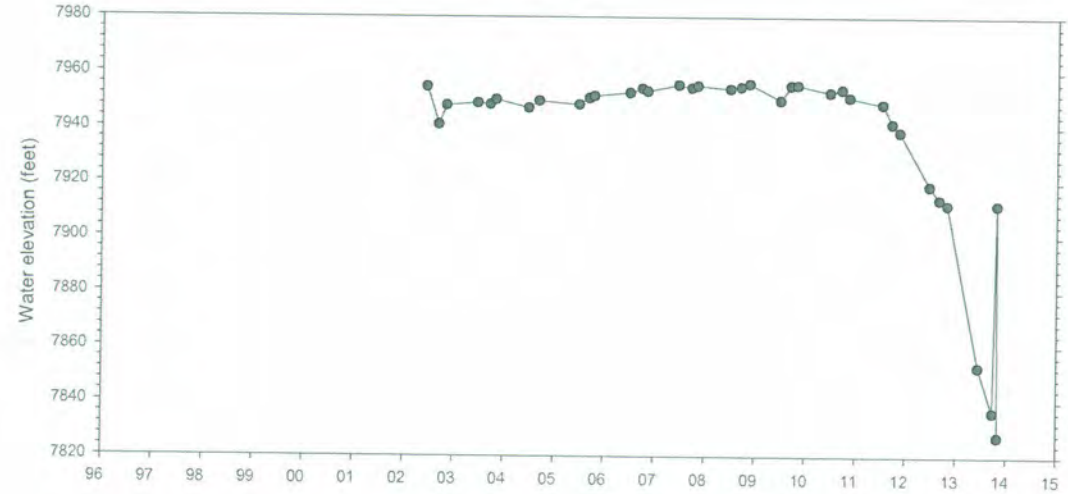

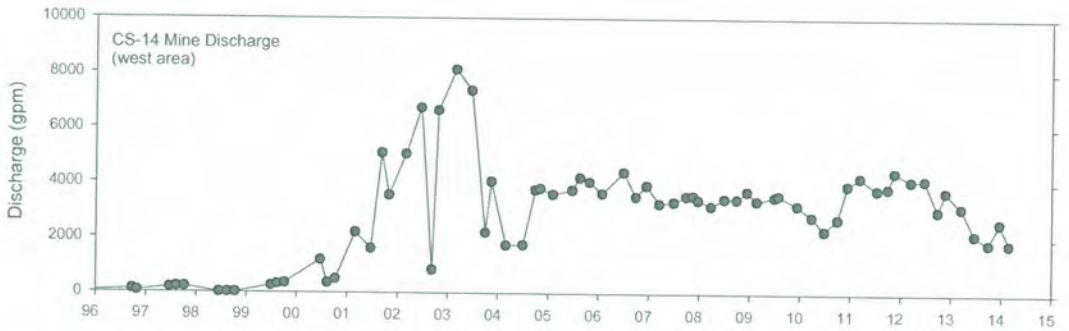

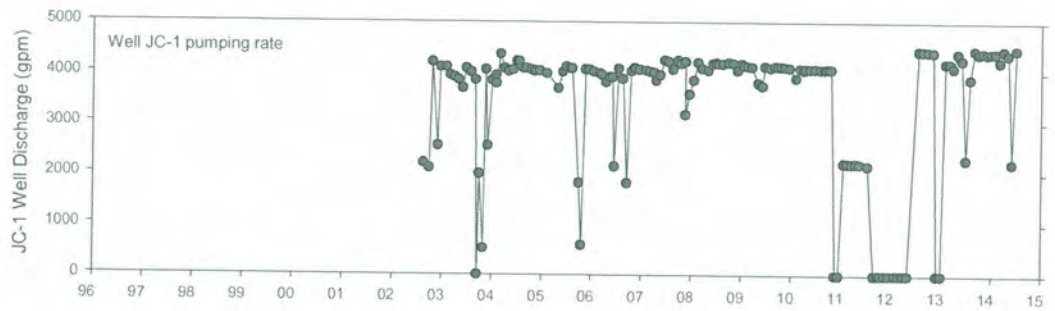

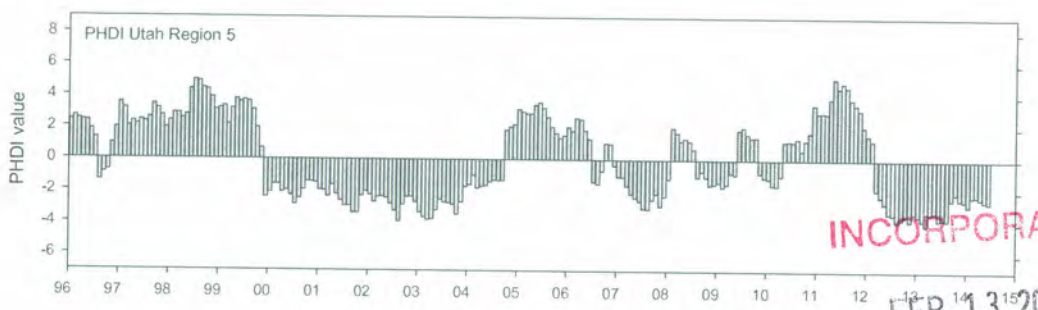

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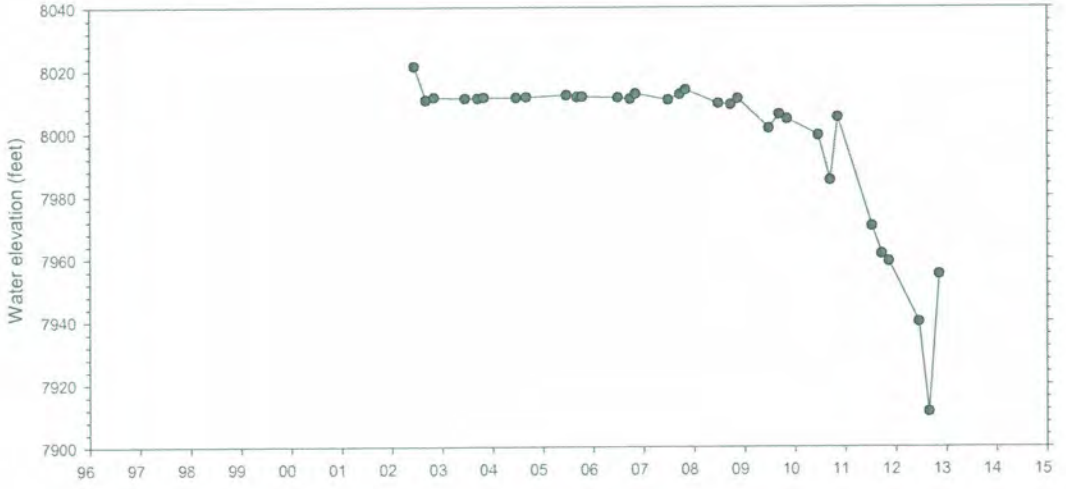

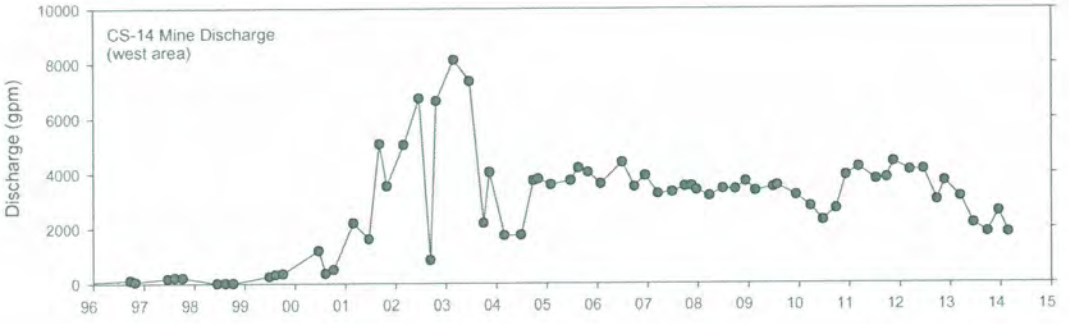

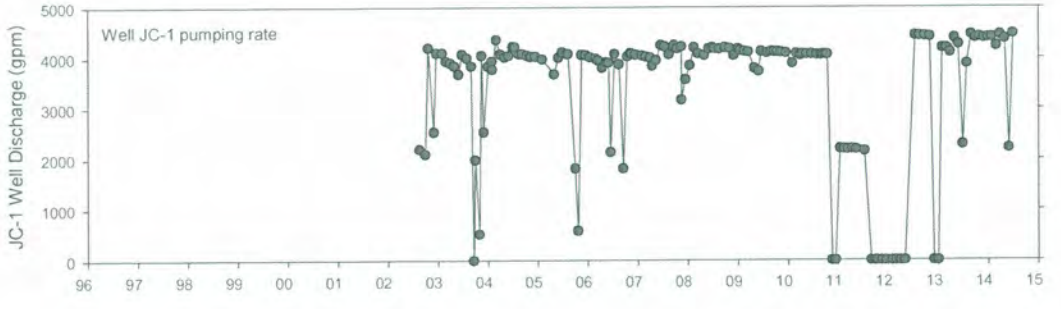

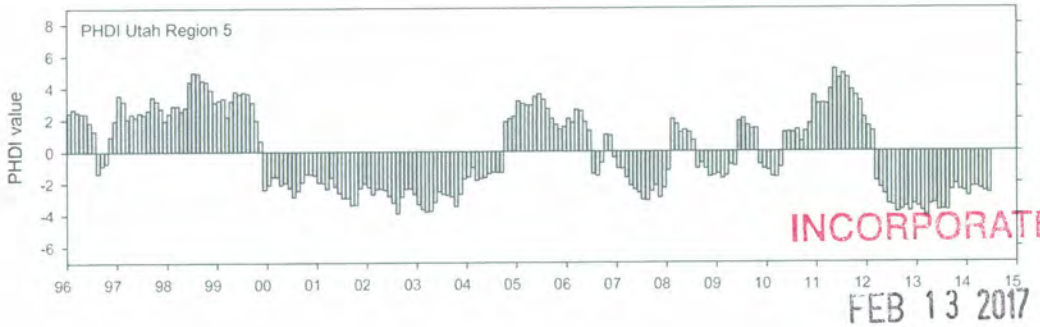

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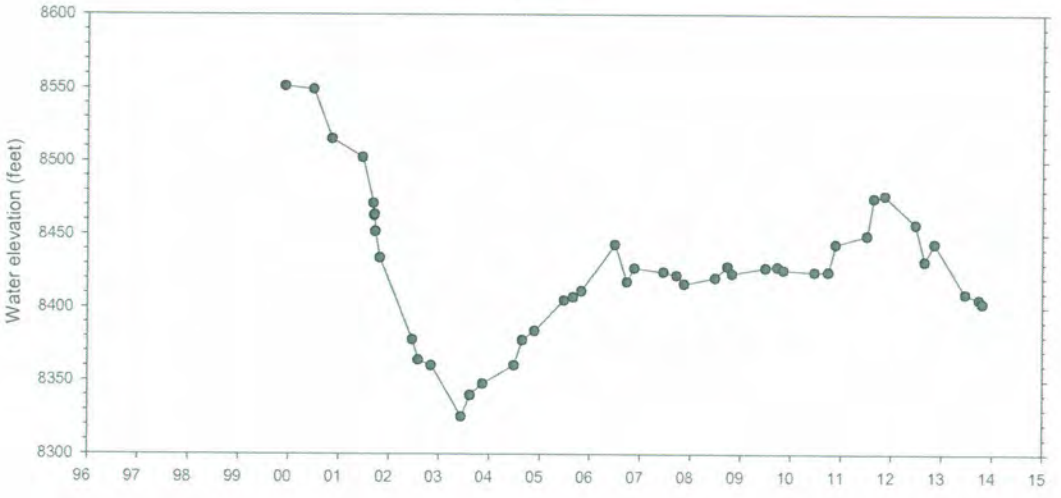

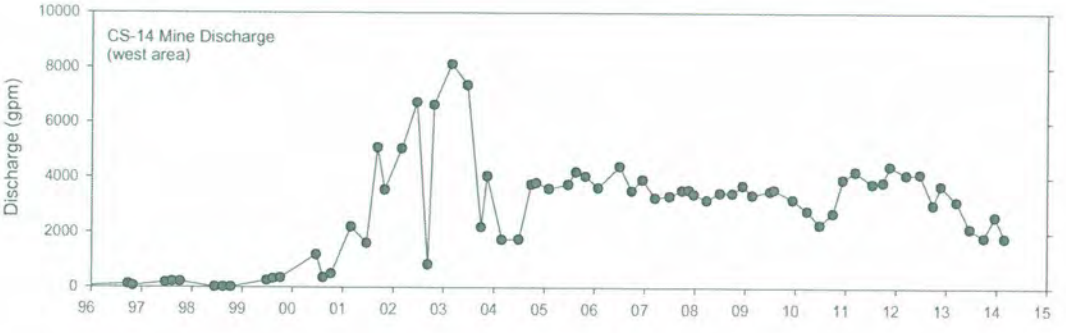

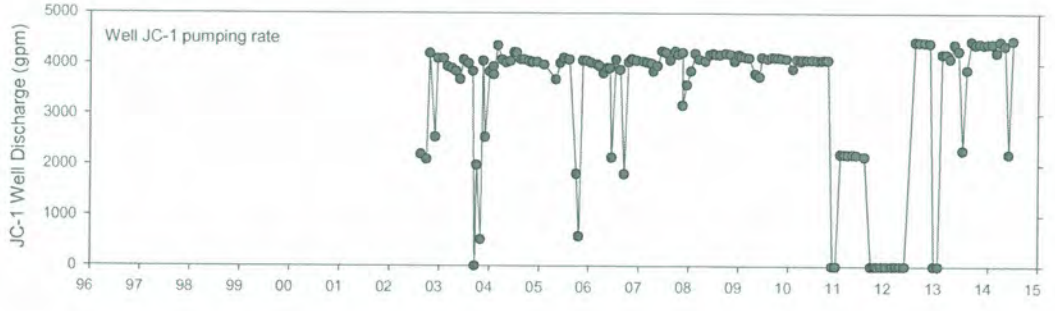

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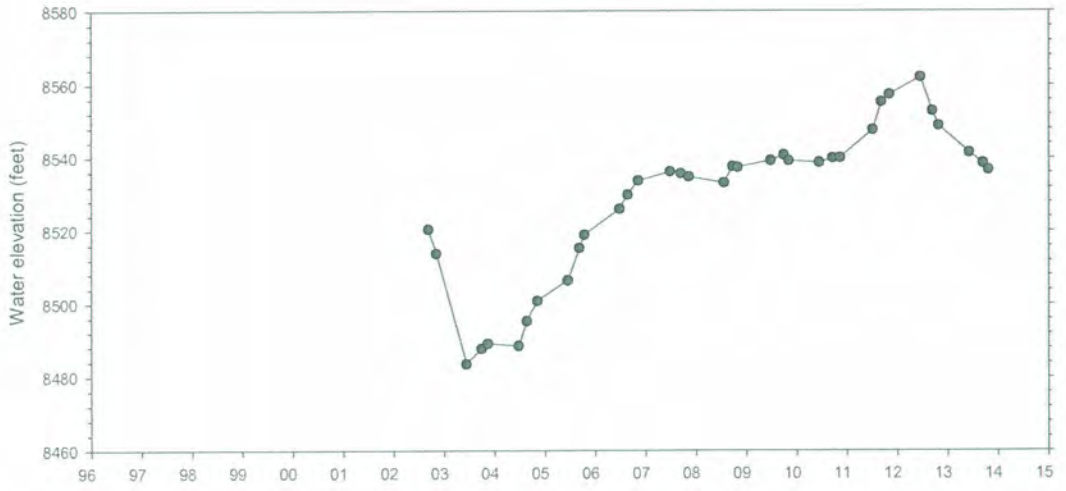

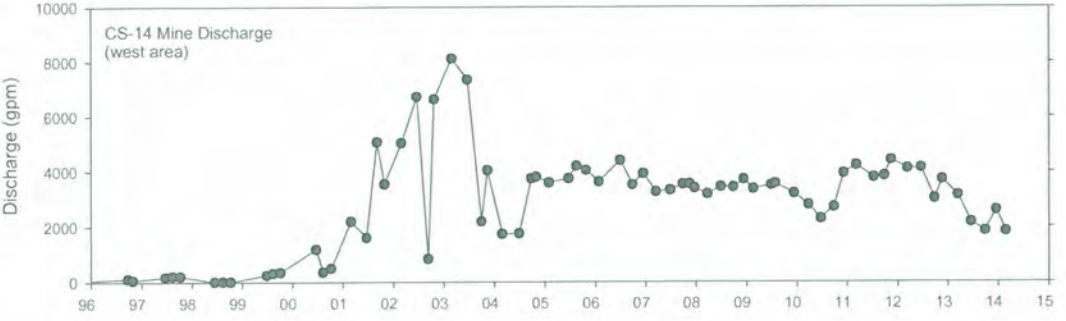

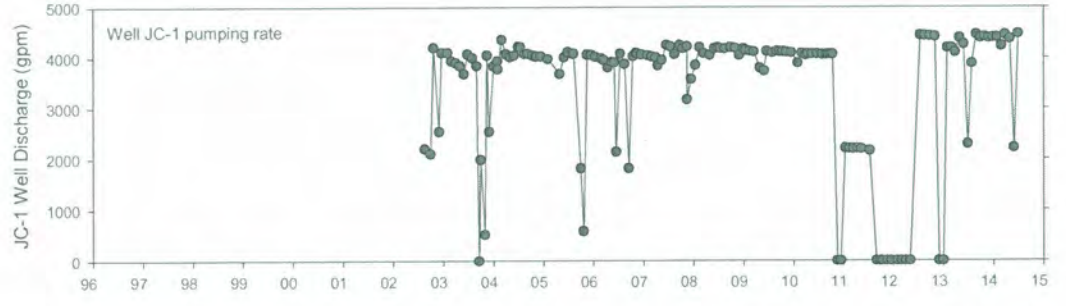

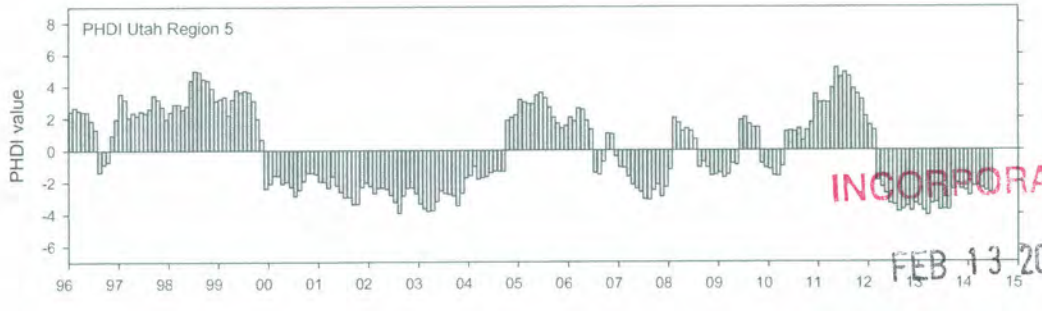

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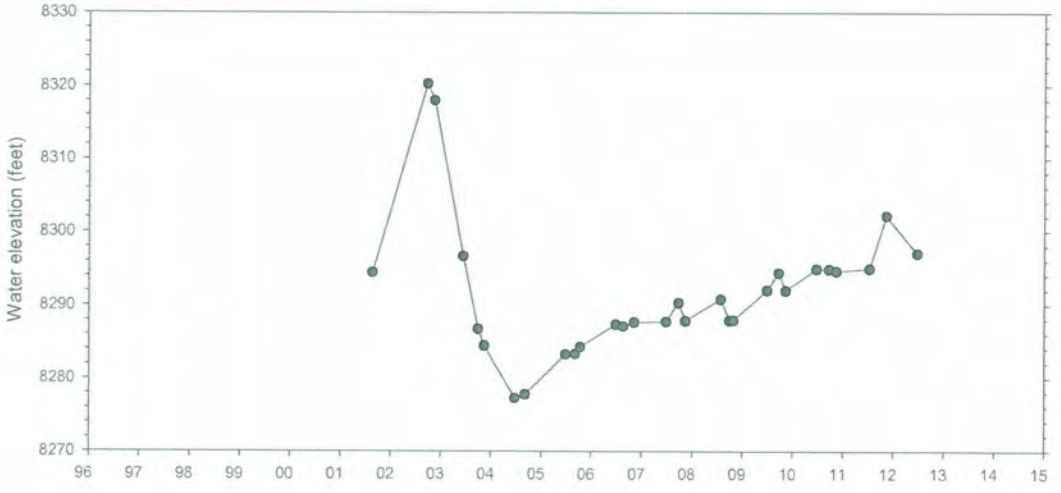

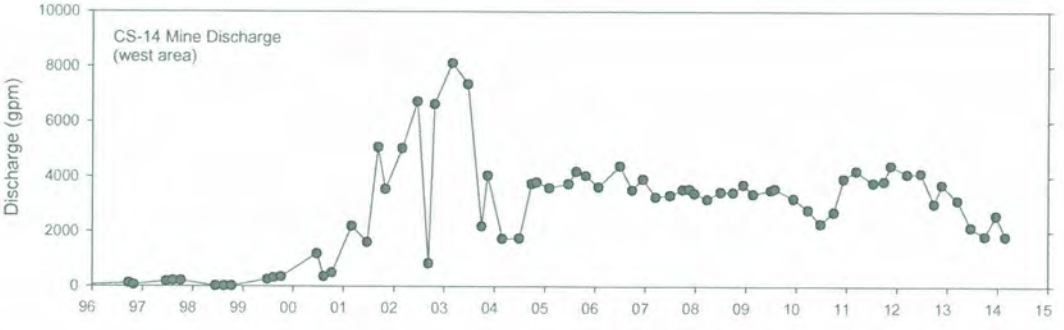

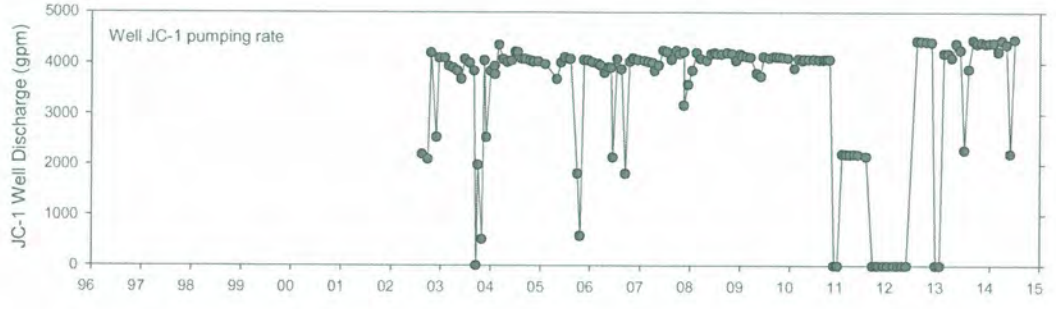

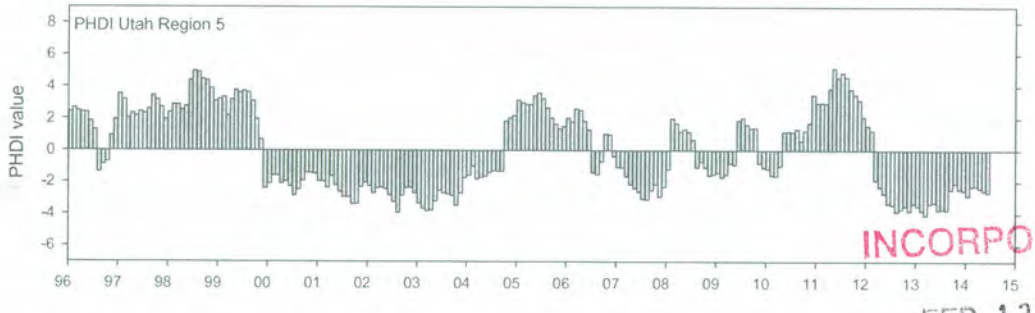

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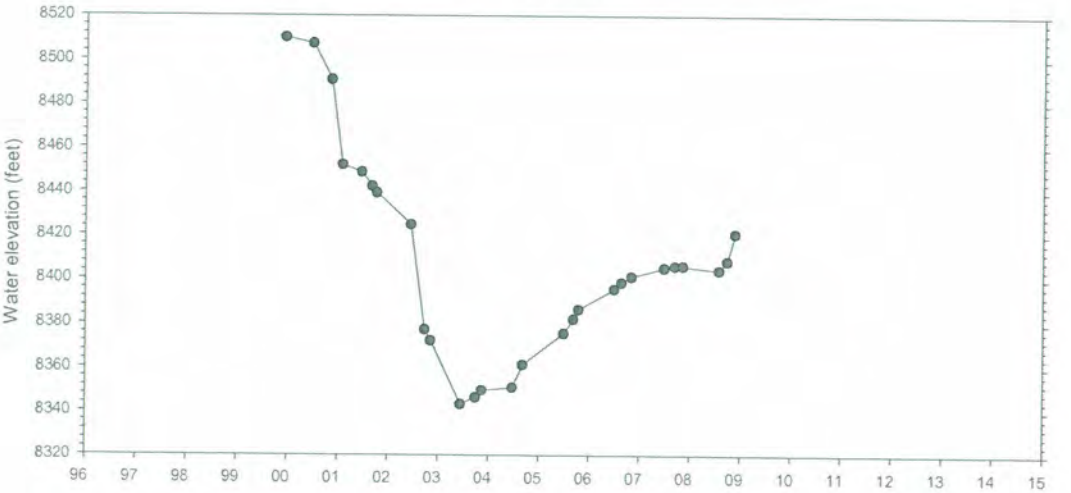

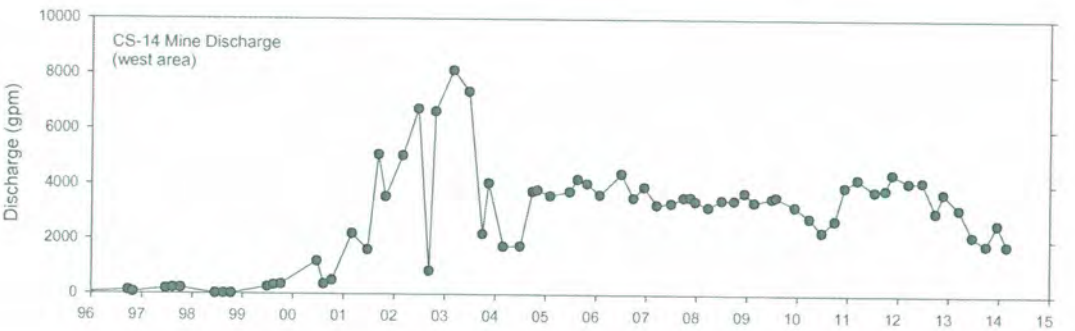

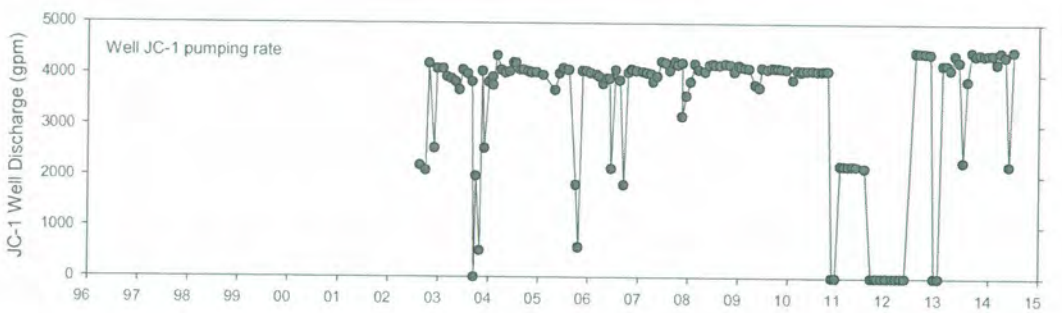

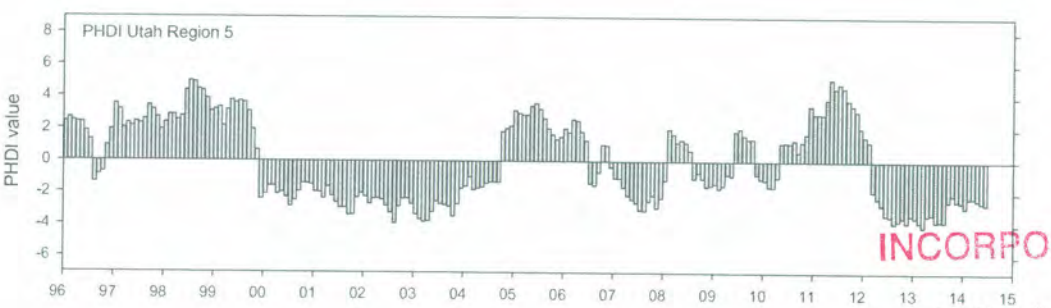

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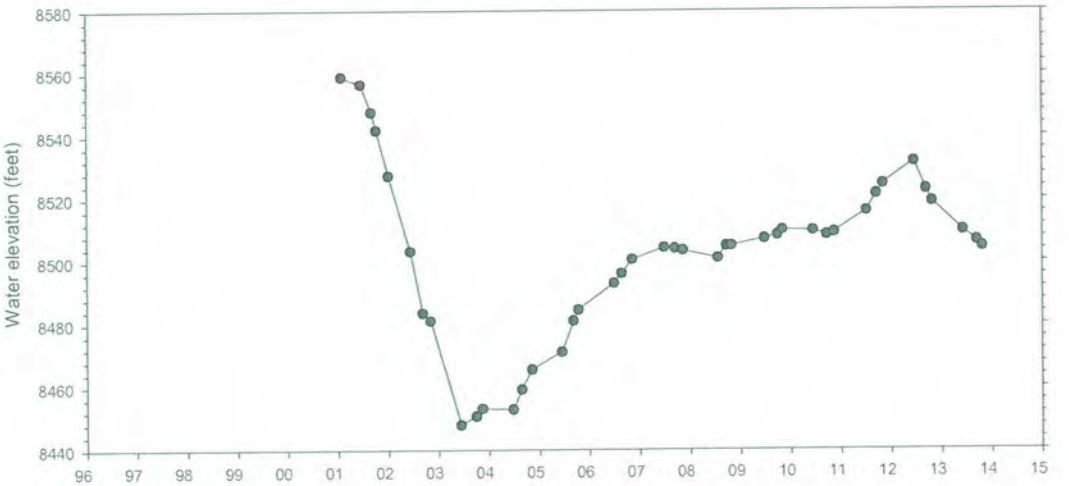

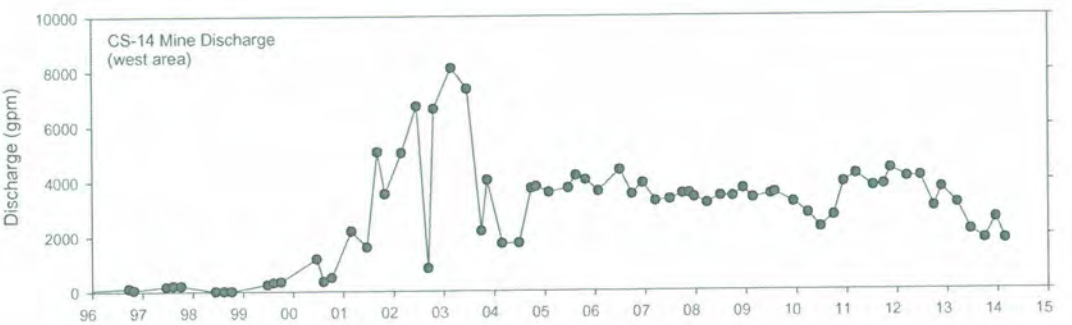

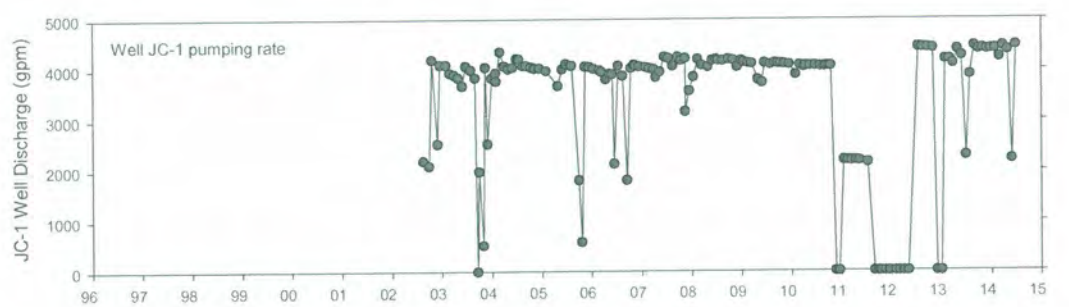

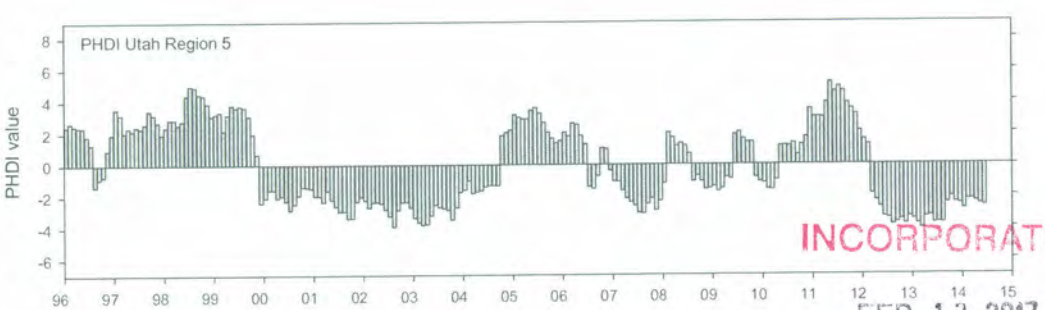

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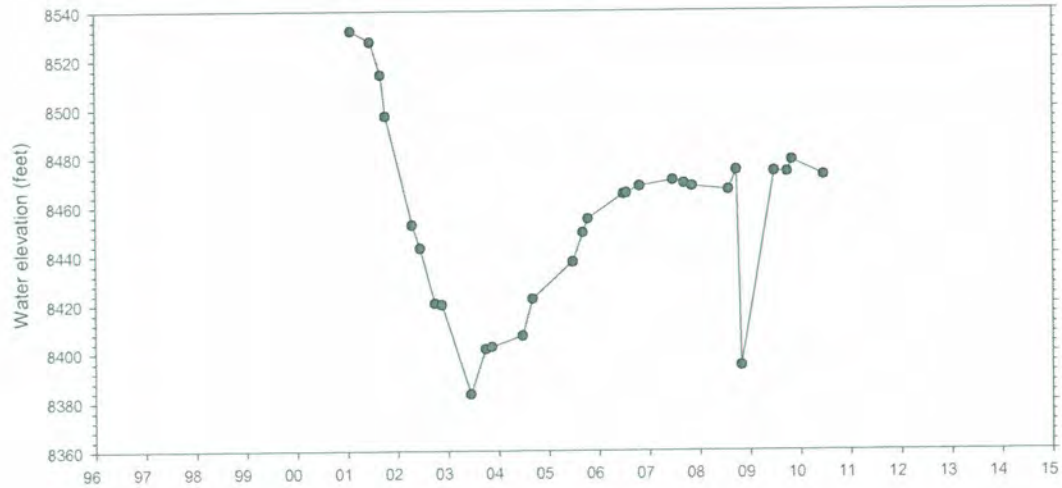

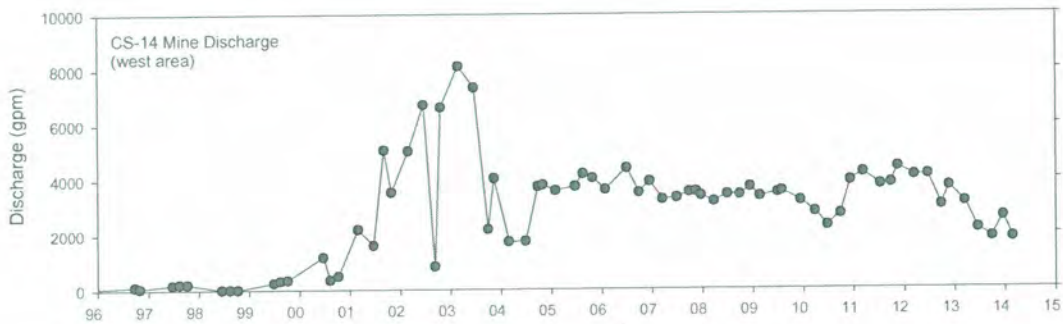

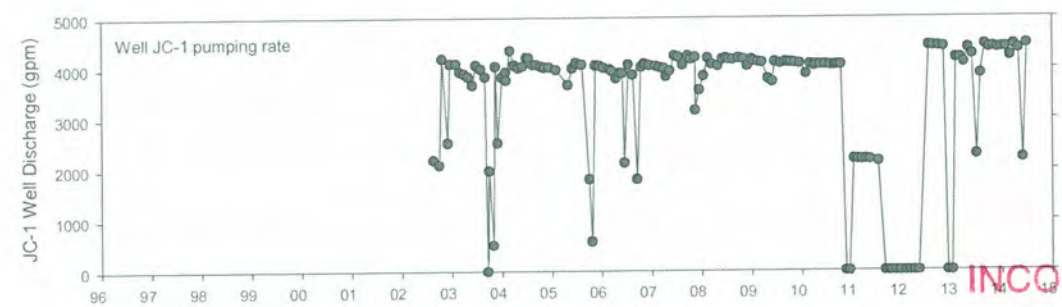

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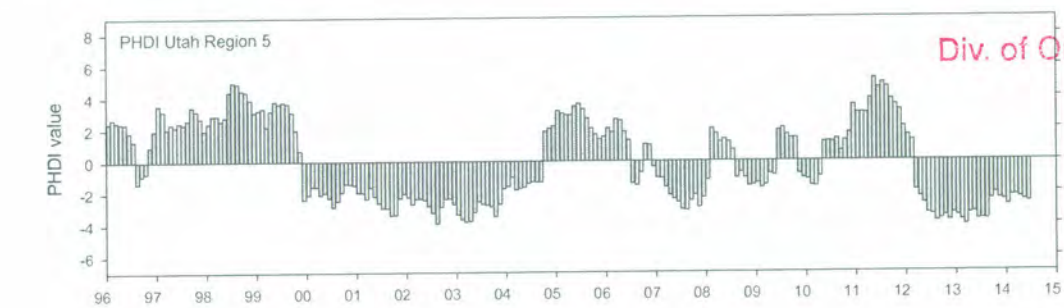

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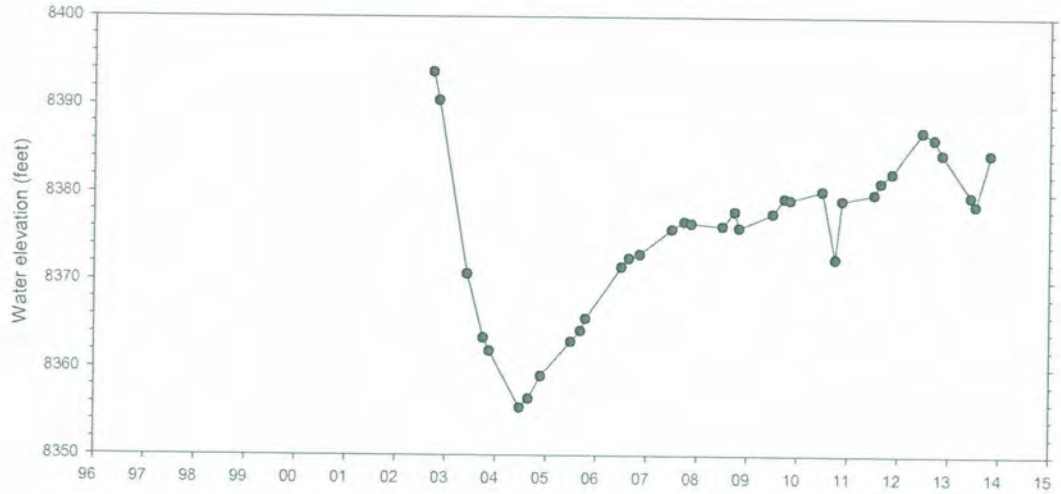

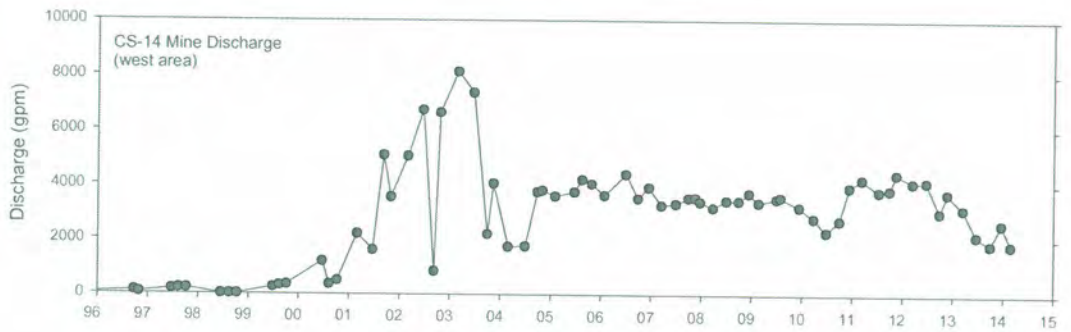

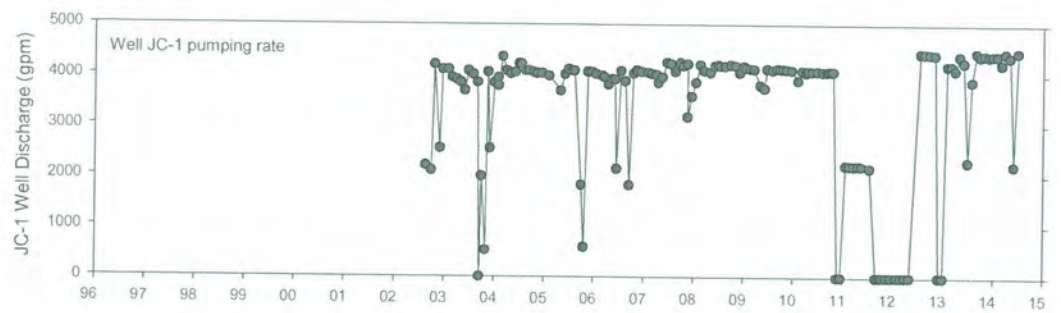

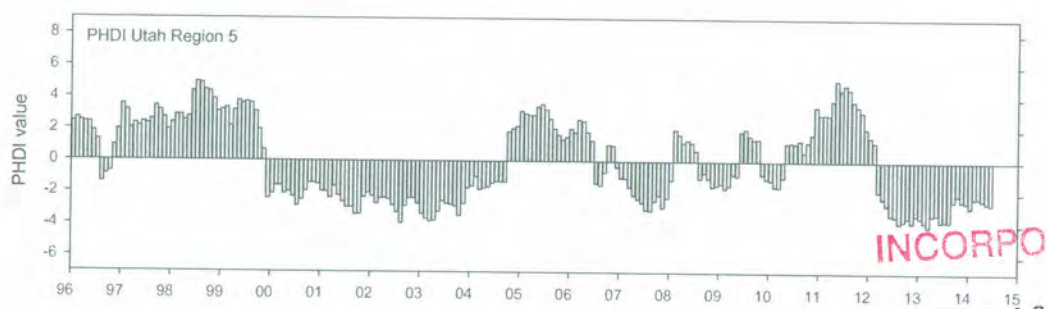

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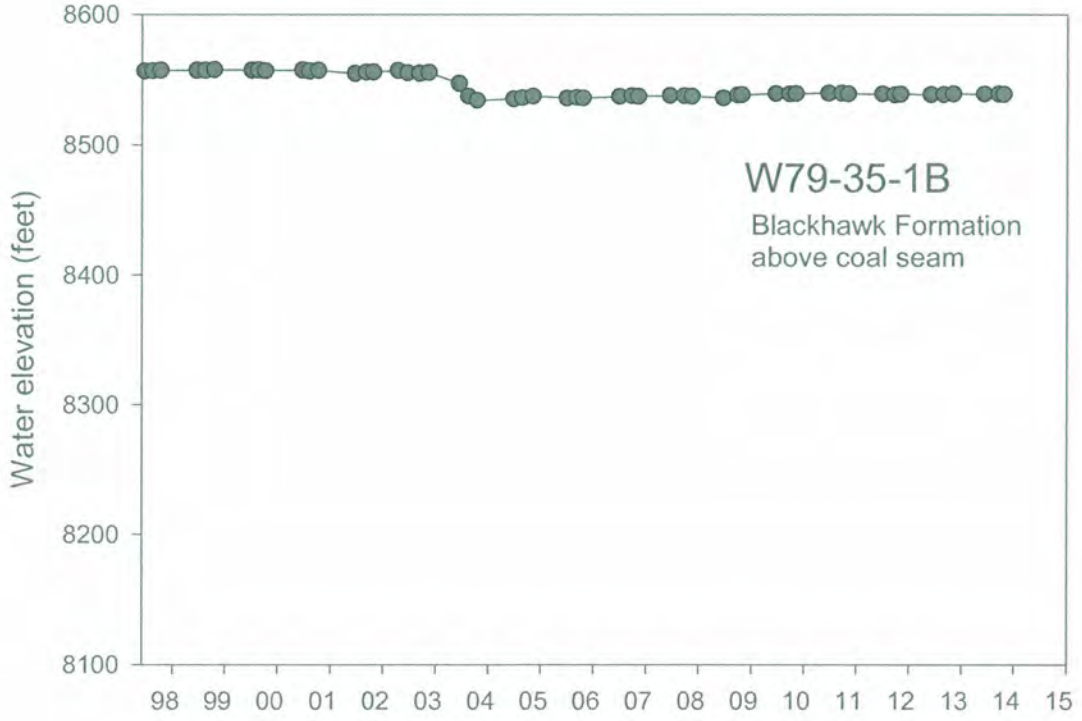

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Figure 5 Comparison of water level declines at the nested piezometers at W79-35-1.

Table 1 Potentiometric data from Star Point Sandstone monitoring wells.

	Date	Water depth (feet)	Water elevation (feet above sea level)
W79-35-1A	7/15/1982	177.5	8551.4
W79-35-1A	8/15/1982	179	8549.9
W79-35-1A	7/15/1983	171.5	8557.4
W79-35-1A	8/15/1983	171.7	8557.2
W79-35-1A	9/15/1983	171.2	8557.7
W79-35-1A	10/15/1983	172.4	8556.5
W79-35-1A	6/15/1984	182.2	8546.7
W79-35-1A	8/15/1984	183.7	8545.2
W79-35-1A	6/15/1985	188.3	8540.6
W79-35-1A	7/15/1985	187.2	8541.7
W79-35-1A	8/15/1985	186.2	8542.7
W79-35-1A	9/15/1985	186.7	8542.2
W79-35-1A	6/15/1986	193.7	8535.2
W79-35-1A	8/15/1986	190.7	8538.2
W79-35-1A	10/15/1986	192.2	8536.7
W79-35-1A	6/15/1987	204.8	8524.1
W79-35-1A	8/15/1987	203.6	8525.3
W79-35-1A	10/15/1987	205.4	8523.5
W79-35-1A	7/15/1988	206.2	8522.7
W79-35-1A	10/15/1988	205.3	8523.6
W79-35-1A	8/15/1989	207.6	8521.3
W79-35-1A	10/15/1989	214.6	8514.3
W79-35-1A	6/15/1990	222.9	8506.0
W79-35-1A	8/15/1990	214.7	8514.2
W79-35-1A	10/15/1990	221.2	8507.7
W79-35-1A	6/15/1991	223.4	8505.5
W79-35-1A	9/15/1991	228	8500.9
W79-35-1A	10/15/1991	229.4	8499.5
W79-35-1A	6/15/1992	236.5	8492.4
W79-35-1A	9/15/1992	238.2	8490.7
W79-35-1A	10/15/1992	243.3	8485.6
W79-35-1A	6/15/1993	246.7	8482.2
W79-35-1A	9/15/1993	239.9	8489.0
W79-35-1A	10/15/1993	237.2	8491.7
W79-35-1A	6/15/1994	239.7	8489.2
W79-35-1A	9/15/1994	241.5	8487.4
W79-35-1A	10/15/1994	244.7	8484.2
W79-35-1A	7/15/1995	230.2	8498.7
W79-35-1A	9/5/1995	232.4	8496.5
W79-35-1A	11/15/1995	235.2	8493.7
W79-35-1A	6/19/1997	244.2	8484.7

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	Date	(feet)	(feet above sea level)
W79-35-1A	8/15/1997	238.5	8490.4
W79-35-1A	10/9/1997	237.7	8491.2
W79-35-1A	6/15/1998	245.4	8483.5
W79-35-1A	8/13/1998	240.7	8488.2
W79-35-1A	10/17/1998	239	8489.9
W79-35-1A	7/5/1999	312.2	8416.7
W79-35-1A	8/19/1999	317.3	8411.6
W79-35-1A	10/6/1999	322.3	8406.6
W79-35-1A	6/20/2000	317.3	8411.6
W79-35-1A	8/7/2000	363	8365.9
W79-35-1A	10/9/2000	374	8354.9
W79-35-1A	6/19/2001	484.9	8244
W79-35-1A	9/3/2001	495.2	8233.7
W79-35-1A	10/25/2001	505.5	8223.4
W79-35-1A	6/19/2002	533.71	8195.19
W79-35-1A	8/2/2002	535.9	8193
W79-35-1A	11/14/2002	538.97	8189.93
W79-35-1A	6/11/2003	557.26	8171.64
W79-35-1A	8/15/2003	553.02	8175.88
W79-35-1A	10/15/2003	541.92	8186.98
W79-35-1A	6/24/2004	500.9	8228
W79-35-1A	8/25/2004	452.08	8276.82
W79-35-1A	11/9/2004	442.64	8286.26
W79-35-1A	6/30/2005	439.33	8289.57
W79-35-1A	8/31/2005	438.41	8290.49
W79-35-1A	10/20/2005	437.5	8291.4
W79-35-1A	6/29/2006	429.11	8299.79
W79-35-1A	9/22/2006	433.59	8295.31
W79-35-1A	11/7/2006	434.35	8294.55
W79-35-1A	6/15/2007	434.78	8294.12
W79-35-1A	9/21/2007	436.23	8292.67
W79-35-1A	11/15/2007	436.16	8292.74
W79-35-1A	6/18/2008	434.4	8294.5
W79-35-1A	9/26/2008	434.87	8294.03
W79-35-1A	10/24/2008	434.98	8293.92
W79-35-1A	6/18/2009	434.26	8294.64
W79-35-1A	9/22/2009	434.7	8294.2
W79-35-1A	11/4/2009	434.71	8294.19
W79-35-1A	6/21/2010	433.03	8295.87
W79-35-1A	9/19/2010	435	8293.9
W79-35-1A	11/4/2010	443.62	8285.28
W79-35-1A	6/29/2011	428.95	8299.95
W79-35-1A	9/23/2011	421.68	8307.22

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	Date	(feet)	(feet above sea level)
W79-35-1A	11/1/2011	421.22	8307.68
W79-35-1A	5/31/2012	421.68	8307.22
W79-35-1A	8/27/2012	432.77	8296.13
W91-26-1	6/13/2002	1296.35	7954.65
W91-26-1	9/9/2002	1310.1	7940.9
W91-26-1	11/4/2002	1303.16	7947.84
W91-26-1	6/16/2003	1302.3	7948.7
W91-26-1	9/17/2003	1302.79	7948.21
W91-26-1	10/28/2003	1301	7950
W91-26-1	6/22/2004	1304.05	7946.95
W91-26-1	9/6/2004	1301.51	7949.49
W91-26-1	6/25/2005	1302.79	7948.21
W91-26-1	9/6/2005	1300.4	7950.6
W91-26-1	10/13/2005	1299.66	7951.34
W91-26-1	6/28/2006	1298.41	7952.59
W91-26-1	9/26/2006	1296.81	7954.19
W91-26-1	11/2/2006	1297.81	7953.19
W91-26-1	6/16/2007	1295.48	7955.52
W91-26-1	9/21/2007	1296.56	7954.44
W91-26-1	11/2/2007	1295.85	7955.15
W91-26-1	6/26/2008	1296.9	7954.1
W91-26-1	9/12/2008	1296.25	7954.75
W91-26-1	11/14/2008	1295.04	7955.96
W91-26-1	6/26/2009	1301.06	7949.94
W91-26-1	9/9/2009	1295.7	7955.3
W91-26-1	10/27/2009	1295.52	7955.48
W91-26-1	6/20/2010	1298.14	7952.86
W91-26-1	9/14/2010	1297.1	7953.9
W91-26-1	11/8/2010	1300	7951
W91-26-1	7/8/2011	1302.42	7948.58
W91-26-1	9/15/2011	1309.55	7941.45
W91-26-1	11/11/2011	1312.6	7938.4
W91-26-1	6/16/2012	1332.22	7918.78
W91-26-1	8/27/2012	1337.1	7913.9
W91-26-1	10/25/2012	1339.1	7911.9
W91-26-1	6/11/2013	1398.28	7852.72
W91-26-1	9/27/2013	1414.7	7836.3
W91-26-1	10/21/2013	1339.1	7911.9
W91-26-1	11/1/2013	1423.5	7827.5
W91-35-1	6/13/2002	1213.7	8021.3
W91-35-1	9/5/2002	1224.5	8010.5
W91-35-1	11/4/2002	1223.65	8011.35

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	Date	(feet)	(feet above sea level)
W91-35-1	6/17/2003	1223.94	8011.06
W91-35-1	9/17/2003	1223.94	8011.06
W91-35-1	10/30/2003	1223.62	8011.38
W91-35-1	6/22/2004	1223.71	8011.29
W91-35-1	9/2/2004	1223.53	8011.47
W91-35-1	6/22/2005	1222.85	8012.15
W91-35-1	9/6/2005	1223.51	8011.49
W91-35-1	10/13/2005	1223.38	8011.62
W91-35-1	6/29/2006	1223.67	8011.33
W91-35-1	9/26/2006	1224.08	8010.92
W91-35-1	11/2/2006	1222.43	8012.57
W91-35-1	6/29/2007	1224.38	8010.62
W91-35-1	9/21/2007	1222.64	8012.36
W91-35-1	11/2/2007	1221.19	8013.81
W91-35-1	6/26/2008	1225.6	8009.4
W91-35-1	9/24/2008	1225.95	8009.05
W91-35-1	11/14/2008	1223.95	8011.05
W91-35-1	6/26/2009	1233.55	8001.45
W91-35-1	9/9/2009	1229.07	8005.93
W91-35-1	11/4/2009	1230.55	8004.45
W91-35-1	6/20/2010	1235.79	7999.21
W91-35-1	9/14/2010	1250	7985
W91-35-1	11/8/2010	1230	8005
W91-35-1	7/12/2011	1264.59	7970.41
W91-35-1	9/20/2011	1273.5	7961.5
W91-35-1	11/11/2011	1275.85	7959.15
W91-35-1	6/16/2012	1295.18	7939.82
W91-35-1	8/28/2012	1323.8	7911.2
W91-35-1	11/8/2012	1280	7955
W98-2-1	12/3/1999	719.6	8551.4
W98-2-1	6/26/2000	721.8	8549.2
W98-2-1	11/8/2000	755.8	8515.2
W98-2-1	6/18/2001	768.9	8502.1
W98-2-1	9/5/2001	800.1	8470.9
W98-2-1	9/5/2001	800.1	8470.9
W98-2-1	10/23/2001	837.5	8433.5
W98-2-1	6/19/2002	893.55	8377.45
W98-2-1	8/2/2002	907.02	8363.98
W98-2-1	11/5/2002	910.83	8360.17
W98-2-1	6/11/2003	945.71	8325.29
W98-2-1	8/14/2003	931.06	8339.94
W98-2-1	11/14/2003	923.24	8347.76

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	Date	(feet)	(feet above sea level)
W98-2-1	6/28/2004	910.66	8360.34
W98-2-1	8/25/2004	893.44	8377.56
W98-2-1	11/23/2004	887.13	8383.87
W98-2-1	6/26/2005	866.15	8404.85
W98-2-1	8/31/2005	863.77	8407.23
W98-2-1	10/30/2005	859.69	8411.31
W98-2-1	6/29/2006	827.85	8443.15
W98-2-1	9/25/2006	853.5	8417.5
W98-2-1	11/18/2006	843.91	8427.09
W98-2-1	6/16/2007	846.6	8424.4
W98-2-1	9/21/2007	849.01	8421.99
W98-2-1	11/15/2007	854.83	8416.17
W98-2-1	6/28/2008	850.68	8420.32
W98-2-1	9/25/2008	842.75	8428.25
W98-2-1	10/29/2008	847.73	8423.27
W98-2-1	6/28/2009	843.87	8427.13
W98-2-1	9/22/2009	843.2	8427.8
W98-2-1	11/7/2009	845.24	8425.76
W98-2-1	6/20/2010	846.57	8424.43
W98-2-1	9/27/2010	846.5	8424.5
W98-2-1	11/19/2010	827.54	8443.46
W98-2-1	7/7/2011	821.63	8449.37
W98-2-1	8/24/2011	796.1	8474.9
W98-2-1	11/11/2011	794.24	8476.76
W98-2-1	6/21/2012	813.95	8457.05
W98-2-1	8/28/2012	839.18	8431.82
W98-2-1	11/7/2012	827.11	8443.89
W98-2-1	6/19/2013	861.45	8409.55
W98-2-1	9/28/2013	865.3	8405.7
W98-2-1	10/21/2013	868	8403
W99-4-1	9/10/2002	321.53	8520.47
W99-4-1	11/5/2002	328.2	8513.8
W99-4-1	6/11/2003	358.45	8483.55
W99-4-1	9/29/2003	354.18	8487.82
W99-4-1	11/12/2003	352.86	8489.14
W99-4-1	6/24/2004	353.43	8488.57
W99-4-1	8/24/2004	346.72	8495.28
W99-4-1	11/8/2004	341.12	8500.88
W99-4-1	6/16/2005	335.53	8506.47
W99-4-1	9/7/2005	326.7	8515.3
W99-4-1	10/14/2005	323.1	8518.9
W99-4-1	6/26/2006	315.98	8526.02

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	Date	(feet)	(feet above sea level)
W99-4-1	8/23/2006	312.14	8529.86
W99-4-1	11/7/2006	308.26	8533.74
W99-4-1	6/27/2007	305.82	8536.18
W99-4-1	9/12/2007	306.3	8535.7
W99-4-1	11/9/2007	307.19	8534.81
W99-4-1	7/22/2008	308.86	8533.14
W99-4-1	9/22/2008	304.33	8537.67
W99-4-1	10/28/2008	304.62	8537.38
W99-4-1	6/26/2009	302.73	8539.27
W99-4-1	9/28/2009	301.26	8540.74
W99-4-1	11/2/2009	302.83	8539.17
W99-4-1	6/12/2010	303.26	8538.74
W99-4-1	9/21/2010	302.09	8539.91
W99-4-1	11/12/2010	302	8540
W99-4-1	7/7/2011	294.4	8547.6
W99-4-1	9/6/2011	286.72	8555.28
W99-4-1	11/3/2011	284.72	8557.28
W99-4-1	6/16/2012	279.95	8562.05
W99-4-1	9/11/2012	289.17	8552.83
W99-4-1	10/25/2012	293.21	8548.79
W99-4-1	6/6/2013	300.58	8541.42
W99-4-1	9/13/2013	303.5	8538.5
W99-4-1	10/23/2013	305.3	8536.7
W99-21-1	8/21/2001	1052.6	8294.4
W99-21-1	9/24/2002	1026.74	8320.26
W99-21-1	11/14/2002	1029.04	8317.96
W99-21-1	6/12/2003	1050.4	8296.6
W99-21-1	9/29/2003	1060.29	8286.71
W99-21-1	11/14/2003	1062.55	8284.45
W99-21-1	6/23/2004	1069.73	8277.27
W99-21-1	9/8/2004	1069.22	8277.78
W99-21-1	6/29/2005	1063.73	8283.27
W99-21-1	9/7/2005	1063.67	8283.33
W99-21-1	10/14/2005	1062.71	8284.29
W99-21-1	6/29/2006	1059.65	8287.35
W99-21-1	8/21/2006	1059.9	8287.1
W99-21-1	11/7/2006	1059.34	8287.66
W99-21-1	6/28/2007	1059.27	8287.73
W99-21-1	9/25/2007	1056.71	8290.29
W99-21-1	11/14/2007	1059.18	8287.82
W99-21-1	7/28/2008	1056.22	8290.78
W99-21-1	9/30/2008	1059.12	8287.88

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	Date	(feet)	(feet above sea level)
W99-21-1	10/28/2008	1059.07	8287.93
W99-21-1	6/29/2009	1055	8292
W99-21-1	9/21/2009	1052.65	8294.35
W99-21-1	11/11/2009	1055.04	8291.96
W99-21-1	6/22/2010	1052.1	8294.9
W99-21-1	9/21/2010	1052.15	8294.85
W99-21-1	11/12/2010	1052.4	8294.6
W99-21-1	7/12/2011	1052.05	8294.95
W99-21-1	11/11/2011	1044.83	8302.17
W99-21-1	6/22/2012	1050	8297
W99-28-1	9/24/2002	973.7	8377.3
W99-28-1	11/5/2002	978.73	8372.27
W99-28-1	6/12/2003	1007.71	8343.29
W99-28-1	9/29/2003	1004.64	8346.36
W99-28-1	11/14/2003	1001.31	8349.69
W99-28-1	6/23/2004	1000.08	8350.92
W99-28-1	9/8/2004	989.61	8361.39
W99-28-1	6/29/2005	975.36	8375.64
W99-28-1	9/7/2005	968.92	8382.08
W99-28-1	10/14/2005	964.57	8386.43
W99-28-1	6/29/2006	955.41	8395.59
W99-28-1	8/22/2006	952.42	8398.58
W99-28-1	11/1/2006	949.75	8401.25
W99-28-1	6/28/2007	945.82	8405.18
W99-28-1	9/12/2007	944.96	8406.04
W99-28-1	11/9/2007	944.93	8406.07
W99-28-1	7/29/2008	946.83	8404.17
W99-28-1	9/25/2008	942.7	8408.3
W99-28-1	11/21/2008	930.25	8420.75
W20-4-1	9/10/2002	387.27	8483.73
W20-4-1	11/5/2002	389.75	8481.25
W20-4-1	6/11/2003	422.95	8448.05
W20-4-1	9/29/2003	420.14	8450.86
W20-4-1	11/12/2003	417.74	8453.26
W20-4-1	6/24/2004	417.98	8453.02
W20-4-1	8/25/2004	411.63	8459.37
W20-4-1	11/8/2004	405.27	8465.73
W20-4-1	6/16/2005	399.71	8471.29
W20-4-1	9/7/2005	389.83	8481.17
W20-4-1	10/14/2005	386.3	8484.7
W20-4-1	6/29/2006	377.9	8493.1
W20-4-1	8/23/2006	374.81	8496.19

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	Date	(feet)	(feet above sea level)
W20-4-1	11/7/2006	370.28	8500.72
W20-4-1	6/27/2007	366.5	8504.5
W20-4-1	9/12/2007	366.75	8504.25
W20-4-1	11/9/2007	367.39	8503.61
W20-4-1	7/22/2008	369.86	8501.14
W20-4-1	9/22/2008	365.92	8505.08
W20-4-1	10/28/2008	365.88	8505.12
W20-4-1	6/26/2009	363.63	8507.37
W20-4-1	9/28/2009	362.49	8508.51
W20-4-1	11/2/2009	360.95	8510.05
W20-4-1	6/12/2010	361.14	8509.86
W20-4-1	9/20/2010	362.5	8508.5
W20-4-1	11/12/2010	361.71	8509.29
W20-4-1	7/7/2011	354.96	8516.04
W20-4-1	9/16/2011	349.65	8521.35
W20-4-1	11/3/2011	346.45	8524.55
W20-4-1	6/16/2012	339.45	8531.55
W20-4-1	9/11/2012	348.18	8522.82
W20-4-1	10/25/2012	352.08	8518.92
W20-4-1	6/6/2013	361.25	8509.75
W20-4-1	9/13/2013	364.5	8506.5
W20-4-1	10/23/2013	366.4	8504.6
W20-4-2	9/27/2002	1133.47	8420.53
W20-4-2	11/16/2002	1134	8420
W20-4-2	6/12/2003	1170.79	8383.21
W20-4-2	9/29/2003	1152.28	8401.72
W20-4-2	11/12/2003	1151.38	8402.62
W20-4-2	6/24/2004	1146.82	8407.18
W20-4-2	9/7/2004	1131.72	8422.28
W20-4-2	6/26/2005	1116.6	8437.4
W20-4-2	9/7/2005	1104.74	8449.26
W20-4-2	10/14/2005	1099.18	8454.82
W20-4-2	6/29/2006	1088.96	8465.04
W20-4-2	7/20/2006	1088.56	8465.44
W20-4-2	10/24/2006	1085.81	8468.19
W20-4-2	6/23/2007	1083.39	8470.61
W20-4-2	9/12/2007	1084.65	8469.35
W20-4-2	11/9/2007	1085.85	8468.15
W20-4-2	7/30/2008	1087.31	8466.69
W20-4-2	9/25/2008	1079.36	8474.64
W20-4-2	10/28/2008	1159.27	8394.73
W20-4-2	6/26/2009	1079.92	8474.08

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	Date	(feet)	(feet above sea level)
W20-4-2	9/28/2009	1080.25	8473.75
W20-4-2	11/2/2009	1075.27	8478.73
W20-4-2	6/19/2010	1081.47	8472.53
W20-28-1	9/24/2002	477.3	8393.7
W20-28-1	11/5/2002	480.55	8390.45
W20-28-1	6/3/2003	500.29	8370.71
W20-28-1	9/29/2003	507.57	8363.43
W20-28-1	11/14/2003	509.07	8361.93
W20-28-1	6/23/2004	515.56	8355.44
W20-28-1	8/25/2004	514.52	8356.48
W20-28-1	11/23/2004	511.93	8359.07
W20-28-1	6/29/2005	507.99	8363.01
W20-28-1	9/7/2005	506.72	8364.28
W20-28-1	10/14/2005	505.34	8365.66
W20-28-1	6/29/2006	499.44	8371.56
W20-28-1	8/22/2006	498.46	8372.54
W20-28-1	11/7/2006	498.02	8372.98
W20-28-1	6/28/2007	495.17	8375.83
W20-28-1	9/25/2007	494.3	8376.7
W20-28-1	11/14/2007	494.49	8376.51
W20-28-1	6/30/2008	494.8	8376.2
W20-28-1	9/26/2008	493.13	8377.87
W20-28-1	10/28/2008	494.99	8376.01
W20-28-1	6/29/2009	493.34	8377.66
W20-28-1	9/21/2009	491.6	8379.4
W20-28-1	11/2/2009	491.75	8379.25
W20-28-1	6/22/2010	490.73	8380.27
W20-28-1	9/27/2010	498.5	8372.5
W20-28-1	11/12/2010	491.81	8379.19
W20-28-1	7/7/2011	491.07	8379.93
W20-28-1	8/21/2011	489.75	8381.25
W20-28-1	11/11/2011	488.69	8382.31
W20-28-1	6/16/2012	484	8387
W20-28-1	9/11/2012	484.79	8386.21
W20-28-1	11/8/2012	486.5	8384.5
W20-28-1	6/6/2013	491.32	8379.68
W20-28-1	7/11/2013	492.35	8378.65
W20-28-1	10/23/2013	486.5	8384.5

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PHC Addendum Vol. 2
Appendix P

Addendum to:

Investigation of Fault-related Groundwater Inflows at the Skyline Mine

Petersen Hydrologic, LLC
27 October 2002

19 August 2016

Prepared for:
Dorsey & Whitney LLP
Salt Lake City, Utah

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PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Addendum to:

Investigation of Fault-related Groundwater Inflows at the Skyline Mine

Petersen Hydrologic, LLC
27 October 2002

19 August 2016

Prepared for:
Dorsey & Whitney LLP
Salt Lake City, Utah

Prepared by:

Erik C. Petersen, P.G.
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1.0 Introduction

Petersen Hydrologic, LLC previously prepared a report entitled *Investigation of Fault-Related Groundwater Inflows at the Skyline Mine*, dated 27 October 2002. The purpose of that investigation was to 1) characterize the nature and likely origins of the fault-related groundwater systems, and 2) determine the likely impacts of the fault inflows on the hydrologic balance. That report was submitted by Skyline Mine to the Utah Division of Oil, Gas and Mining in 2002.

In March 2016, the Utah Division of Oil, Gas and Mining requested that this report be updated to include an analysis of hydrologic data collected in the region over the more than 13 years that have transpired subsequent to the production of the 2002 report. The results of the requested analysis are presented in this addendum to our October 2002 report.

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The reader is referred to our original 2002 report for supporting information regarding the fault-related groundwater inflows at the Skyline Mine. Additional information relevant to this investigation is available in our 13 August 2014 report entitled *Investigation of Groundwater and Surface-Water Systems in the Flat Canyon Tract and Adjacent Area; Probable Hydrologic Consequences of Coal Mining in the Flat Canyon Tract, Sanpete County, Utah* (Petersen

Hydrologic 2014a) and our 18 August 2014 report entitled *Groundwater Conditions in the Star Point Sandstone in the Vicinity of the Skyline Mine, 2014* (Petersen Hydrologic, 2014b).

2.0 Overview of Groundwater Interception at the Skyline Mine

The Canyon Fuel Company, LLC Skyline Mine is located in the northern Wasatch Plateau coal mining district, approximately 3.5 miles southwest of the town of Scofield, Utah (Figure 1). Operations at the Skyline Mine commenced in 1981 and continue at present. Prior to 1999, generally only modest quantities of groundwater were intercepted during underground mining operations in the Skyline Mine. Most commonly, groundwater was intercepted in perched Blackhawk Formation sandstone paleochannels in the mine roof in newly opened mining areas. These groundwater inflows were commonly short lived. Groundwater inflows into the mine workings through floor seeps and faults also occurred. During this time, the total discharge from the Skyline Mine was usually on the order of a few hundred gallons per minute or less (UDOGM, 2016). Beginning in 1999, larger inflows began to be encountered as mining operations progressed into the southwest portion of Mine 2 at the Skyline Mine. These larger inflows originated from the mine floor as warm water upwelled through faults and fractures in the underling Star Point Sandstone bedrock. Unlike discharges from the overlying Blackhawk Formation sandstone paleochannels, discharges from the underlying Star Point Sandstone encountered since 1999 have generally been more persistent. In response to the groundwater intercepted in the Star Point Sandstone, mine water discharge rates at monitoring station CS-14

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(which includes the combined drainage from the southwest portion of Mine 2) peaked in early 2003 at rates exceeding 8,000 gpm (UDOGM, 2016). Much of the peak discharge was in response to a particularly large inflow (>4,000 gpm) that occurred while mining in the 10-left development entries in August 2001. It should be noted that the 10-Left inflow was encountered at a location that is about 0.5 miles east of Electric Lake and about 540 feet below the lake elevation.

Mining in the various mining districts in the southwest portion of Mine 2 at the Skyline Mine were completed during 2002 and 2003. After mining in these regions was completed, water levels in the underground mine pool were allowed to rise as pumping was stopped and the mined-out southwest Mine 2 area workings gradually filled with groundwater. By September of 2004 the water levels in the Mine 2 pool had risen to the 8,300 foot level. It is evident that groundwater inflows from the Star Point Sandstone into the Skyline Mine underground workings have continued after the region became flooded (as evidenced by the continuing outflow of groundwater from the area). Currently, the pool is maintained at an elevation of approximately 8,300 feet by pumping from the pool at the rate necessary to maintain the current pool elevation. This is done in order to keep mine workings accessible. Pumping the water from the pool is required because, while the groundwater gravity flows into the flooded mine workings, the elevation of the Skyline Mine surface portals is approximately 300 feet higher than the current 8,300 foot pool elevation. The mine water is pumped to CS-14 at the Skyline Mine surface facilities where it is discharged to Eccles Creek.

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It is noted that after the region became flooded in 2002-2004, the individual Star Point Sandstone inflow locations in the southwest portion of Mine 2 became inaccessible. However, groundwater from the region can still be sampled at locations where the water is collected in the piping/pumping system in route to the surface discharge location. These locations include CS-14 at the mine surface facilities, and the West Mains 16 Left and West Mains 6 Left pumping stations in the underground mine workings. Groundwater sampled underground at the West Mains 16 Left and 6 Left pumping locations are essentially the same as water sampled at CS-14, although the underground sampling locations are physically closer to the underground pool location (Figure 1).

In September of 2001, a groundwater pumping well (JC-1) was drilled and completed at the land surface in James Canyon in a location overlying the 10-Left inflow area. The purpose of the well was to intercept groundwater in the fault/fracture zone associated with the then recently intercepted 10-Left inflow prior to its flowing into the Skyline Mine underground workings. Accordingly, the well was designed to intersect the fracture zone just up-gradient of the 10-Left area within the Storrs Sandstone member of the Star Point Sandstone (HCI, 2003). JC-1 was drilled as a 19-inch borehole that was inclined about 13 degrees from vertical. The well is cased with 14-inch steel casing to 880 feet and screened with continuous wire-wrap screen (0.100-inch) from 880 feet to 940 feet. The well was initially equipped with a 600-horsepower pump which produced a discharge of about 2,150 gpm. In mid-October 2002 the well was equipped with a larger 1,000-horsepower pump which produced an output of about 4,200 gpm (HCI, 2003). Over the period of its existence, pumping rates at JC-1 have varied from about 2,000 gpm to more than

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4,000 gpm. During the period of its operation, pumping from JC-1 has stopped periodically for varying amounts of time, typically to allow for well maintenance or repairs. Groundwater pumped from JC-1 is discharged to Electric Lake near the mouth of James Canyon through a steel discharge pipe (the discharge end of the pipe is submerged in Electric Lake).

Additionally, in an attempt to prevent Star Point Sandstone groundwater from entering the Skyline Mine workings in the 10-Left area, a large-diameter well (JC-2) was constructed approximately 30 feet east of the JC-1 wellhead. The well was drilled vertically to intercept the Storrs and Panther members of the Star Point Sandstone, but no identified fracture zone was targeted. JC-2 was constructed by advancing a 24-inch boring to a total depth of 1,010 feet. The well was cased with 20-inch steel casing from the surface to 850 feet and from 910 to 995 feet. Continuous wire-wrap screen with 0.100-inch slots was installed from 850 to 910 feet (HCI, 2003). The yield from JC-2 was much less than anticipated (about 300 gpm) with a drawdown of about 900 feet. Because of the disappointingly low yield from JC-2, the well was not pumped for any significant length of time (HCI, 2003).

3.0 Data Collection

Since the production of our 2002 report, Skyline Mine has continued to collect and analyze hydrologic data from the Skyline Mine permit and surrounding areas. The updated data utilized in this investigation have been obtained through the continuing performance of Skyline Mine's

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groundwater and surface-water monitoring program as specified in Skyline Mine's approved Mining and Reclamation Plan, and through supplemental data collection and investigative activities conducted by Petersen Hydrologic, LLC and SRK Consulting (U.S.), Inc. (SRK). Specifically, the updated hydrologic information from the Skyline Mine area that has been incorporated into this investigation is as follows:

- Updated climate data from the National Climatic Data Center (NCDC) has been obtained for use in this investigation.
- Additional discharge data from selected stream and spring monitoring stations and potentiometric data from wells at the Skyline Mine and surrounding areas have been collected.
- Additional groundwater and surface-water solute chemical and temperature data (laboratory and field water quality data) from streams, springs, and in-mine waters have been collected.
- Additional stable isotopic $\delta^{2}H$ and $\delta^{18}O$ data and unstable ^{3}H (tritium) and ^{14}C data from springs, surface waters, JC-1, CS-14, and in-mine locations have been collected.
- Microscopic particulate analysis (MPA) has been performed on groundwater pumped from JC-1.
- Additionally, SRK has recently updated the numerical groundwater flow model of the Skyline Mine area to incorporate the most current hydrologic data available from the region (SRK, 2016).

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4.0 Climate

Updated plots of the Palmer Hydrologic Drought Index for Utah Regions 4 and 5 are provided in Figure 2. The Skyline Mine area is situated near the border between Utah Region 4 (south central), and Utah Region 5 (northern mountains). Information from both regions is provided here for evaluation. The PHDI is a monthly value generated by the National Climatic Data Center using a variety of hydrologic parameters that indicates wet and dry spells. The PHDI is calculated from several hydrologic parameters including precipitation, temperature, evapotranspiration, soil water recharge, soil water loss, and runoff. Consequently, it is a useful tool for evaluating the relationship between climate and groundwater and surface-water discharge data.

As indicated on the PHDI plots on Figure 2, the drought the region was experiencing during 2002 continued until mid-2004 when the region began to transition to a notable period of wetness that peaked in 2005. In 2006 the region transitioned from the wet spell to dryer climatic conditions. The period from 2007 to 2010 was characterized by alternating wet and dry cycles of relatively short duration. In late 2010 and continuing into 2011 the region transitioned into another notable period of extreme wetness. Beginning in 2012 and continuing through the first half of 2015 the region experienced a prolonged period of nearly continuous drought. Conditions have been near normal for the last half of 2015 and the first several months of 2016.

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5.0 Mine Water Discharge Rates

Discharge from the southwest portion of Mine 2 at the Skyline Mine (including groundwater from the now inaccessible 10-Left inflow area) reports to the surface and is monitored at CS-14. A plot of the discharge rate from CS-14 is presented in Figure 3. It is apparent from Figure 3 that, prior to the interception of appreciable Star Point Groundwater inflows in 1999, mine-water discharge rates were modest. During the period from 1989 through 1998 the mine water discharge rate at CS-14 ranged from 5 gpm to 475 gpm, averaging 167 gpm (UDOGM, 2016). Beginning in March 1999, larger sustained fault-related inflows began to be encountered, which resulted in substantially increased discharge rates from the Skyline Mine. Discharge rates at CS-14 peaked in February 2003 at 8,125 gpm (UDOGM, 2016). Since peaking in February 2003, discharge rates at CS-14 have declined gradually over the following 13 years (Figure 3). As of June 2016 (the most recent date for which data are available), the discharge rate from CS-14 was only 1,321 gpm.

Over many years, as deep groundwater from the Star Point Sandstone has been intercepted and pumped from the Skyline Mine workings, and as groundwater has been pumped from well JC-1, a large quantity of groundwater has been extracted from the area and subsequently discharged to Eccles Creek (CS-14) and Electric Lake (JC-1). The observed gradually declining discharge rates measured at CS-14 are likely a result of the local depressurization (declining potentiometric

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head) of the Star Point Sandstone groundwater system that has occurred as groundwater has drained from the formation to the mine workings and to JC-1 over time. As discussed below, groundwaters from the Star Point Sandstone are predominantly thousands of years old and are not in good hydraulic communication with shallow recharge sources. As discussed below, a component of modern recharge is also present in the discharge from JC-1 and also to a significantly lesser extent in the discharge at CS-14.

6.0 Monitoring Well Water Levels

Water level information is regularly collected from monitoring wells in the Skyline Mine area in accordance with the mine's water monitoring plan. Water level and water elevation data for selected monitoring wells in the Skyline Mine area are provided in Table 1. Water elevation hydrographs for selected wells in the Skyline Mine area are presented together with plots of the PHDI for Utah Region 5 in Figure 4. It is noted that over the last several years some of the Skyline Mine monitoring wells have failed and are no longer available for monitoring (usually in response to ground movement in the well area and resulting well casing failure).

It is apparent in the water level hydrographs in Figure 4 that, as anticipated, potentiometric levels in monitoring wells screened in the deep Star Point Sandstone groundwater systems in the southwest portion of Mine 2 responded to the extractions of groundwater at the Skyline Mine with marked declines in water levels. These wells have also responded to mine flooding events

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with recovering water levels. Water levels in wells screened in the shallow system have not responded to the interception of deep Star Point Sandstone groundwaters in the mine workings. The deep Star Point Sandstone wells evaluated here include W20-4-1, W20-4-2, W2-1, W79-35-1a, W99-21-1, and W99-28-1 (It should be noted that this is not an exhaustive list of all wells in the Skyline Mine area that have shown a response to the Star Point Sandstone fault-related inflows). The shallow monitoring wells evaluated here include W79-10-1b, W79-14-2a, W79-26-1, and W79-35-1b. The monitoring wells selected for evaluation in this addendum are the wells evaluated in our previous 2002 report.

As mining in the various southwest Mine 2 mining area districts was completed during 2002 and 2003, the deepest mined-out areas were gradually allowed to become flooded. In January 2004, pumping of mine water from the southwest portion of Mine 2 was entirely halted and the inflowing groundwaters were allowed to accumulate in the mined-out portions of the mine resulting in the formation of an underground mine pool. By September 2004 the elevation of the underground pool had reached an elevation of about 8,300 feet and the pool was allowed to stabilize at that level by resuming pumping to CS-14. It is noteworthy that the elevations of the various Star Point Sandstone fault-related groundwater inflows in the Skyline Mine were at elevations ranging from about 8,000 to 8,140 feet. This indicates that the hydraulic head from the mine pool overlying the inflow locations is about 160 to 300 feet at the now submerged groundwater inflow locations. This hydraulic head has also likely resulted in somewhat diminished discharge rates from the various groundwater inflow sources in the now flooded mine workings.

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The effects of the pumping of Star Point Sandstone groundwater from the Skyline Mine workings and subsequent pumping to Eccles Creek (period of declining hydraulic head), and the flooding of the mine workings and subsequent establishment of the underground mine pool that began in 2003 and 2004 (period of recovering groundwater hydraulic head) are apparent in the deep monitoring wells for which water level hydrographs are presented in Figure 4. Relative to pre-1999 levels, water levels in monitoring well W79-35-1A had declined by more than 350 feet by mid-2003. Water levels located in areas more distant from the largest in-mine groundwater inflow areas responded with lesser water level declines. Water levels in monitoring wells W2-1, W20-4-2, 20-4-1, and 99-28-1 declined by 100 feet or more in response to the in-mine Star Point Sandstone inflows. Water levels in monitoring wells 20-28-1 and W99-21-1 declined by about 30 feet or more.

It is noteworthy that the water levels in wells screened in the upper shallow groundwater systems did not respond to the interception of the deep Star Point Sandstone groundwater systems in the Skyline Mine, although responses to other factors associated with mining in the vicinity of some wells are apparent. This condition is readily apparent in the plot of water levels at the nested monitoring well pair W79-35-1a and W79-35-1b (Figure 5). While water levels in the deep well (W79-35-1a) declined by more than 300 feet by the end of 2002, there was no appreciable corresponding drawdown in the shallow monitoring well at that location (W97-35-1b), illustrating the hydraulic disconnect between the deep and shallow groundwater systems at that location.

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Since the construction of well JC-1, it has been apparent that during periods when JC-1 is not pumping, there is a measurable increase in the rates of groundwater inflow into the Skyline Mine underground workings. However, the increase in the mine inflow rate is likely much less than the long-term pumping rate from JC-1. The magnitude of the JC-1 influence is not easily quantified. It is reported that pumping at 4,000 gpm from JC-1 had only minor effects on the groundwater inflow rates into the Skyline Mine (SRK, 2016). It is also noted that water levels in deep monitoring wells surrounding the JC-1 location respond in varying degrees when pumping at JC-1 is stopped. The water level responses observed in the deep monitoring wells are a likely in response to the withdrawal of old groundwater from the Star Point Sandstone groundwater system (which would include the old components from both the CS-14 and JC-1 discharges).

7.0 Spring and Seep Discharge Rates

Spring and seep discharge rates have been monitored during the 2nd, 3rd, and 4th quarters of the each year as specified in the water monitoring plan in the approved Mining and Reclamation Plan for the Skyline Mine. The discharge data obtained from the springs and seeps have been entered into the Division of Oil, Gas and Mining on-line database. Discharge hydrographs for selected springs in the Skyline Mine area (located near the fault-related Star Point Sandstone in-mine groundwater inflow locations) are presented in Figure 6. The effects of seasonal and climatic variability are apparent in these plots. Perceptible or quantifiable impacts to discharge

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rates at springs and seeps that could be attributed to the interception of the deep Star Point Sandstone groundwater systems in the Skyline Mine are not observed. As described previously by Petersen Hydrologic (2014a), impacts to shallow groundwater systems in response to the interception of the deep Star Point Sandstone groundwater systems are not anticipated.

8.0 Tritium Isotopic Compositions

Tritium (^3H) is a radioactive isotope of hydrogen with a half-life of about 12.3 years. In groundwater investigations, tritium is commonly used as a qualitative tool, indicating whether a groundwater has a component of water that recharged since about 1954. The tritium contents of groundwaters and surface waters collected subsequent to the issuance of our 2002 report are presented in Table 2. It is apparent from Table 2 that tritium concentrations in surface-water (Electric Lake) and shallow groundwater in the Skyline Mine area have decreased appreciably since the time of our 2002 report. It is noted that tritium, with a half-life of 12.3 years, is removed by radioactive decay at a rate of about 5.5% per year. Another factor influencing global atmospheric tritium concentrations is attenuation by the oceans and groundwaters, which have become reservoirs of thermonuclear ^3H (Clark and Fritz, 1997). In other words, the declining tritium concentrations in the atmosphere worldwide are a result of both radioactive decay over time and also the removal of tritium from the atmosphere to storage in the oceans and groundwater.

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Plots of the tritium concentrations of groundwater pumped from JC-1 (plotted in red) and groundwater sampled from the southwest portion of Mine 2 (plotted in blue) are presented in Figure 7. It is apparent from Figure 7 that the tritium concentration of Star Point Sandstone groundwater first sampled from JC-1 in 2001 was low (0.20 TU). As pumping of JC-1 continued, tritium concentrations gradually increased until stabilizing around 2004 at levels of about 2.9 TU. For the seven-year period from 2004 through 2010, the tritium concentration in JC-1 groundwater was essentially unchanged, with an average concentration of 2.92 TU – ranging from a low of 2.74 TU to a high of 3.14 TU. Tritium levels measured in JC-1 water during 2012-2015 were considerably lower, ranging from 1.7 to 2.5 TU, averaging 2.1 TU. The average yearly concentrations of tritium measured in JC-1 during 2014 and 2015 were 1.9 TU and 2.3 TU, respectively.

The data plotted from the southwest portion of the Mine 2 on Figure 7 are from three different locations. The data points plotted from 2002 represent tritium data collected directly from the 10-Left inflow location which averaged 1.26 TU. The data points from 2005 and 2006 represent tritium data from samples collected at CS-14, which averaged about 1 TU. The data points from 2015 and 2016 represent tritium values from samples collected from the West Mains 16 Left pumping location, which averaged about 1 TU.

To assist in determining whether the groundwater pumped from JC-1 is representative of the groundwater that flows into the Skyline Mine, samples of groundwater from JC-3, CS-14, and

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the West Mains 16 Left area were collected for tritium analysis. The results of these analyses are presented below.

Sample date(s)	JC-3	CS-14	16 Left	JC-1
11 Mar 2004	1.78 TU	---	---	2.74 TU
15, 28 Jun 2004	1.41 TU	---	---	2.74 TU
3, 25 May 2005	---	0.92 TU	---	2.76 TU
18 Jul, 28 Jun 2005	---	0.95 TU	---	2.79 TU
14, 20 Oct. 2005	---	1.00 TU	---	3.07 TU
27 Jan, 27 Feb 2006	---	1.07 TU	---	2.91 TU
5 Mar 2015	---	---	1.1 TU	---
20 Jan 2016	---	---	0.97 TU	---

It is apparent from these data that the tritium concentrations measured at JC-1 were always significantly higher than those measured contemporaneously at JC-3 (JC-3 is a water production well that is completed within the flooded underground mining voids very near the 10-Left inflow area), at CS-14, or at the West Mains 16 Left pumping station.

It is noteworthy that the tritium concentrations measured in the groundwater from the southwest portion of Mine 2 have consistently been lower than the tritium concentrations measured in JC-1 (Figure 7; Table 2). Additionally, while the tritium concentrations in JC-1 groundwater increased gradually over the first several years of pumping (2001-2004), the tritium

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concentrations in the Star Point Sandstone groundwater from southwest portion of Mine 2 did not show a corresponding increase. Rather, tritium concentrations in groundwaters from the southwest portion of Mine 2 have been similar to (or slightly lower than) those initially measured in 2002 at the 10-Left inflow. The reasons for the lower in-mine tritium concentrations relative to those measured at JC-1 are not completely understood. However, it seems likely that the higher tritium concentrations in water pumped from JC-1 may be a consequence of the long-term heavy pumping of groundwater from JC-1. It would be anticipated that in response to the heavy, prolonged pumping at JC-1, groundwater flow would be induced to flow through the fracture system in which the well is screened from more distant locations toward the well. Shallow groundwaters or surface waters containing tritium that may be in communication with the fracture system in more distant regions could be a source of the increased tritium contents at JC-1.

It is also noteworthy that, as evidenced by the experience of constructing and pumping from well JC-2 (a large-diameter well screened in apparently un-fractured sandstone only a few feet away from the JC-1 fracture location from which only meager amounts of groundwater could be produced), groundwater flow to JC-1 (which is completed in a known fault system) likely occurs along preferential pathways corresponding with the orientations of faults and fractures rather than locally from diffuse flow through the intergranular spaces in the sandstone. This suggests the probability that pumping-induced groundwater flowing toward JC-1 could originate from considerable distances from the surface location of JC-1, particularly after several years of

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essentially continuous pumping of the well screened in the fault/fracture zone at rates of several thousand gallons per minute.

It is an interesting possibility that pumping at JC-1 during 2001 and 2002 could possibly have influenced tritium concentrations measured at the 10-Left inflow area in 2002. The location of pumping well JC-1 is only a few tens of feet horizontally from the location of the 10-Left inflow. It is noted that the first tritium monitoring event at the 10-Left inflow did not occur until July of 2002, which was 10 months after the initial inflow from 10-Left, and 9 months after the startup of JC-1. While tritium was generally not encountered in appreciable quantities in any of the numerous other deep Star Point Sandstone groundwater inflow locations sampled in the mine from 1999 through 2002 (other than in long boreholes which are subject to contamination and mixing), tritium was measured at the 10-Left inflow area during each of the five sampling events at the 10-Left location at concentrations ranging from 1.16 to 1.31 TU (all five sampling events were during the months of July and August of 2002). The tritium concentrations of water pumped from JC-1 during July and August of 2002 ranged from 1.00 to 1.31 TU. Assuming some degree of interconnection between the faults and fractures from which the deep Star Point Sandstone groundwaters entered the Skyline Mine, it seems counterintuitive to assume that only the 10-Left fracture would contain any tritium while nearby fractures in the likely interconnected fracture flow system contained none. Previously, samples of groundwater collected from fault inflows in the Skyline Mine from 1999 through mid-2002 generally had little or no tritium with groundwater mean residence times of many thousands of years (Table 2). Although there is no concrete evidence to substantiate this possibility, it does not seem unreasonable to conclude that

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the presence of a well pumping at more than 4,000 gpm only a few tens of feet from the 10-Left inflow locations could potentially have caused tritium-rich water to migrate from more distant locations toward the 10-Left area in 2002. Being located at greater distances from the influence of the pumping at JC-1, other Star Point Sandstone groundwater inflows (such as the East Submains E1 XC5 Fault location) continued to have ^{3}H concentrations much lower than those measured at 10-Left during contemporaneous 2002 monitoring events (Table 2).

In our 2002 investigation, tritium was also utilized as a quantitative tool to assist in estimating the magnitude of a potential modern recharge component in JC-1 water. This was accomplished by using assumptions for the tritium content of modern recharge water based on recent tritium sampling of shallow groundwaters and surface waters, and assuming a 0.0 tritium content for the old component of groundwater. It should be noted that a groundwater that is thousands of years old and isolated from the surface (absent the presence of geogenic ^{3}H) should in theory have absolutely no tritium. However, it is not uncommon in our experience for old mine waters that have been exposed to the underground mine atmosphere/environment and underground mining activities to contain a small component of tritium. Nevertheless, a 0.0 tritium assumption is used here for the old groundwater component. The modern water component calculations for JC-1 have been updated in this investigation using recently collected tritium data from springs and Electric Lake waters. These calculations are shown on Table 3. As anticipated, the results of these calculations show an increased modern water component in JC-1 discharge water based on increased tritium concentrations in JC-1 since 2001 and 2002 and also to decreased tritium concentrations in shallow groundwaters and Electric Lake surface water.

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When the modern water component calculations were performed in 2002, it was assumed that the water pumped from JC-1 was essentially the same water as that from the southwest portion of Mine 2 at the Skyline Mine. As discussed above, the low tritium contents of groundwaters that have historically discharged and currently discharge from the southwest portion of Mine 2 indicate that there is apparently a much smaller component of modern recharge in the mine water discharge than that pumped from JC-1. Accordingly, modern water calculations for the combined discharge from the southwest portion of Mine 2 are presented in Table 3. The calculated modern component for the drainage from the southwest portion of Mine 2 is much smaller than that calculated for recent JC-1 discharge water.

9.0 Carbon-14 (^{14}C) Isotopic Compositions

Carbon-14 information is collected from JC-1 during the 2nd, 3rd, and 4th quarters of each year from well JC-1. This information is entered into the Utah Division of Oil, Gas and Mining on-line hydrology database. Carbon-14 data from JC-1 and selected underground locations collected at the Skyline Mine since 2002 is presented in Table 2.

Radiocarbon (^{14}C) and tritium (^{3}H) isotopic information have been used together in this investigation to determine groundwater mean residence times. In considering the "age" of groundwater it is important to consider that groundwater arriving at groundwater discharge

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points (i.e. springs or wells) rarely travels via pure piston flow (i.e. pipe like flow conditions where all flowpaths are the same length with equal travel times along flowpaths). Rather, it is not uncommon for the water molecules discharging at springs or wells to have migrated to the discharge point from several different recharge locations, each having recharged at different times. Consequently, the term "mean groundwater residence time", which is the average age of all of the water molecules sampled, is commonly used when evaluating the age of groundwater.

The radiocarbon (^{14}C) content of a groundwater is used to calculate the number of years that have elapsed since the groundwater became isolated from soil-zone gasses and near-surface groundwaters. Groundwaters with radiocarbon activities greater than about 50 pmC in carbonate-rich terrains are usually indicative of modern groundwater. Groundwaters with radiocarbon activities significantly greater than about 50 pmC can indicate the presence of anthropogenic carbon that is typically associated with atmospheric thermonuclear weapons testing, which also suggests a modern origin.

Carbon-14 dating of recent (2014-2015) samples of groundwater from JC-1 indicates average groundwater mean residence times of about 2,000 years. The recent tritium information for JC-1 indicates that there is a component of modern recharge present in JC-1 groundwater. This indicates that, while the mean residence time of the water is about 2,000 years, the mean residence time of the old component is likely considerably older.

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The carbon-14 of the West Mains 16 Left sample collected in March 2015 had a carbon-14 activity of 17.1 pmC, which is indicative of a radiocarbon mean residence time of about 8,000 years. The very old age of this groundwater is consistent with the primary source of the groundwater being from storage in the deep Star Point Sandstone aquifer below the mined coal seam.

As shown on Table 2, the carbon-14 compositions of springs discharging from shallow, active-zone groundwater systems and surface waters in the Skyline Mine area are clearly modern in origin as evidenced by carbon-14 compositions appreciably exceeding 50 pmC and the likely presence of anthropogenic carbon-14.

10.0 Deuterium (δ^2H) and Oxygen-18 ($\delta^{18}O$)

Since the production of our 2002 report, a substantial amount of additional stable isotopic deuterium and oxygen-18 data has been collected from JC-1 as part of Skyline Mine's approved water monitoring plan. Samples are collected for stable isotopic analysis during the 2nd, 3rd, and 4th quarters of each year from JC-1. These data are submitted to the Utah Division of Oil, Gas and Mining on-line hydrology database. A plot of deuterium and oxygen-18 compositions of in-mine groundwaters, JC-1 discharge waters, Electric Lake waters, and spring and stream waters from the Skyline Mine area are plotted together with the meteoric water line (MWL) in Figure 8.

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The δ^2H and $\delta^{18}O$ composition of a water molecule falling as precipitation is determined primarily by the temperature at which nucleation of the water droplet occurs. In most non-thermal hydrogeologic environments, the stable isotopic δ^2H and $\delta^{18}O$ compositions of groundwaters are set at the time of recharge and are not affected appreciably by interactions with the aquifer skeleton (i.e., mineral dissolution and precipitation reactions and groundwater residence times). Thus, the stable isotopic chemistry of a groundwater can be evaluated independent of the chemical composition of the water. Stable isotopic δ^2H and $\delta^{18}O$ compositions are commonly used to differentiate groundwaters from different sources (i.e., isotopic "fingerprinting" of waters).

It is useful to analyze stable isotopic δ^2H and $\delta^{18}O$ compositions relative to the meteoric water line (MWL). The MWL is derived empirically from worldwide δ^2H and $\delta^{18}O$ compositions of coastal precipitation waters. Water falling as precipitation in coastal areas will plot along the meteoric water line. Precipitation that forms in colder conditions will plot lower on the MWL relative to precipitation forming under warmer conditions. This relationship is also commonly evident in the plotting locations of waters recharging at different elevations. Commonly in the Wasatch Plateau coal mining district, the plotting of stable isotopic compositions near the meteoric water line in the lower left region of the plot is related to paleorecharge of groundwaters that occurred under cooler climatic conditions. Waters recharging in high-elevation areas will typically plot lower on the MWL than will waters recharging at lower elevations. A local meteoric water line may be determined by analyzing and plotting the δ^2H and $\delta^{18}O$ compositions of local precipitation waters. In the central Utah coal fields, precipitation

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waters often plot slightly to the right of the global meteoric water line. The plotting locations of waters which have undergone evaporation will commonly plot along an evaporation trajectory, migrating progressively to the right and upward relative to the non-evaporated source water.

It is apparent from the stable isotopic data plotted in Figure 8 that the in-mine groundwaters and groundwater pumped from JC-1 continue to plot in plotting locations that are distinct from the plotting locations of samples of Electric Lake water. The stable isotopic information clearly indicates that the water pumped from JC-1 is not simply Electric Lake water. However, a mixed source of water for JC-1 is not precluded by the stable isotopic data from JC-1.

11.0 Solute Chemical Compositions

In our previous 2002 report, we demonstrated that the groundwater sampled from the Star Point Sandstone fault-related inflows during 2002 was chemically distinct from water sampled in Electric Lake during 2001 and 2002. Since the production of our 2002 report, the in-mine groundwater inflow locations have become inaccessible. In accordance with Skyline Mine's approved water monitoring plan, major ion solute chemical compositions are not routinely monitored at JC-1 or Electric Lake waters. Consequently, there has not been an appreciable amount of new laboratory chemical data collected subsequent to the production of our 2002 report. Accordingly, no additional modeling of recent solute chemical compositions has been performed as part of this addendum.

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12.0 Aquifer Temperature

Petersen Hydrologic (2002) described the implications of groundwater discharge temperatures to groundwater circulation patterns. The average discharge temperatures of the upwelling fault groundwaters sampled within the mine from 1999 to 2003 range from approximately 13.2 to 15.6 °C, while groundwaters discharging from sandstone paleochannels in the mine roof near the fault inflows, such as 11 Left HG E1 XC62 (longwall set-up room) roof drip, which discharges at 8.9 °C, is more than 4 °C cooler. The water in the sandstone channel, with a radiocarbon age of 5,900 years and essentially no tritium and, prior to being intercepted by the mine workings, was not actively flowing, has equilibrated with the temperature of the surrounding rocks in the mine roof. Thus, based on an average geothermal gradient of approximately 23°C per kilometer depth (Written Communication, Dr. David S. Chapman, University of Utah, 2002), upwelling fault groundwater has a circulation depth on the general order of 187 to 291 meters (614 to 955 feet) below the mine workings. These circulation depths are consistent with groundwater residing in the Star Point Sandstone beneath the coal seams. It is difficult to envision a mechanism whereby warm groundwater could migrate downward vertically through horizons of colder rock and colder groundwater above the coal seams and subsequently emerge as warm groundwater in the mine floor.

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It is noted that the discharge temperature for groundwater discharging from JC-1 has generally trended downward from the time the well was first monitored in 2001. The average discharge temperature measured at JC-1 during 2015 was 12.6°C. While the discharge locations for the fault-related Star Point Sandstone groundwater inflows in the Skyline Mine are no longer accessible, monitoring of the discharge from that district of the mine has been monitored at West Mains 16 Left pumping location. The discharge temperature of the collected water at that location during monitoring events in 2015 and 2016 was 13.8°C. This temperature is similar to the average discharge temperature of the 10 Left inflow groundwater measured 14 years previously during 2002 (average 13.2°C). The water temperature measured at CS-14 (at the mine surface facilities) during 2015 averaged 13.5°C.

13.0 Microscopic Particulate Analysis (MPA)

Since the date of our 2002 report, Microscopic Particulate Analysis (MPA) has been performed on groundwater pumped from well JC-1. Microscopic Particulate Analysis testing is included in the EPA Consensus Method for Determining Groundwaters Under the Direct Influence (GWUDI) of Surface Water Using Microscopic Particulate Analysis. MPA is one parameter used to determine if a groundwater source is under the direct influence of surface water. The testing procedure is performed using a flow-through filter unit with an in-line totalizing flow meter. To collect the sample for the test, a large volume of water (several hundred gallons) is allowed to pass through the filter at a low flow rate. After a sufficient amount of water has

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passed through the filter, the filter is removed from the unit, placed in a sealed plastic bag and sent to the laboratory (Analytical Services, Inc. of Williston, Vermont) for analysis. At the laboratory, the filter is processed chemically and/or mechanically to separate any material trapped by the filter during the flow-through test. The recovered material is then examined under the microscope to ascertain whether particulates are present in the sample that would indicate the water was from a surface-water source. The sample is examined for the presence of "bioindicators" such as plant debris, algae, diatoms, insects, protozoa, rotifers, and other particulates that are characteristic of surface waters. The number and type of bioindicators are tabulated and used to calculate a risk rating score, which indicates the risk of surface water contamination (Analytical Services, Inc., 2006).

MPA testing was performed on groundwater from JC-1 on two occasions. The initial test was performed during January of 2003. The second MPA test was performed during July of 2006. The results of these tests are presented in Appendix A. The MPA risk rating for both samples was "Low", as no appreciable biological particulates that contribute to the EPA Risk Raging score were not detected in either the 2003 or 2006 test. This information suggests that the water pumped from JC-1 is not under the direct influence of surface water based on the laboratory results. The lack of bioindicators in the MPA samples is not consistent with a conceptual model that includes rapid downward flow of surface water into the fracture in which JC-1 is completed.

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14.0 Numerical Model of the Skyline Mine Area

SRK has recently updated the numerical model of groundwater systems in the Skyline Mine area to reflect recent conditions. In considering the updated groundwater model, it should be noted that the hydrogeology of the proposed Flat Canyon Mine area is structurally and stratigraphically complex. Groundwater flow in the Star Point Sandstone is controlled largely by the presence of fractures and faults in the formation, with groundwater migration through the intergranular spaces in the sandstone occurring at a much lower rate. The fault and fracture densities, orientations, and water transmitting properties are not uniform within the formation. In the experience of mining at the Skyline Mine, it has been observed that while some faults and fractures intercepted by the mine workings convey appreciable amounts of groundwater, other similar faults and fractures intercepted underground do not. Additionally, individual geologic strata (in the Star Point Sandstone and overlying Blackhawk Formation) are often laterally and vertically discontinuous and lenticular permeable strata are commonly encased in surrounding lower permeability zones which creates complex groundwater flow patterns (Figure 9). The presence of the generally low-permeability Blackhawk Formation bedrock overlying the Star Point Sandstone generally isolates the deep groundwater system from the overlying shallow groundwater and surface-water systems. (It should be noted that, historically, in locations where sustained Star Point Sandstone groundwater inflows have been encountered in the Skyline Mine, these inflow locations have almost always been associated with upwelling from the mine floor rather than leakage from the mine roof). For these reasons, the construction of a numerical model of the groundwater flow regime in such an environment is complicated. Additionally, as

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is the case with any numerical flow model, the model output is dependent on the many assumptions employed in the model construction. The data necessary to fully validate these assumptions in the Skyline Mine area are limited. It is important to consider these limitations when evaluating the results of any numerical model from the Skyline Mine area.

When the Skyline Mine numerical model was initially constructed in 2003, the model demonstrated that it was possible to account for the quantity of groundwater extracted from the Skyline Mine in full (including JC-1 discharge) and also to account for the observed potentiometric response of the Star Point Sandstone and shallow Blackhawk Formation groundwater systems exclusively by the extraction of old groundwater from storage in the deep Star Point Sandstone members below the mine. When the model was updated in 2016 to include recently collected data (including water level "recovery" data subsequent to the mine flooding events and decreased mine water discharge rates), it was found that acceptable calibration (during both drawdown and recovery) was achieved when an additional shallow recharge source was added to the model simulation. The postulated shallow nature of the additional recharge source was consistent with the presence of a modern water component identified in JC-1 (and possibly to a lesser extent in the 10-Left inflow area – which was found to contain some tritium in 2002 when the area was accessible). To evaluate possible source(s) of the additional shallow recharge component, two different model simulation runs were performed using the existing model framework. (It should be noted that the two scenarios modeled here represent only two possible sources, and are not the only potential recharge sources for the shallow recharge component). To model the shallow recharge component the modeling simulations evaluated two scenarios. These include:

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Scenario 1 – The shallow recharge component recharging through the South Gooseberry Fault zone from a shallow groundwater system, and

Scenario 2 – The shallow recharge component recharging from Electric Lake through a splay of the Diagonal Fault.

Note that both of the above scenarios also incorporate recharge from storage in the deep Star Point Sandstone groundwater system.

The results of the modeling simulations indicated that the model can be calibrated to Scenario 1 or Scenario 2 *equally well* (SRK, 2016). SRK noted that the source of the shallow recharge component and its mechanism are not clear. It should be emphasized that the modeled solutions for these two scenarios are not unique. Rather, these modeled scenarios reflect two possible sources of the modern recharge component that generally satisfy the mathematical constraints of the numerical groundwater model.

It is important to note that in constructing the groundwater flow model for the Skyline Mine, the modeled total discharge from the mine is the sum of that pumped from the Skyline Mine to Eccles Creek and also that pumped from JC-1 to Electric Lake. While these two discharge sources are lumped together in the groundwater model, based on isotopic compositions, we have determined that these two discharges likely represent two largely different sources. While the

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outflow from the southwest portion of Mine 2 has declined appreciably over the years and contains predominantly ancient groundwater, the discharge from JC-1 has been held constant at about 4,000 gpm in recent years and now contains an increased component of modern water. We suspect that much of the groundwater discharging from JC-1 is groundwater that is induced to flow toward the well from potentially distant sources as a result of long-term pumping of JC-1.

15.0 Potential Impacts to the Hydrologic Balance

It is anticipated that groundwater will be encountered in the Star Point Sandstone during the proposed mining in Mine 4 in the Flat Canyon Tract. However, impacts to water quantity and water quality in streams and groundwaters discharging from springs and seeps from shallow active-zone groundwater systems are not anticipated as a result of the interception of deep Star Point Sandstone groundwater in the mine. This conclusion is based largely on the observation that over the previous 17 years since the deep Star Point Sandstone groundwater systems were first intercepted in significant quantities in the Skyline Mine underground workings, no perceptible or quantifiable impacts to water quantity and water quality in overlying springs and streams in the vicinity have been observed in the hydrologic data collected during the performance of the Skyline Mine's rigorous DOGM approved water monitoring plan that could be attributable to the depressurization of the deep Star Point Sandstone groundwater system (UDOGM, 2016). As described in Section 6 above, the shallow groundwater regime is isolated from the Star Point Sandstone groundwater system by significant thicknesses of low-permeability Blackhawk Formation bedrock. As a result, the depressurization of the deep Star

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Point Sandstone groundwater system has not resulted in appreciable impacts on potentiometric levels in the shallow system (i.e. the shallow and deep systems are hydraulically isolated).

16.0 Conclusions and Implications to Groundwater Flow Patterns at the Skyline Mine

It is apparent from the information provided in this report that the groundwater systems in the Skyline Mine area, which reside in interbedded sequences of heterogeneous, anisotropic bedrock which have been appreciably faulted and fractured locally, are complex. However, while the precise groundwater flow paths and recharge mechanisms of these groundwater systems in the region are not completely understood, the updated information presented in this report has important implications to the determination of general groundwater flow patterns at the Skyline Mine and adjacent area. Some of these are summarized below.

- Recent carbon-14 compositions of groundwaters sampled from CS-14 and the West Mains 16 Left pumping location indicate the continued presence of a principal component of very old water. The presence of low ^{3}H concentrations (~1 TU) in these waters indicates the presence of a smaller component of modern recharge. The mean groundwater residence time (~8,000 years) reflects the average age of all of the water molecules included in the water sample. Thus, the "age" of the old component of groundwater would be greater than 8,000 years. Historically, groundwaters from other

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portions of the underground Skyline Mine workings have also typically had very old radiocarbon mean groundwater residence times.

- Recent carbon-14 compositions of groundwaters sampled from JC-1 indicate the continuing presence of a substantial component of very old groundwater. The mean groundwater residence time of recent JC-1 groundwater is about 2,000 years. The younger mean residence time calculated for JC-1 groundwater reflects the presence of a component of modern recharge.

- The measured tritium concentrations in recent groundwater from JC-1 demonstrate the continuing presence of a modern recharge component at JC-1. It is noted that the tritium concentrations in JC-1 groundwater have declined appreciably in recent years. The presence of tritium in the groundwater sampled at JC-1 does not of itself provide any information regarding the source of the modern water component.

- Groundwater flow to JC-1 is likely induced to flow through the fracture system in which the well is screened from more distant locations toward the well. Shallow groundwaters or surface waters containing tritium that may be in communication with the fracture system in more distant regions could be a source of the increased tritium contents at JC-1. Groundwater flow to JC-1 likely occurs along preferential pathways corresponding with the orientations of faults and fractures rather than locally from diffuse flow through the intergranular spaces in the sandstone.

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- Using recent tritium information from JC-1, active-zone groundwater discharge to springs, and water in Electric Lake, updated calculations of the potential modern recharge component in JC-1 water have been performed. The calculated magnitude of the modern recharge component in pumping well JC-1 has increased from that calculated in 2002.

- The markedly decreased flow from the southwest portion of Mine 2 at the Skyline Mine relative to the 2003 peak discharge rates demonstrates that the system is not in good hydraulic communication with active recharge sources. This observation is consistent with the radiocarbon mean residence times of the deep Star Point Sandstone inflow waters (many thousands of years). The lesser quantity of modern recharge potentially present in the southwest portion of Mine 2 does not provide sufficient recharge to sustain groundwater potentiometric levels. Rather, a large cone of depression is formed in the Star Point Sandstone groundwater system in response to the withdrawal of groundwater from Mine 2 and JC-1, which is reflective of the groundwater extraction from the Star Point Sandstone.

- We suggest the possibility that the long-term heavy pumping of JC-1 may induce the flow of groundwater from more distant locations along the fault/fracture zones toward the 10-Left/JC-1 location. The modern component of the groundwater sampled in JC-1 may possibly in large part originate from shallow groundwater or surface water induced to flow to the well from unidentified more distant locations. In the absence of the JC-1 pumping, it is possible that the modern water component would not arrive at the

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underground mine workings at the rate it does under the JC-1 pumping regime, although this conclusion is only speculative at this point.

- The stable isotopic deuterium and oxygen-18 information provides clear evidence that the groundwater sampled at JC-1 is not simply surface water/Electric Lake water. The stable isotopic information does not, however, preclude the possibility that there is a component of surface-water recharge to the fracture system that supports the discharge at JC-1.

- The discharge temperatures of groundwater sampled at the West Mains 16 Left pumping location and JC-1 are elevated relative to the temperatures of groundwaters entering the Skyline Mine workings from overlying strata. The observed discharge temperatures are consistent with groundwater being sourced primarily from the Star Point Sandstone beneath the mine workings. It is noted that, while the discharge temperatures of waters in the southwest portion of Mine 2 have apparently not changed substantially (although this cannot be confirmed directly because direct access to the Star Point Sandstone groundwater inflow locations is no longer possible), the discharge temperature of JC-1 groundwater has gradually become somewhat cooler since the date of our previous 2002 investigation.

- The water level responses observed in deep monitoring wells in the vicinity of the southwest portion of Mine 2 at the Skyline Mine in response to the long term groundwater extraction from storage in the deep Star Point Sandstone groundwater

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systems demonstrates that drainage from the deep groundwater system is a primary source of the groundwater flowing to the Skyline Mine. The hydraulic responses measured in deep Star Point Sandstone monitoring wells in the region are consistent with what would be anticipated as groundwater was removed from storage (depressurization) in the deep Star Point Sandstone groundwater system and rebounding water levels in response to mine flooding events and decreased mine water discharge rates.

- The hydraulic disconnect between the deep Star Point Sandstone groundwater systems encountered in the southwest portion of Mine 2 and the shallow groundwater systems that feed springs and seeps and provide baseflow discharge to streams is apparent in the water level hydrographs for shallow monitoring wells. This disconnect is also apparent in the plots of spring and seep discharge rates in the vicinity of the southwest portion of Mine 2, which have not been impacted by the interception of the deep Star Point Sandstone groundwater systems. The observed discharge variability at springs and seeps is likely in response to seasonal and climatic variability, while no such responses to climate or season are noted in potentiometric levels in monitoring wells from the deep Star Point Sandstone groundwater systems.

- The Microscopic Particulate Analysis performed during 2003 and 2006 strongly suggests that the groundwater pumped from JC-1 is not under the direct influence of surface water (i.e. streams or lakes). If the groundwater flowing into the mine in the 10-Left/JC-1 area was flowing from Electric Lake primarily or in part along an open fault/fracture system,

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it is considered likely that diagnostic particulate matter (observed to be present in recent samples of the lake water) would have been transported to the well location and readily identified in the JC-1 MPA tests.

It is noted that while the results of the JC-1 MPA tests contradict the possibility of a direct fracture flow communication between the well and Electric Lake, the results do not preclude the possibility that a component of shallow groundwater and/or surface water recharge (from whatever source) could arrive at the JC-1 pumping location through a much slower, diffuse groundwater flow pathway.

- The updated numerical groundwater model for the Skyline Mine area continues to indicate that groundwater from the deep Star Point Sandstone is a primary source of the mine discharge water from Mine 2 and also water pumped from JC-1. The results of the recent model update suggest an additional source of shallow recharge to the system. In an attempt to evaluate possible sources of the shallow recharge component (primarily in JC-1 groundwater and possibly to a lesser extent in the Mine 2 discharge), modeling simulations were performed to evaluate two potential recharge resources. The modeled potential recharge sources selected for evaluation included Scenario 1) groundwater from the South Gooseberry Fault zone, and Scenario 2) surface water from Electric Lake. The results of the modeling simulations indicated that the model can be calibrated to Scenario 1 or Scenario 2 equally well. It is noted that the while the numerical groundwater model can be used to evaluate the feasibility of potential recharge sources, the modeling of itself does not indicate the source or mechanism of the shallow recharge. It is also noted that the solution to such a numerical groundwater model is not unique, but rather represents

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one of likely many possible mathematical solutions to the constraints of the model. It should also be emphasized that, while numerical modeling can be one of many useful tools that can be employed to evaluate the characteristics of a groundwater flow regime, the correctness and reliability of any numerical model is directly related to the adequacy and correctness of the data upon which it is based. While the output of the model may be informative, the above mentioned limitations should be considered when evaluating the results of the numerical model of the Skyline Mine.

- It is anticipated that groundwater will be encountered from the deep Star Point Sandstone groundwater system during mining in the Flat Canyon area. Based on 17 years of groundwater and surface-water monitoring data from regions overlying and adjacent to previously mined areas where inflows of deep Star Point Sandstone groundwater were encountered in the Skyline Mine workings, impacts to water quantity and water quality in nearby streams and springs that could be attributable to the depressurization of the underlying Star Point Sandstone groundwater systems are not anticipated.

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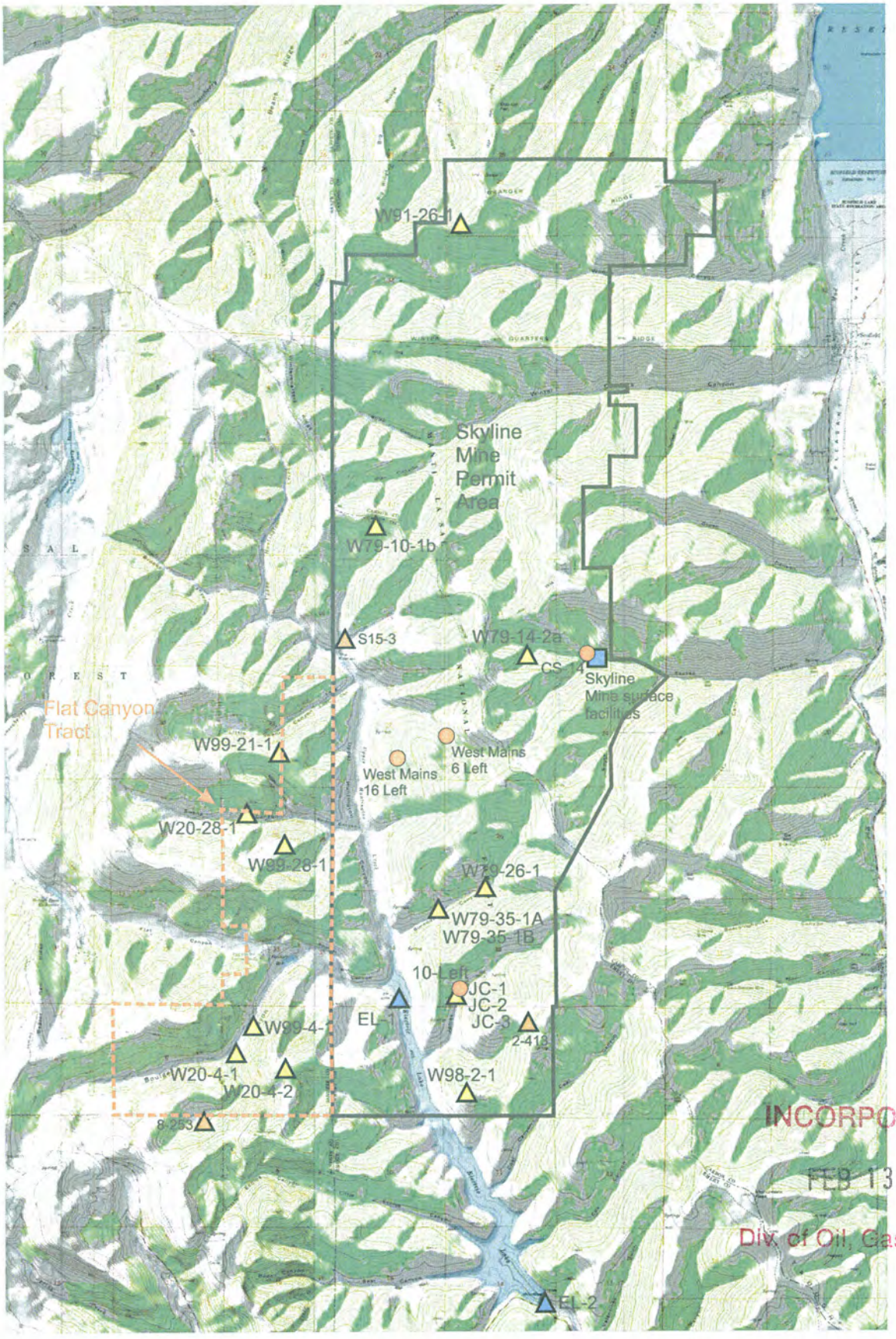

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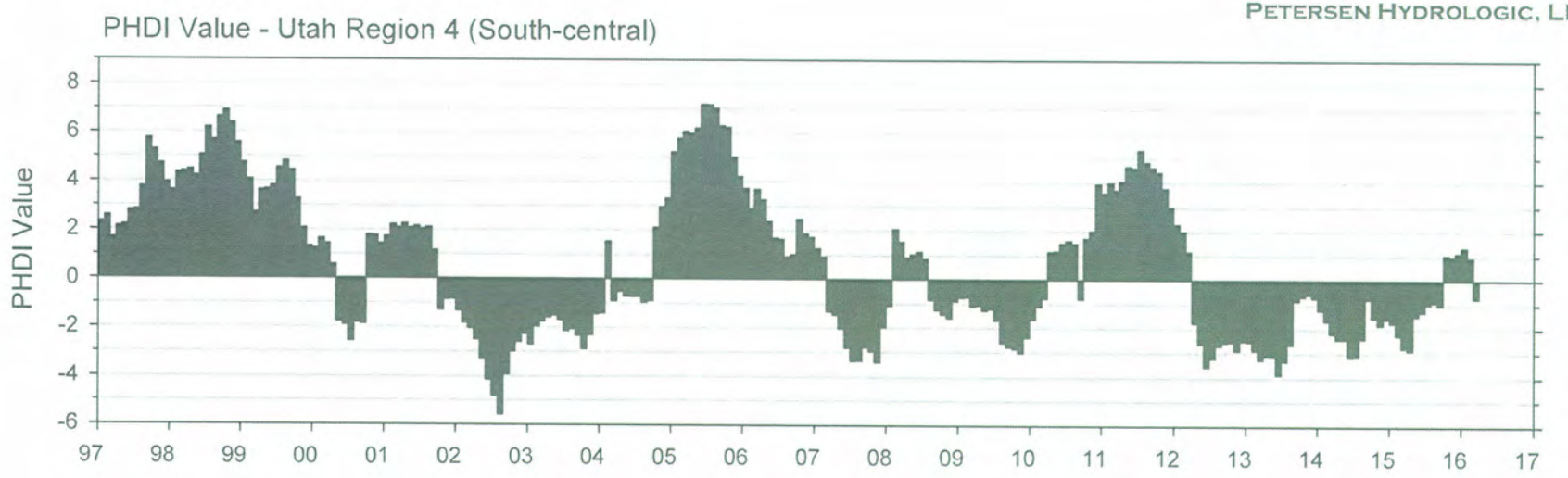
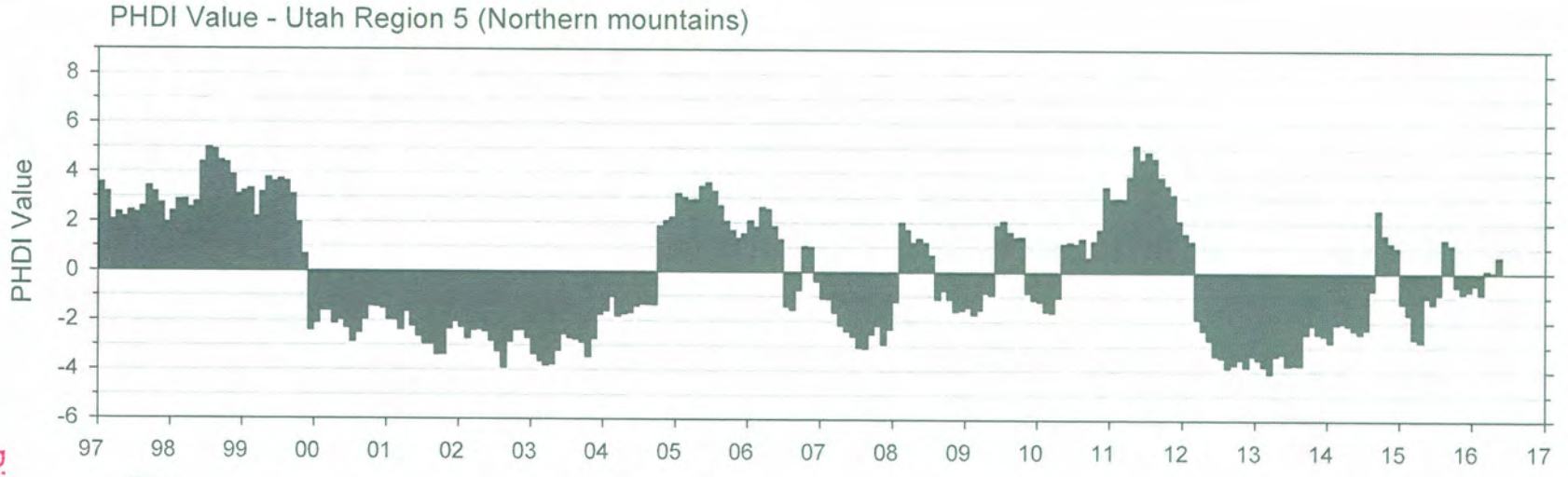
Figure 1 Location map for the Skyline Mine area.





-1 to -2 Mild Drought
-2 to -3 Moderate Drought
-3 to -4 Severe Drought
-4 to -5 Extreme Drought

1 to 2 Mild Wet Spell
2 to 3 Moderate Wet Spell
3 to 4 Severe Wet Spell
4 to 5 Extreme Wet Spell

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Figure 2 Plots of Palmer Hydrologic Drought Index for Utah Regions 4 and 5.

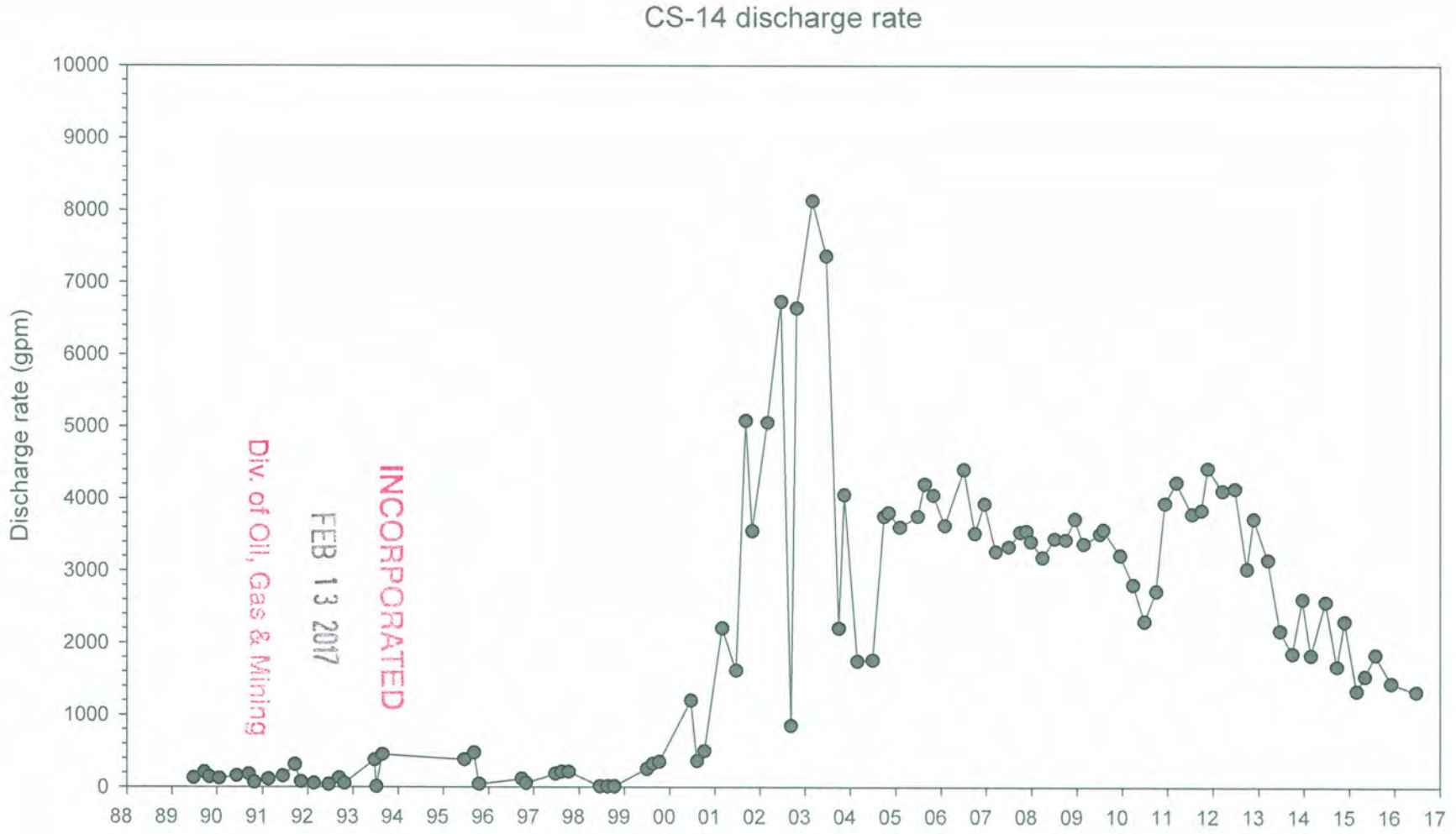

Figure 3 Plot of discharge rates from CS-14.

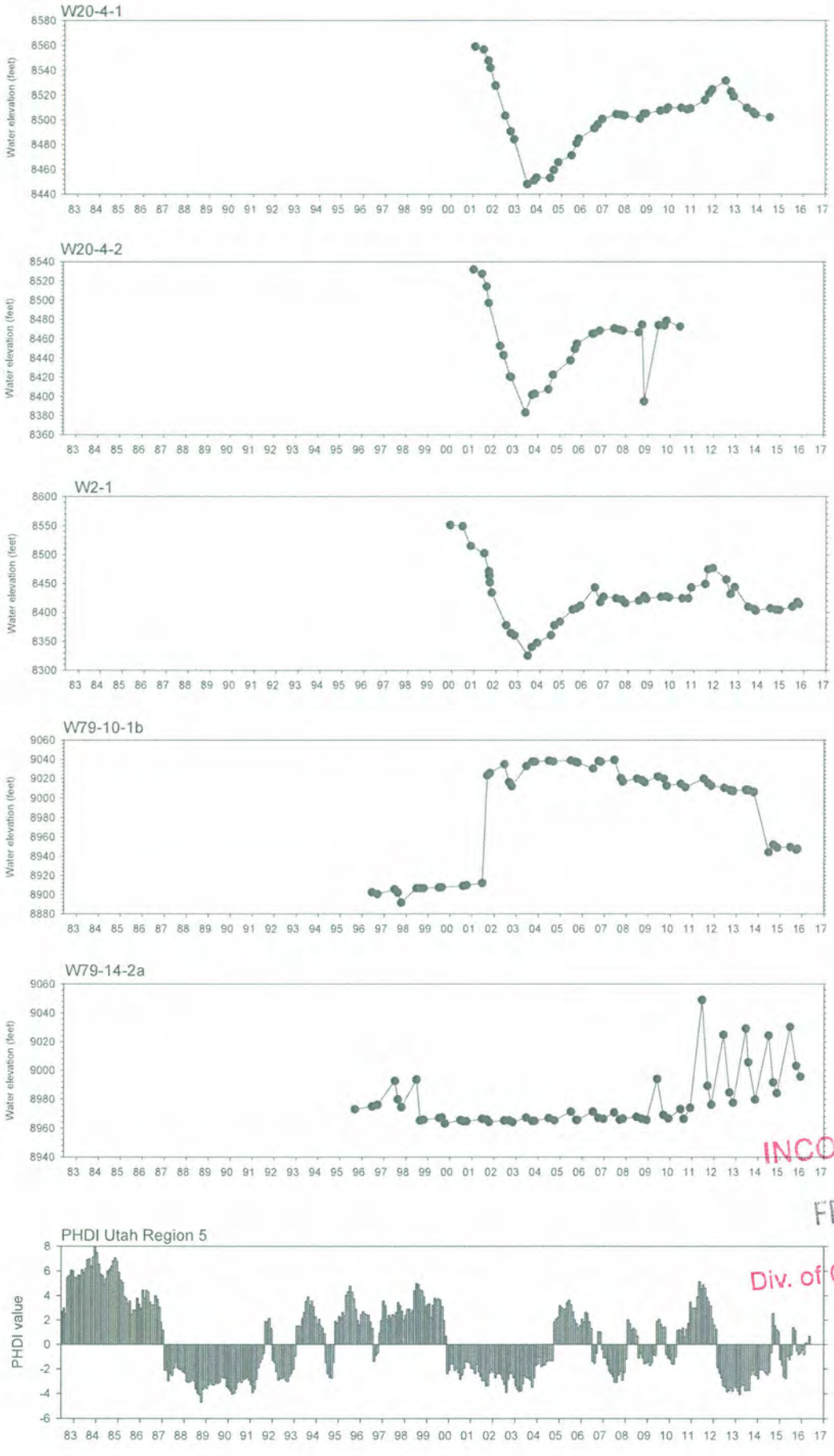

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Figure 4 Water-level hydrographs for wells.

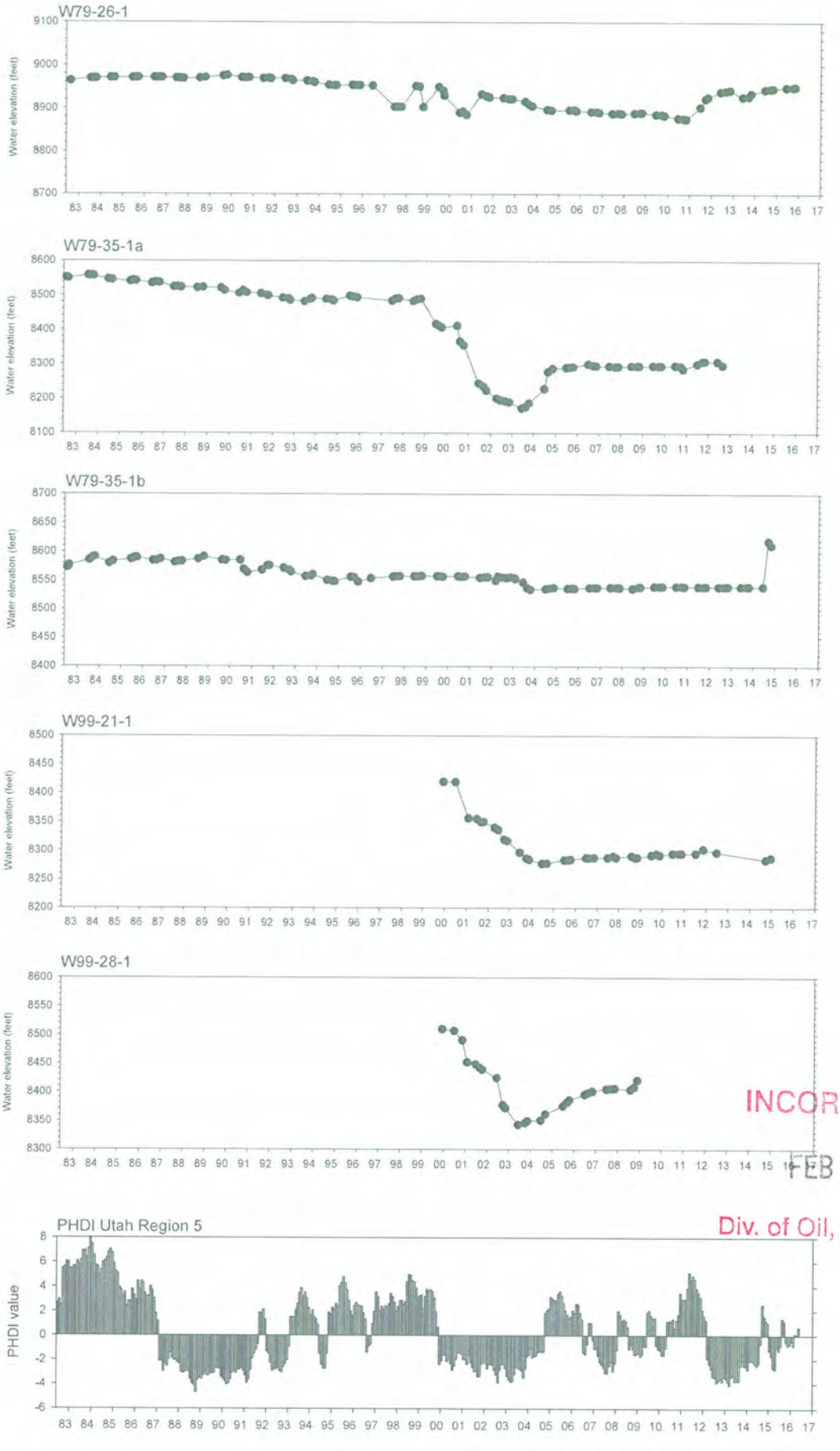

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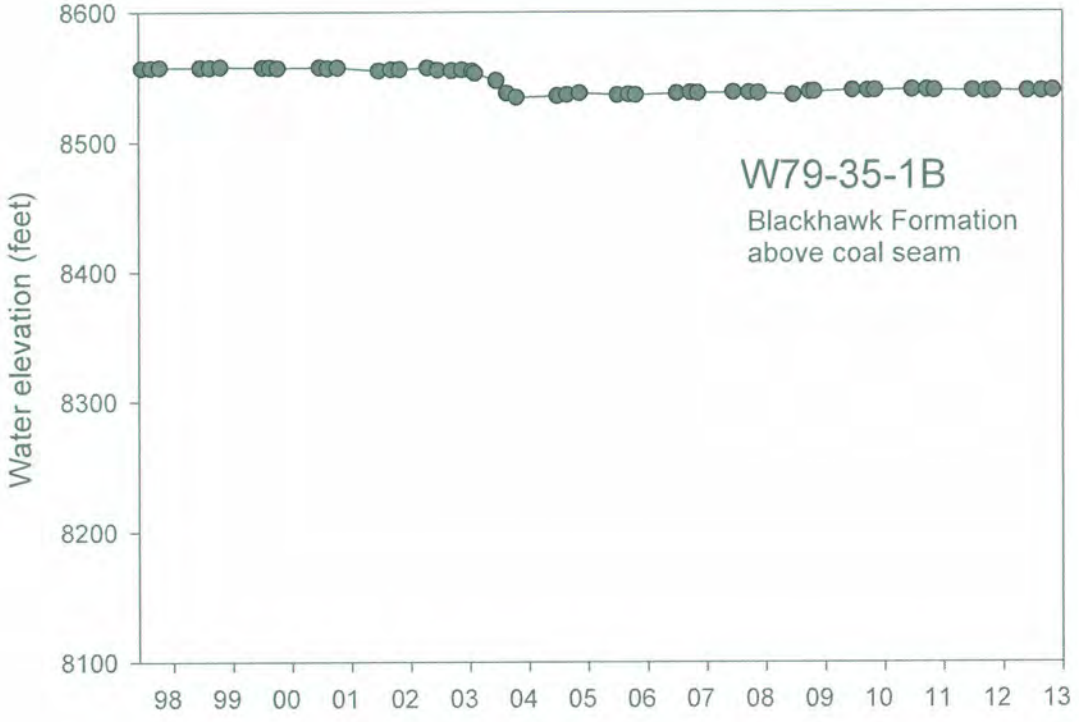
Figure 4 Continued Water-level hydrographs for wells.



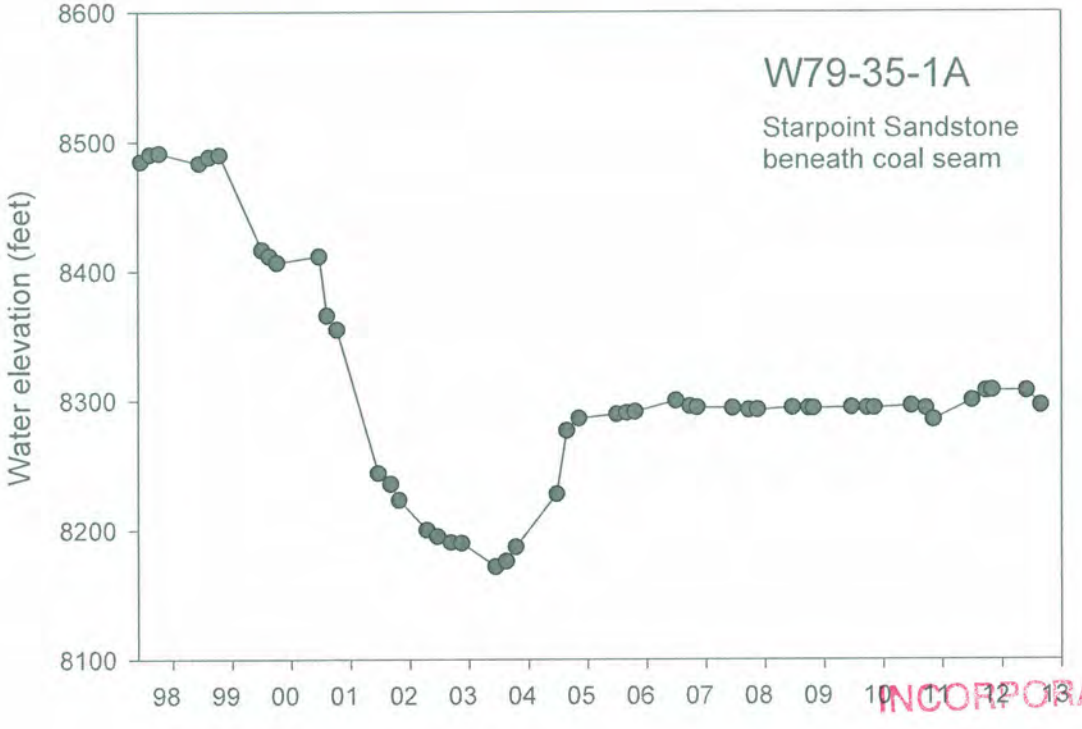


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Figure 5 Water-level hydrographs for wells W790-35-1a and W79-35-1b.

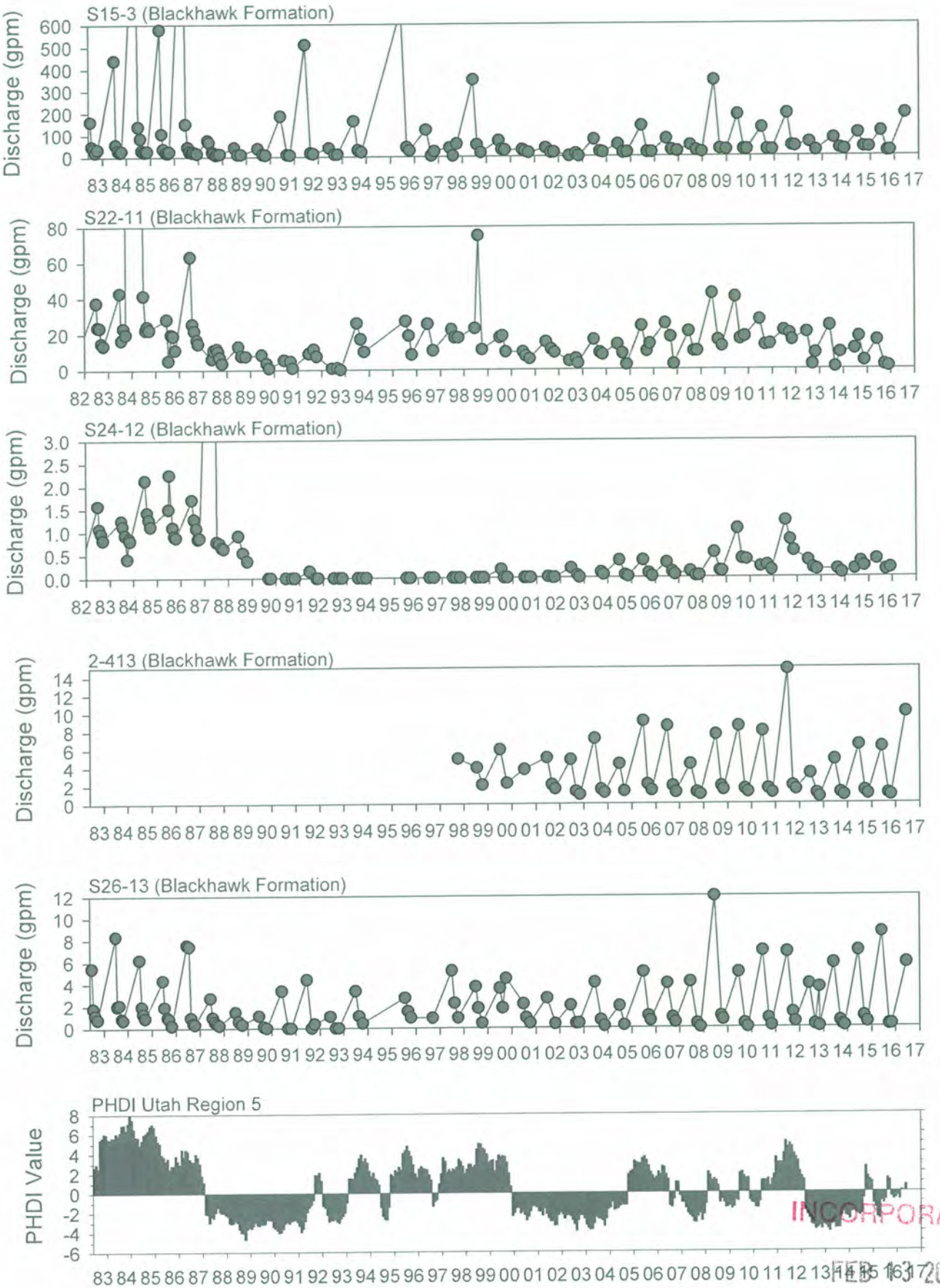

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Figure 6 Discharge hydrographs for springs.

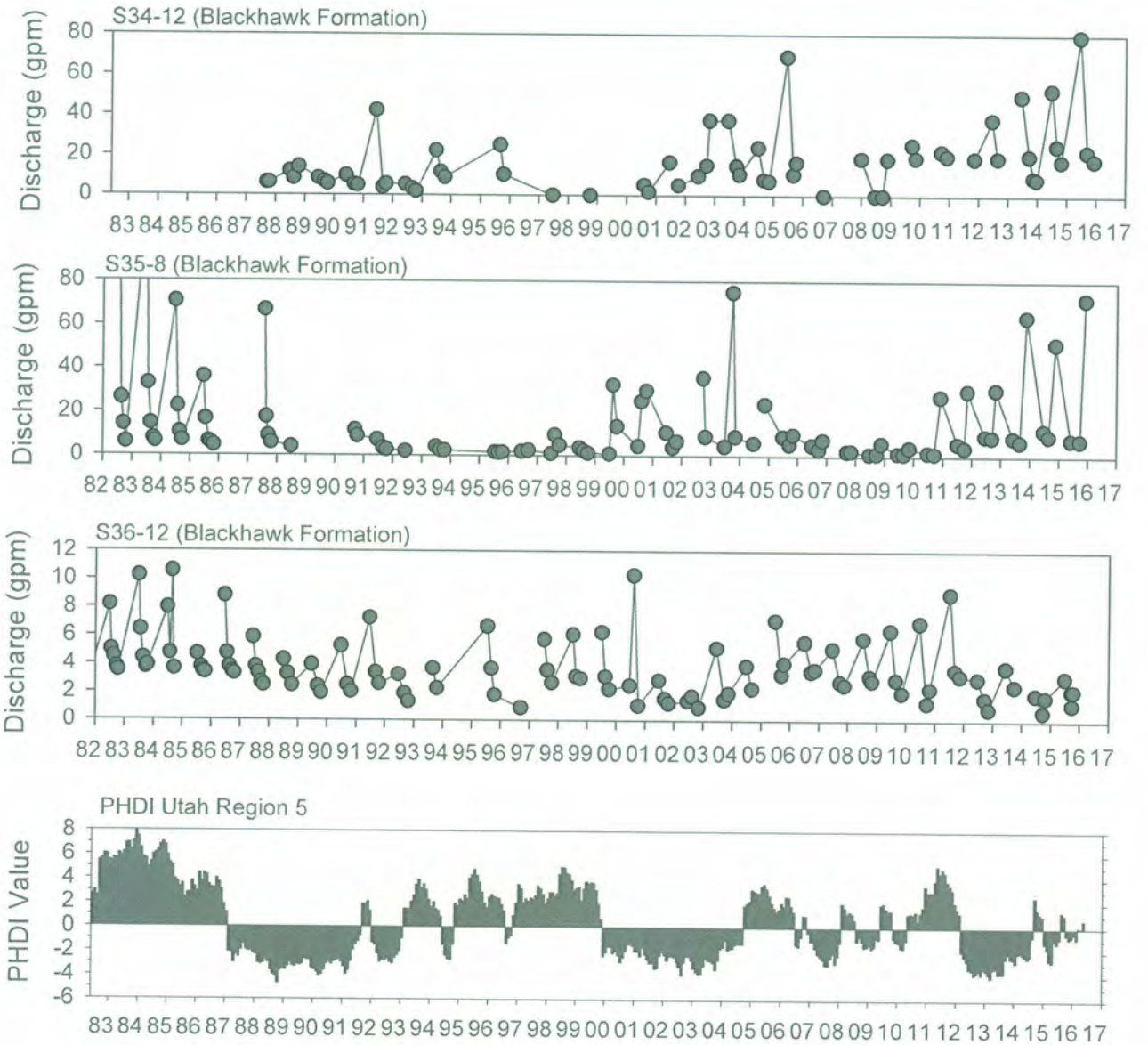

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Figure 6 continued Discharge hydrographs for springs.

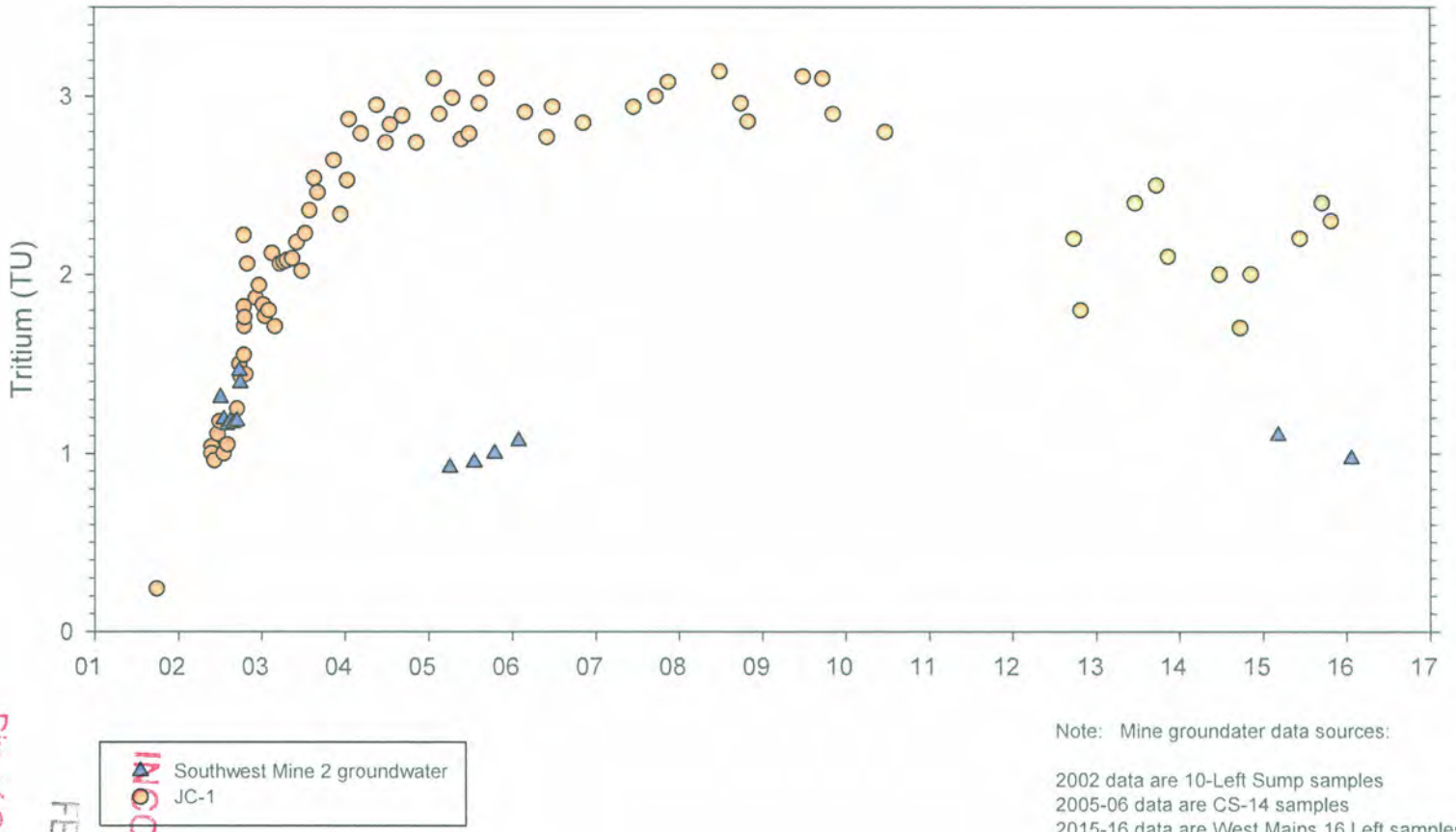

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Figure 7 Plot of tritium concentrations.

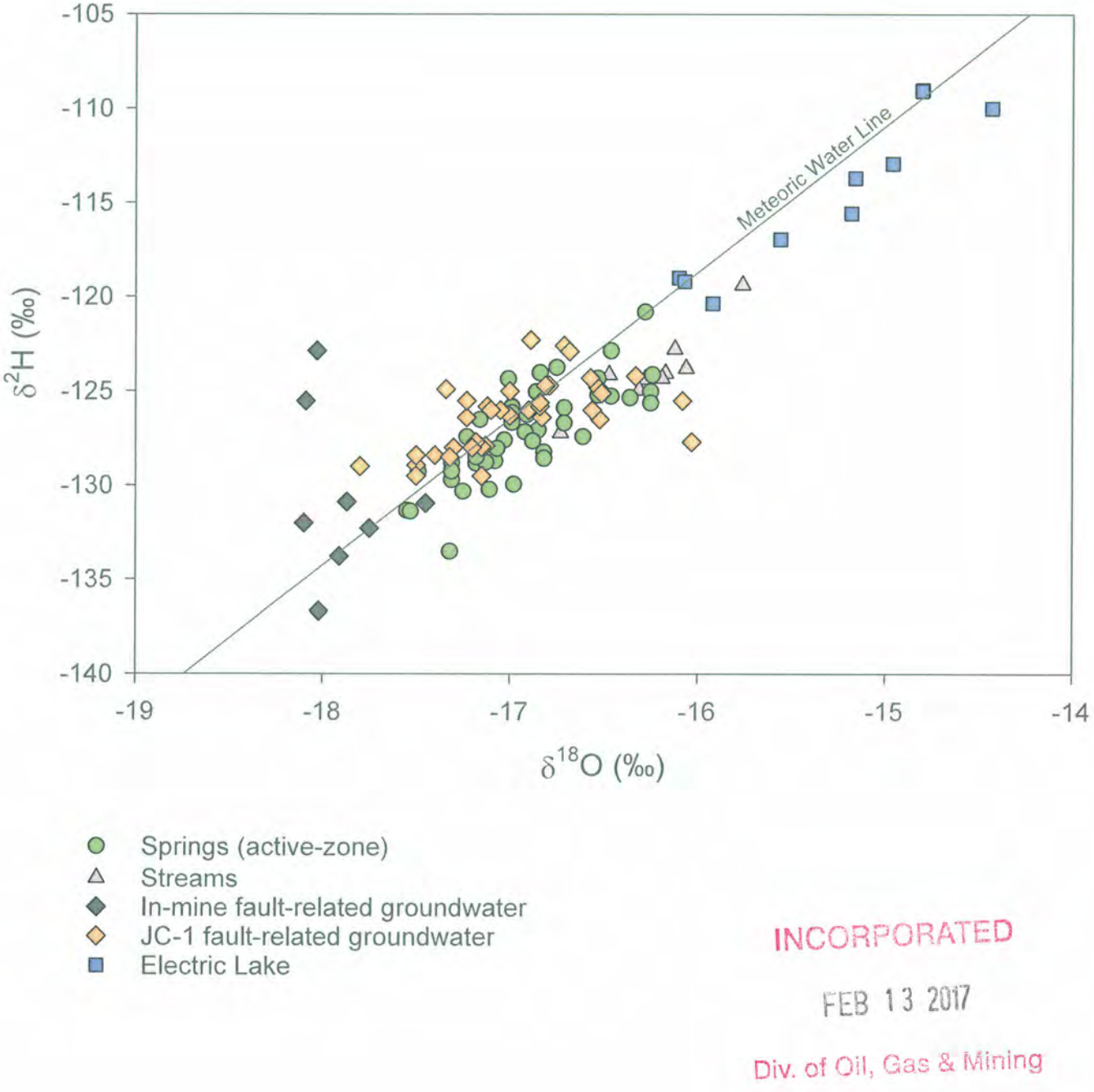

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Figure 8 Deuterium and oxygen-18 plot.

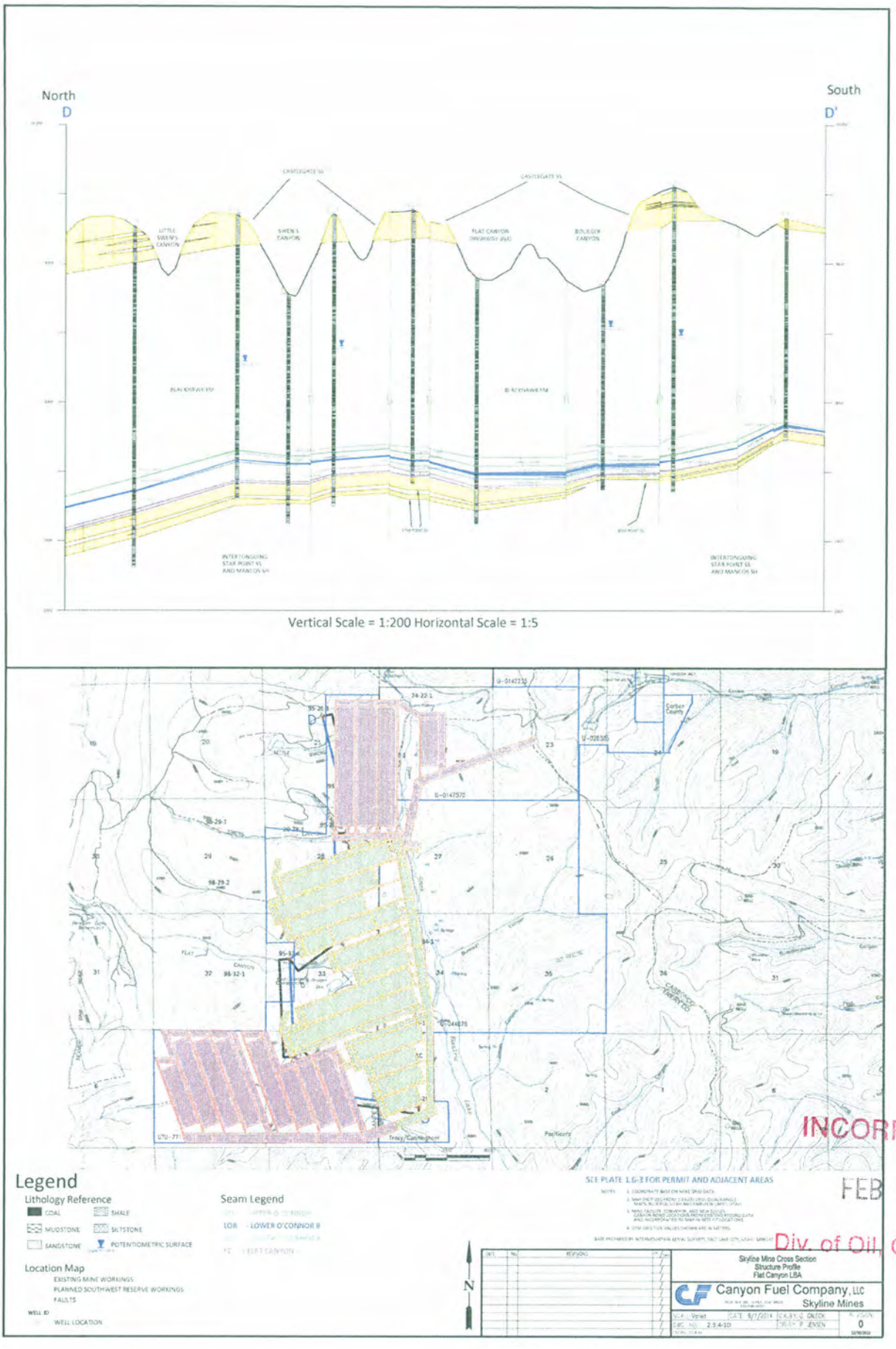

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Figure 9 Skyline Mine cross-section structure profile, Flat Canyon LBA.

Table 1 Potentiometric data from monitoring wells.

W79-26-1			W79-35-1A			W79-35-1B			W79-10-1			W79-14-2A			99-21-1			99-28-1			20-4-1			20-4-2			W2-1		
Date	Depth	Elevation	Date	Depth	Elevation	Date	Depth	Elevation	Date	Depth	Elevation	Date	Depth	Elevation	Date	Depth	Elevation	Date	Depth	Elevation	Date	Depth	Elevation	Date	Depth	Elevation	Date	Depth	Elevation
8/15/1982	58.30	8963.50	7/15/1982	177.50	8551.40	7/15/1982	154.70	8572.20	6/15/1996	480.30	8902.50	9/5/1995	78.70	8973.00	12/9/1999	926.50	8419.50	12/9/1999	841.00	8510.00	1/29/2001	315.00	8559.00	1/29/2001	1022.00	8532.00	12/3/1999	720.00	8551.40
7/15/1983	52.20	8969.60	8/15/1982	179.00	8549.90	8/15/1982	150.40	8576.50	9/11/1996	482.19	8900.61	6/15/1996	76.90	8974.80	6/26/2000	927.00	8419.00	6/26/2000	843.70	8507.30	6/18/2001	317.4	8556.6	6/18/2001	1026.5	8527.5	6/26/2000	722.26	8549.20
8/15/1983	52.50	8969.30	7/15/1983	171.50	8557.40	7/15/1983	141.70	8585.20	6/23/1997	477.26	8905.60	9/12/1996	75.66	8976.04	1/29/2001	990.00	8356.00	11/8/2000	860.10	8490.90	9/3/2001	326.33	8547.67	9/3/2001	1040	8514	11/8/2000	756.26	8515.20
9/15/1983	52.80	8969.00	8/15/1983	171.70	8557.20	8/15/1983	139.60	8587.30	6/15/1997	480.70	8902.10	6/27/1997	59.06	8992.64	6/18/2001	990.7	8355.3	1/29/2001	899	8452	10/8/2001	332.1	8541.9	10/8/2001	1058.9	8497.1	6/18/2001	768.90	8502.50
10/15/1983	52.20	8969.60	9/15/1983	171.20	8557.70	9/15/1983	136.80	8590.10	10/9/1997	491.10	8891.70	8/15/1997	71.90	8979.80	9/3/2001	996.8	8349.2	6/18/2001	902.3	8448.7	1/3/2002	346.5	8527.5	4/16/2002	1101.5	8452.54	9/5/2001	800.1	8471.3
6/15/1984	51.60	8970.20	10/15/1983	172.40	8556.50	10/15/1983	135.90	8591.00	6/22/1998	476.30	8906.50	10/12/1997	77.30	8974.40	10/8/2001	996.1	8349.9	9/3/2001	908.7	8442.3	6/12/2002	370.5	8503.5	6/13/2002	1111	8443.05	9/10/2001	808.4	8463
8/15/1984	51.20	8970.60	6/15/1984	182.20	8546.70	6/15/1984	147.40	8579.50	8/22/1998	476.20	8906.60	6/22/1998	58.20	8993.50	4/15/2002	1005.8	8340.21	10/8/2001	911.7	8439.3	9/10/2002	383.27	8490.73	9/27/2002	1133.5	8420.53	9/14/2001	807.7	8463.7
6/15/1985	51.20	8970.60	8/15/1984	183.70	8545.20	8/15/1984	143.80	8583.10	10/17/1998	476.00	8906.80	8/22/1998	86.40	8965.30	6/12/2002	1010.3	8335.7	6/12/2002	926.3	8424.75	11/5/2002	389.75	8484.25	10/16/2002	1134	8420	9/20/2001	819.4	8452
7/15/1985	51.00	8970.80	6/15/1985	188.30	8540.60	6/15/1985	140.10	8586.80	6/29/1999	475.30	8907.50	10/17/1998	85.90	8965.80	9/24/2002	1026.7	8319.26	9/24/2002	973.7	8377.3							10/23/2001	837.5	8433.9
8/15/1985	50.90	8970.90	7/15/1985	187.20	8541.70	7/15/1985	139.10	8587.80	8/17/1999	475.10	8907.70	7/6/1999	84.70	8967.00	11/14/2002	1029	8316.96	11/5/2002	978.7	8372.27							6/19/2002	893.6	8377.85
9/15/1985	50.70	8971.10	8/15/1985	186.20	8542.70	8/15/1985	137.10	8589.80	8/7/2000	473.70	8909.10	8/19/1999	84.30	8967.40													9/2/2002	907	8364.38
6/15/1986	50.70	8971.10	9/15/1985	186.70	8542.20	9/15/1985	137.30	8589.60	10/2/2000	472.80	8910.00	10/12/1999	88.60	8963.10													11/5/2002	910.8	8360.57
8/15/1986	50.80	8971.00	6/15/1986	193.70	8535.20	6/15/1986	142.30	8584.80	6/18/2001	470.7	8912.1	6/27/2000	86.20	8965.50															
10/15/1986	50.90	8970.90	8/15/1986	190.70	8538.20	8/15/1986	142.40	8584.50	9/3/2001	359.7	9023.1	8/8/2000	85.90	8964.80															
6/15/1987	51.90	8969.90	10/15/1986	192.20	8536.70	10/15/1986	139.70	8587.20	10/23/2001	357.1	9025.7	10/2/2000	87	8964.7															
8/15/1987	52.30	8969.50	6/15/1987	204.80	8524.10	6/15/1987	145.60	8581.30	6/17/2002	348.2	9034.6	6/18/2001	85.3	8966.4															
10/15/1987	52.80	8969.00	8/15/1987	203.60	8525.30	8/15/1987	144.30	8582.60	9/2/2002	366.7	9016.1	9/5/2001	85.9	8965.8															
7/15/1988	52.10	8969.70	10/15/1987	205.40	8523.50	10/15/1987	143.80	8583.10	10/16/2002	371	9011.85	10/8/2001	87.5	8964.2															
10/15/1988	50.40	8971.40	7/15/1988	206.20	8522.70	7/15/1988	139.80	8587.10				6/18/2002	86.5	8965.2															
8/15/1989	47.00	8974.80	10/15/1988	205.30	8523.80	10/15/1988	135.40	8591.50				9/9/2002	86.5	8965.2															
10/15/1989	45.30	8976.50	8/15/1989	207.60	8521.30	8/15/1989	141.80	8585.10				11/5/2002	87.6	8964.1															
8/15/1990	50.80	8971.00	10/15/1989	214.60	8514.30	10/15/1989	142.60	8584.30																					
8/15/1990	51.20	8970.60	6/15/1990	222.90	8506.00	6/15/1990	141.80	8585.10																					
10/15/1990	51.00	8970.80	8/15/1990	214.70	8514.20	8/15/1990	157.50	8569.40																					
6/15/1991	52.80	8969.00	10/15/1990	221.20	8507.70	10/15/1990	163.00	8563.90																					
9/15/1991	52.10	8969.70	6/15/1991	223.40	8505.50	6/15/1991	158.80	8568.10																					
10/15/1991	52.80	8969.00	9/15/1991	228.00	8500.90	9/15/1991	151.60	8575.30																					
6/15/1992	52.80	8969.00	10/15/1991	229.40	8499.50	10/15/1991	151.00	8575.90																					
9/15/1992	54.40	8967.40	6/15/1992	236.50	8492.40	6/15/1992	155.30	8571.60																					
10/15/1992	57.50	8964.30	9/15/1992	238.20	8490.70	9/15/1992	159.00	8567.90																					
6/15/1993	58.20	8963.60	10/15/1992	243.30	8485.60	10/15/1992	161.90	8565.00																					
9/15/1993	59.80	8962.00	6/15/1993	246.70	8482.20	6/15/1993	169.60	8557.30																					
10/15/1993	61.60	8960.20	9/15/1993	239.90	8489.00	9/15/1993	168.50	8558.40																					
6/15/1994	67.80	8954.00	10/15/1993	237.20	8491.70	10/15/1993	168.40	8560.50																					
9/15/1994	68.60	8953.20	6/15/1994	239.70	8489.20	6/15/1994	176.10	8550.80																					
10/15/1994	68.50	8953.30	9/15/1994	241.50	8487.40	9/15/1994	177.80	8549.10																					
7/15/1995	67.90	8953.90	10/15/1994	244.70	8484.20	10/15/1994	178.20	8548.70																					
9/5/1995	68.50	8953.30	7/15/1995	230.20	8498.70	7/15/1995	170.60	8556.30																					
11/15/1995	68.70	8953.10	9/5/1995	232.40	8496.50	9/5/1995	171.10	8555.80																					
8/15/1996	69.00	8952.80	11/15/1995	235.20	8493.70	11/15/1995	179.00	8547.90																					
6/19/1997	118.50	8903.30	6/19/1997	244.20	8484.70	6/15/1996	173.00	8553.90																					
8/13/1997	118.44	8903.36	8/15/1997	238.50	8490.40	6/19/1997	170.10	8556.80																					
10/12/1997	118.44	8903.36	10/9/1997	237.70	8491.20	8/15/1997	169.80	8557.10																					
6/15/1998	70.30	8951.50	6/15/1998	245.40	8483.50	10/9/1997	169.40	8557.50																					
8/13/1998	71.00	8950.80	8/13/1998	240.70	8488.20	6/15/1998	169.60	8557.30																					
10/17/1998	118.90	8902.90	10/17/1998	239.00	8489.90	8/13/1998	169.60	8557.30																					
7/5/1999	71.90	8949.90	7/5/1999	312.20	8416.70	10/17/1998	169.00	8557.90																					
9/19/1999	81.20	8940.60	8/19/1999	317.30	8411.60	7/5/1999	169.40	8557.50																					
10/6/1999	91.80	8930.00	10/6/1999	322.30	8406.60	8/19/1999	169.10	8557.80																					
6/20/2000	131.70	8890.10	6/20/2000	317.30	8411.60	10/6/1999	169.90	8557.00																					
8/7/2000	129.00	8892.80	8/7/2000	363.00	8365.90	6/20/2000	169.10	8557.80																					
10/9/2000	136.70	8885.10	10/9/2000	374.00	8354.90	8/7/2000	170.00	8556.90																					
6/19/2001	89.00	8932.80	6/19/2001	484.90	8244.00	10/9/2000	169.50	8557.40																					
9/3/2001	93.10	8928.70	9/3/2001	493.30	8235.60	6/19/2001	171.80	8555.10																					
10/25/2001	95.50	8926.30	10/25/2001	505.5	8223.4	9/3/2001	170.90	8556.00																					
6/19/2002	97.60	8924.20	4/15/2002	528.8	8200.15	10/25/2001	170.70	8556.20																					
9/15/2002	99.78	8922.02	6/19/2002	533.7	8195.19	4/15/2002	169.75	8557.15																					
11/14/2002	100.02	8921.78	9/2/2002	535.9	8193	6/19/2002	171.25	8555.65																					
			11/14/2002	539	8189.93	9/2/2002	171.73	8555.17																					
			3/10/2003	554.5	8174.45	11/14/2002	171.05	8555.85																					
						1/16/2003	172.11	8554.79																					
						2/1/2003	173.81	8553.09																					
						3/9/2002	176.91	8549.99																					

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Table 2 Selected isotopic compositions of groundwaters and surface waters.

Site	Date	δ^2H (‰)	$\delta^{18}O$ (‰)	$\delta^{34}S$ (‰)	$\delta^{13}C$ (‰)	^{14}C (pmC)	Tritium (TU)	Mean residence time
Creeks								
CS-9	10/17/1995						21.8	
CS-10	5/22/1996						15.8	
C-1	Oct-97	-124.37	-16.28					
C-1	Jul-98	-124.94	-16.31					
C-2	Oct-97	-16.06	-123.8					
C-2	Jul-98	-119.38	-15.76					
C-3	Oct-97	-16.73	-127.22					
C-3	Jul-98	-124.99	-16.52					
C-4	Oct-97	-16.17	-124.05					
C-4	Jul-98	-124.32	-16.19					
C-5	Oct-97	-16.47	-124.13					
C-5	Jul-98	-122.77	-16.12					
Springs, Flat Canyon Tract								
7-242	10/9/1997	-120.81	-16.28		-13.1	73.52	10.5	modern
7-242	7/1/1998	-122.86	-16.46					
29-138	10/8/1997	-127.06	-16.85		-12.3	88.58	12.9	modern
29-138	7/21/1998	-125.02	-16.25		-13.5	90.96	14	modern
32-279	10/9/1997	-127.42	-17.23		-12.3	68.62	14	modern
32-279	7/21/1998	-125.03	-16.86		-12.5	71.67	15	modern
MST-3	9/11/1997	-127.6	-17.03				13.1	modern
MST-3	7/21/1998	-125.61	-16.25		-12.1	71.35	10.3	modern
MSS-1	10/1/1997	-128.7	-17.08					
MST-1	10/1/1997	-125.87	-16.71					
MST-1	7/1/1998	-124.13	-16.24					
MST-2	10/1/1997	-128.82	-17.18					
MST-2	7/1/1998	-125.33	-16.36					
19-175	10/1/1997	-131.33	-17.55					
19-175	7/1/1998	-130.21	-17.11					
21-222	10/1/1997	-126.24	-16.91					
21-222	7/1/1998	-128.24	-16.82					
28-110	10/1/1997	-127.17	-16.92					
28-110	7/1/1998	-128.78	-17.13					
29-133	10/1/1997	-128.04	-17.07					
29-133	7/1/1998	-124.32	-16.53					
3-290	10/1/1997	-130.31	-17.25					
3-290	7/1/1998	-128.56	-16.82					
31-181	10/1/1997	-126.66	-16.99					
32-183	10/1/1997	-127.65	-16.88					
32-183	7/1/1998	-125.25	-16.46					
32-276	10/1/1997	-125.8	-16.99					
32-277	10/1/1997	-124.03	-16.84					
32-277	7/1/1998	-127.41	-16.61					
33-268	10/1/1997	-129.24	-17.31					
33-271	10/1/1997	-128.49	-17.18					
33-271	7/1/1998	-125.19	-16.53					
33-273	10/1/1997	-129.28	-17.49					
33-273	7/1/1998	-126.51	-17.16					
4-173	10/1/1997	-131.37	-17.53					
4-173	7/1/1998	-125.84	-16.99					
4-429	10/1/1997	-126.13	-16.99					
5-231	10/1/1997	-124.35	-17.01					
5-231	7/1/1998	-126.69	-16.71					
5-238	10/1/1997	-123.75	-16.75					
2-413	10/8/1997	-128.79	-17.31		-13.8	95.71	14.9	modern
2-413	7/22/1998	-129.94	-16.98		-12.4	91.68	15	modern
2-413	10/31/2005						9.5	
2-413	6/29/2006						8.62	
2-413	11/7/2006						8.52	
2-413	6/16/2007						7.69	
2-413	9/21/2007						7	
2-413	11/15/2007						7.97	

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Site	Date	δ^2H (‰)	$\delta^{18}O$ (‰)	$\delta^{34}S$ (‰)	$\delta^{13}C$ (‰)	^{14}C (pmC)	Tritium (TU)	Mean residence time
2-413	7/9/2008						7.57	
2-413	9/28/2008						8.18	
2-413	10/29/2008						8.1	
2-413	6/17/2009						7.88	
2-413	9/22/2009						7.2	
2-413	9/22/2009						7.2	
2-413	6/12/2010						6.7	
2-413	9/11/2010						6.0	
2-413	11/18/2010						6.4	
2-413	7/7/2011						7.1	
2-413	9/24/2011						6.1	
2-413	11/11/2011						5.6	
2-413	11/11/2011						5.5	
2-413	6/15/2012						6.4	
2-413	9/23/2012						5.1	
2-413	11/5/2012						5.4	
2-413	6/19/2013						5.4	
2-413	9/20/2013						5.0	
2-413	11/10/2013						5.2	
2-413	6/24/2014						5.3	
2-413	9/22/2014						4.5	
2-413	11/4/2014						4.8	
2-413	8/9/2015						4.1	
2-413	10/23/2015						4.7	
8-253	10/9/1997	-129.7	-17.31		-16.0	84.39	29.7	modern
8-253	7/21/1998	-133.51	-17.32		-16.1	79.06	30.0	modern
8-253	9/23/2004						16.1	
8-253	6/26/2005						11.1	
8-253	10/14/2005						16.5	
8-253	8/18/2006						14.7	
8-253	11/7/2006						15	
8-253	6/27/2007						13.9	
8-253	9/20/2007						13.4	
8-253	11/17/2007						13.4	
8-253	6/30/2008						10.2	
8-253	9/22/2008						12.6	
8-253	10/29/2008						12.5	
8-253	6/17/2009						10.6	
8-253	9/21/2009						9.5	
8-253	11/7/2009						8.9	
8-253	6/12/2010						8.1	
8-253	9/12/2010						9.5	
8-253	11/17/2010						9.3	
8-253	7/7/2011						7.6	
8-253	9/24/2011						8.2	
8-253	11/11/2011						7.0	
8-253	11/11/2011						7.0	
8-253	6/15/2012						7.5	
8-253	9/23/2012						6.9	
8-253	11/5/2012						6.9	
8-253	6/19/2013						7.2	
8-253	9/20/2013						6.4	
8-253	11/10/2013						6.9	
8-253	6/23/2014						5.5	
8-253	9/22/2014						6.4	
8-253	11/7/2014						5.9	
8-253	6/9/2015						5.9	
8-253	9/14/2015						6.9	
8-253	10/23/2015						6.5	
S24-1	9/23/2009						0.5	
S24-1	11/3/2009						0.8	
S24-1	6/12/2010						0.9	
S24-1	9/9/2010						0.9	
S21-1	11/17/2010						0.5	

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S24-1	6/22/2011						1.9	
S24-1	9/17/2011						0.7	
S24-1	9/17/2011						0.7	
S24-1	6/15/2012						0.7	
S24-1	12/4/2012						0.5	
S24-1	6/21/2013						0.7	
S24-1	9/10/2013						0.8	
S24-1	12/11/2013						1.5	
S24-1	6/26/2014						0.9	
S24-1	9/10/2014						0.6	
S24-1	12/10/2014						0.8	
S24-1	6/8/2015						1.3	
S24-1	9/18/2015						1.8	
Springs, Winter Quarters Area								
WQ1-39	6/6/1996			+12.1	-15.0		12	
WQ2-15	6/5/1996			+8.5	-12.45			
WQ3-6	6/5/1996			+5.7	-12.4	87.36	13.9	modern
WQ3-26	6/5/1996			+8.1	-14.6	107.14	11.1	modern
WQ3-41	6/6/1996			+13.5	-12.0	100.40	18.4	modern
WQ3-43	6/6/1996			+10.4	-12.7		15.1	
WQ4-12	6/5/1996			+11.3	-13.7	82.78	10.6	modern
Springs, Existing Permit Area								
S13-2	10/17/1995			+10.4	-12.0	80.12	18.8	modern
S14-4	10/17/1995			+14.75	-13.1			
S22-11	10/18/1995			+5.1	-13.3	75.49	21.6	modern
S22-5	10/18/1995			+10.6	-12.1			
S26-13	10/17/1995			+8.9				
S34-12	10/18/1995			+9.1	-13.0	78.26	20.4	modern
S35-8	10/18/1995			+12.9	-10.8			
S36-12	10/17/1995			+10.6	-13.3	85.16	18.1	modern
S15-3	10/18/1995			+16.5	-13.2	62.40	17.1	modern
S15-3	6/26/2005						8.78	
S15-3	11/17/2005						8.84	
S15-3	9/20/2006						8.05	
S15-3	12/14/2006						8.00	
S15-3	6/28/2007						8.32	
S15-3	9/27/2007						7.71	
S15-3	12/22/2007						7.24	
S15-3	6/24/2008						7.86	
S15-3	9/22/2008						7.08	
S15-3	12/27/2008						7.24	
S15-3	6/17/2009						8.61	
S15-3	9/21/2009						6.8	
S15-3	11/7/2009						6.8	
S15-3	6/22/2010						7.3	
S15-3	9/11/2010						5.6	
S12-3	12/1/2010						6.5	
S15-3	7/7/2011						6.9	
S15-3	9/24/2011						5.0	
S15-3	11/11/2011						4.9	
S15-3	11/11/2011						4.9	
S15-3	6/15/2012						6.6	
S15-3	9/23/2012						4.6	
S15-3	12/4/2012						4.7	
S15-3	6/19/2013						5.7	
S15-3	9/20/2013						3.0	
S15-3	12/1/2013						4.7	
S15-3	6/25/2014						5.7	
S15-3	9/22/2014						4.5	
S15-3	12/9/2014						4.1	
S15-3	6/9/2015						4.9	
S15-3	9/14/2015						4.8	
S15-3	10/23/2015						4.7	

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Fault Related Systems								
S17-2	10/17/1995			-1.5	-10.5	39.56	1.61	3,000 mixed w/modern
S17-2	5/22/1996						1.73	
Green Canyon Spring	7/23/1996			-0.7	-12.5	18.29	0.21	9,500
Alpine Well	7/23/1996			+12.7	-14.7	7.06	-0.02	17,000
G-37	7/23/1996			+19.45	-12.3	20.99	0.05	8,500
Skyline Mine Blackhawk Formation perched Groundwater Systems								
1-01D	10/6/1993			6.7	-8.4			
1-02D	10/6/1993			6.2	-2.1			
1-05D	5/8/1996						0.3	
1-11D	10/6/1993			17.2	-10.3			
1-12D	10/6/1993			16.6	-9.4			
1-14D	5/8/1996			13.9	-8.7	21.4	0	
1-01S	10/6/1993				-13.8	5.6	0	
1-02S	10/6/1993			19.3	-11.1			
3-01D	10/6/1993			8.9	-8.6			
3-04D	10/6/1993				-9.5			
3-05D	10/6/1993				-1.5			
3-06D	10/6/1993				-7.3			
3-07D	10/6/1993			19.4	-10.8	14.1	6.7	
3-07D	5/8/1996						0.1	
3-08D	5/8/1996			14.8	-10.9	41.5	0.3	
3-02S	10/6/1993			16.8	-10			
Roof Drip 1-03D	10/6/1993			+16.35	-10.7	15.4	5.6*	10,500
Roof Drip 1-05D	5/8/1996						0.28	
M1-9L-E1-XC31.5 (Roof Drip 1-14D)	5/8/1996			+13.9	-8.7	21.36	0.16	7,500
M1-9L-E2-XC23.5 (Roof Drip 1-15D)	5/8/1996			+15.5	-10.3	28.65	0.16	5,500
Floor Water 1-01S	10/6/1993				-13.8	5.6	0	18,500
Roof Drip 3-07D	10/6/1993			+19.4	-10.8	14.1	6.7*	10,500
M3-WM-E1-XC85.5 (Roof Drip 3-07D)	5/8/1996						0.12	
M3-1L-TG_XC27 (Roof Drip 3-08D)	5/8/1996			+14.8	-10.9	41.5	0.26	2,500
M1-WM-E2-XC44	5/8/1996						0.28	
Skyline Mine Fault Inflows								
14LHGE1C35 Roof	3/22/1999	-133.77	-17.91	+20.25	-10.3	10.85	-0.01	13,300
14LHGE1C35 Floor	3/22/1999	-130.88	-17.87	+18.9	-9.7	9.63	0.11	14,400
14LHGE1C37 Rib Water	4/12/1999	-132.28	-17.75	+18.6	-9.9	6.91	0.02	16,700
5LTGE1C39	12/17/1998			+20.6	-9.8	19.05	-0.06	8,000
M1SSM E1 C102	12/17/1998			+14.3	-10.6	13.26	0.06	11,000
16LE2XC11.5	12/15/1999	-125.52	-18.09		-10.7	17.25	0.12	9,500
14LE1XC36	12/15/1999	-122.87	-18.03		-10.1	17.66	0.02	9,200
14LHGE1C23 RD	3/22/1999	-130.95	-17.45					
WME2C73 RD	3/22/1999	-136.7	-18.02					
14LHGE1C35	9/22/2000				-10.2	12.98	-0.02	11,500
E6XC22 West Submains	9/22/2000				-10.3	21.15	0.00	7,400
16LXC12	4/18/2001				-9.9	16.02	-0.02	9,250
14LE1XC36	4/18/2001				-10.3	18.65	0.12	8,500
9LE3XC40 Borehole	4/19/2001				-11.2	23.53	0.06	7,250
Diagonal Submains E3XC12	4/19/2001				-10.3	23.98	0.05	6,250
8LE3XC62 Borehole	4/18/2001				-11.9	29.11	0.78	6,000
8L Bleeder XC51 Borehole	4/18/2001				-12.3	13.66	0.51	12,500
8LE2XC62 Borehole (uncased)	4/18/2001				-11.9	8.15	0.06	16,500
Diagonal Fault	4/10/2002				-10.3	11.91	0.01	12,100
11L Headgate E1 XC62	4/10/2002				-10.5	25.57	0.31	5,900
East Submains E3 XC14 Fault	4/10/2002				-10.3	17.36	0.88	9,000
11L Headgate E1 XC39 Fault	4/10/2002				-10.9	2.29	0.01	25,800
11L Headgate XC54	4/25/2002				-10.1	7.26	0.06	16,300
9L Borehole XC59	4/10/2002				-10.4	16.91	0.16	9,300
9L Horizontal Borehole	7/2/2002				-10.1	15.60	0.17	9,700
9L Horizontal Borehole	8/15/2002						0.86	
9L Horizontal Borehole	8/28/2002						0.83	
East Submains E1 XC5 Fault	4/10/2002				-10.7	15.17	0.01	10,200
East Submains E1 XC5 Fault	8/1/2002						0.09	
East Submains E1 XC5 Fault	8/15/2002						0.08	

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East Submains E1 XC5 Fault	8/28/2002						0.07	
10L Sump	7/2/2002				-10.4	24.2	1.31	6,300
10L Sump	7/16/2002						1.19	
10L Sump (alternate)	8/1/2002						1.16	
10L Sump	8/15/2002						1.18	
10L Sump	8/28/2002						1.17	
West Mains 16 Left	3/5/2015				-8.6	14.54	1.1	8,000
West Mains 16 Left	1/20/2016						0.97	
West Mains 6 Left	3/5/2015				-8.9	17.71	1.1	
Boreholes West Mains XC99	3/5/2015				-10.5	14.25	<0.3	
Mine Dewatering Wells								
JC-1	9/25/2001	-128.4	-17.4		-11.80	30.4	0.20	
JC-1	9/26/2001	-128.41	-17.5		-11.8	30.42	0.24	4,600
JC-1	10/3/2001	-129	-17.8				0.2	
JC-1	5/24/2002						1.04	
JC-1	5/24/2002						1.00	
JC-1	5/24/2002						1.04	
JC-1	5/24/2002						1	
JC-1	6/4/2002						0.96	
JC-1	6/4/2002						0.96	
JC-1	6/19/2002						1.11	
JC-1	6/19/2002						1.11	
JC-1	6/28/2002						1.18	
JC-1	6/28/2002						1.18	
JC-1	7/2/2002						1.31	
JC-1	7/16/2002						1.09	
JC-1	7/16/2002						1	
JC-1	8/1/2002						1.22	
JC-1	8/1/2002						1.05	
JC-1	9/13/2002						1.25	
JC-1	9/24/2002						1.5	
JC-1	9/28/2002					23.19	1.43	
JC-1	10/14/2002						1.82	
JC-1	10/14/2002						2.22	
JC-1	10/14/2002						1.55	
JC-1	10/15/2002						1.71	
JC-1	10/17/2002						1.76	
JC-1	10/21/2002						1.44	
JC-1	10/29/2002						2.06	
JC-1	12/6/2002						1.87	
JC-1	12/20/2002						1.94	
JC-1	1/7/2003					27.58	1.83	
JC-1	1/14/2003						1.77	
JC-1	1/31/2003						1.8	
JC-1	2/15/2003						2.12	
JC-1	2/28/2003						1.71	
JC-1	3/22/2003						2.06	
JC-1	4/7/2003						2.07	
JC-1	4/22/2003						2.08	
JC-1	5/15/2003						2.09	
JC-1	6/3/2003						2.18	
JC-1	6/25/2003						2.02	
JC-1	7/11/2003						2.23	
JC-1	7/30/2003						2.36	
JC-1	8/20/2003	-16.9	-126			32.56	2.54	
JC-1	9/4/2003						2.46	
JC-1	11/14/2003	-17.2	-128			31.85	2.64	
JC-1	12/12/2003						2.34	
JC-1	1/12/2004	17.2	-128			32.64	2.53	
JC-1	1/19/2004						2.87	
JC-1	3/11/2004						2.79	
JC-1	5/20/2004						2.95	
JC-1	6/28/2004	-17.5	-129.5			36.75	2.74	
JC-1	7/17/2004						2.84	

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JC-1	9/8/2004	-17	-126.3			37.15	2.89	
JC-1	11/8/2004	17.12	125.8			33.74	2.74	
JC-1	1/26/2005						3.1	
JC-1	2/3/2005					35.21		
JC-1	2/18/2005	-17.32	-128.5				2.9	
JC-1	4/16/2005						2.99	
JC-1	5/25/2005						2.76	
JC-1	6/28/2005	-16.83	-126.4			34.32	2.79	
JC-1	8/10/2005	-17.05	-126			35	2.96	
JC-1	9/13/2005					36.29	3.1	
JC-1	2/27/2006	-17.23	-125.5			35.75	2.91	
JC-1	6/1/2006	-16.84	-125.8			37.95	2.77	
JC-1	6/26/2006						2.94	
JC-1	9/25/2006	-16.52	-126.5					
JC-1	11/7/2006	-16.08	-125.5				2.85	
JC-1	6/16/2007	-16.53	-124.8			34.34	2.94	
JC-1	6/16/2007							
JC-1	9/21/2007	-16.33	-124.2			36.08	3.00	
JC-1	11/15/2007	-16.51	-125.1			38.37	3.08	
JC-1	6/28/2008	-17	-125			36.8	3.14	
JC-1	9/28/2008	-16.56	-126			37.67	2.96	
JC-1	10/29/2008	-16.79	-124.7			39.7	2.86	
JC-1	6/28/2009	-16.57	-124.3			38.31	3.11	
JC-1	9/22/2009	-16.84	-125.6			48.1	3.1	
JC-1	11/7/2009	-16.81	-124.7			38.31	2.9	
JC-1	6/21/2010	-16.71	-122.6			38.6	2.8	
JC-1	6/21/2010	-16.71	-122.6			38.6	2.8	
JC-1	9/23/2012						2.2	
JC-1	10/22/2012						1.8	
JC-1	6/19/2013						2.4	
JC-1	9/20/2013						2.5	
JC-1	11/10/2013						2.1	
JC-1	6/24/2014				-11.03	44.98	2.0	1,200
JC-1	9/22/2014	-122.8	-16.79		-10.89	40.62	1.7	2,100
JC-1	11/7/2014	-123.3	-16.8		-11.10	39.62	2.0	2,350
JC-1	6/9/2015				-11.32	41.51	2.2	2,000
JC-1	9/14/2015						2.4	
JC-1	10/23/2015				-10.82	40.49	2.3	2,200
Electric Lake								
EL-1	9/25/2001	-119.2	-16.1		-8.3	72.4	13	
Upper Electric Lake	9/26/2001	-119.19	-16.07		-8.3	72.44	12.6	modern
Upper Electric Lake (with coal)	9/26/2001	-120.36	-15.92		-8.7	82.44		modern
Electric Lake at outlet	9/26/2001	-110	-14.43					
EL-B-5	10/2/2001	-109	-14.8					
EL-C-55	10/2/2001	-109	-14.8		-9.2	82.2	12	
E. Lake-1 Mid Lake	5/24/2002						7.67	
E.Lake-2 North End	5/24/2002						8.52	
North End Shallow Elect.	7/11/2002						8.66	
North End Deep Elect.	7/11/2002						8.66	
South End Shallow Elect.	7/11/2002						8.69	
South End Deep Elect.	7/11/2002						8.89	
North End Shallow Elect.	7/26/2002							
South End Shallow Elect.	7/26/2002							
EL-1	9/21/2009						5.9	
EL-1	12/4/2009						6.5	
EL-1	12/4/2009						6.5	
EL-1	6/12/2010						6.4	
EL-1	6/12/2010						6.4	
EL-1	9/11/2010						6.2	
EL-1	9/11/2010						6.2	
EL-1	11/17/2010						5.8	
EL-1	11/17/2010						5.8	
EL-1	7/7/2011						6.5	
EL-1	7/7/2011						6.5	
EL-1	9/24/2011						6.2	

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Table 2 Selected isotopic compositions of groundwaters and surface waters.

Site	Date	δ^2H (‰)	$\delta^{18}O$ (‰)	$\delta^{34}S$ (‰)	$\delta^{13}C$ (‰)	^{14}C (pmC)	Tritium (TU)	Mean residence time
EL-1	9/24/2011						6.2	
EL-1	11/11/2011						6.0	
EL-1	11/11/2011						6.0	
EL-1	11/11/2011						6.0	
EL-1	6/15/2012						5.7	
EL-1	6/15/2012						6.0	
EL-1	9/23/2012						4.9	
EL-1	9/23/2012						5.3	
EL-1	12/4/2012						4.4	
EL-1	6/19/2013						6.2	
EL-1	9/10/2013						4.6	
EL-1	9/10/2013						4.6	
EL-1	11/14/2013						4.2	
EL-1	11/14/2013						4.2	
EL-1	6/25/2014						4.7	
EL-1	6/25/2014						4.7	
EL-1	9/22/2014						4.4	
EL-1	12/9/2014						4.1	
EL-1	6/9/2015						4.3	
EL-1	9/14/2015						4.8	
EL-1	10/23/2015						5.0	
EL-2	9/23/2004						5.71	
EL-2	11/7/2004						6.00	
EL-2	6/21/2005						6.49	
EL-2	9/23/2005						5.72	
EL-2	11/17/2005						6.42	
EL-2	9/22/2006						6.42	
EL-2	12/13/2006						6.29	
EL-2	6/19/2007						7.26	
EL-2	9/18/2007						6.28	
EL-2	12/5/2007						6.48	
EL-2	6/3/2008						6.12	
EL-2	9/19/2008						6.68	
EL-2	12/23/2008						6.46	
EL-2	5/21/2009						6.4	
EL-2	9/23/2009						6.4	
EL-2	6/12/2010						5.5	
EL-2	9/9/2010						5.1	
EL-2	11/17/2010						5.5	
EL-2	6/22/2011						6.6	
EL-2	9/14/2011						5.8	
EL-2	11/16/2011						5.5	
EL-2	11/16/2011						5.4	
EL-2	6/15/2012						5.8	
EL-2	9/18/2012						5.3	
EL-2	12/4/2012						4.7	
EL-2	6/21/2013						4.9	
EL-2	9/10/2013						4.6	
EL-2	12/11/2013						4.4	
EL-2	6/26/2014						4.4	
EL-2	9/11/2014						4.1	
EL-2	12/10/2014						3.8	
EL-2	6/8/2015						4.4	
EL-2	9/18/2015						4.3	

[b] Likely analytical error, samples analyzed using less accurate direct counting technique, verified on subsequent resampling at 3-07D

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Table 3 Modern water componente calculations.

		ASSUMPTIONS		
		Modern water at 9.81 TU (average Electric Lake)	Modern water at 17.58 TU (average springs and streams)	Modern water at 13.70 TU (avg. springs, streams, E. Lake)
Date	JC-1 tritium content (TU)	Modern water fraction	Modern water fraction	Modern water fraction
26-Sep-2001	0.24	0.024	0.014	0.018
24-May-2002	1.02	0.104	0.058	0.074
4-Jun-2002	0.96	0.098	0.055	0.070
19-Jun-2002	1.11	0.113	0.063	0.081
28-Jun-2002	1.18	0.120	0.067	0.086
16-Jul-2002	1.09	0.111	0.062	0.080
1-Aug-2002	1.22	0.124	0.069	0.089

		ASSUMPTIONS		
		Modern water at 4.70 TU (average Electric Lake 2015)	Modern water at 5.17 TU (average springs 2015)	Modern water at 4.94 TU (avg. springs, E. Lake 2015)
Date	JC-1 tritium content (TU)	Modern water fraction	Modern water fraction	Modern water fraction
2014 average	1.9	0.404	0.368	0.385
2015 Average	2.3	0.489	0.445	0.466

		ASSUMPTIONS		
		Modern water at 4.70 TU (average Electric Lake 2015)	Modern water at 5.17 TU (average springs 2015)	Modern water at 4.94 TU (avg. springs, E. Lake 2015)
Date	West Mains 16 Left (TU)	Modern water fraction	Modern water fraction	Modern water fraction
1/20/2016	0.97	0.206	0.188	0.196

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Table 3a Average tritium contents.

2002 Information

	Tritium (TU)
Electric Lake	
Electric Lake 26 Sep 01	12.60
Electric Lake 24 May 02 average	8.10
Average	**8.73**
Springs and Creeks	
S13-2 (1995)	18.80
S15-3 (1995)	17.10
S22-11 (1995)	21.60
S34-12	20.40
S36-12	18.10
2-413 average (1997-1998)	14.95
7-242 (1997)	10.50
29-138 (1997)	13.45
8-253 average (1997-1998)	29.85
32-279 average (1997-1998)	14.50
MST-3 average (1997-1998)	11.70
CS-9, Eccles Creek (1995)	21.80
CS-10, upper Huntington Creek (1995)	15.80
Average	**17.58**
Springs, Creeks, and Electric Lake	
Average	**13.70**
Mine Dewatering Well JC-1	
JC-1 (26 Sep 2001)	0.17
JC-1 (24 May 2002)	1.02
JC-1 (4 Jun 2002)	0.96
JC-1 (19 Jun 2002)	1.11
JC-1 (28 Jun 2002)	1.18
JC-1 (16 Jul 2002)	1.00
JC-1 (1 Aug 2002)	1.22

2016 Update Data

Electric Lake	
EL-1 (9 Jun 2015)	4.3
EL-1 (14 Sep 2015)	4.8
EL-1 (23 Oct 2015)	5.0
Electric Lake 2015 Average	**4.70**
Springs	
2-413 average (2015)	4.4
8-253 average (2015)	6.4
S15-3 average (2015)	4.7
Springs 2015 Average	**5.17**
Springs and Electric Lake 2015 Average	**4.94**
Mine Dewatering Well JC-1	
JC-1 (24 Jun 2014)	2.0
JC-1 (22 Sep 2014)	1.7
JC-1 (7 Nov 2014)	2.0
JC-1 2014 Average	**1.9**
JC-1 (9 Jun 2015)	2.2
JC-1 (14 Sep 2015)	2.2
JC-1 (23 Oct 2015)	2.4
JC-1 2015 Average	**2.3**
West Mains 16 Left (1/20/2016)	**0.97**

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Appendix A

Analytical Services, Inc.

Williston, Vermont

Microscopic Particulate Analysis

Laboratory Reports

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ANALYTICAL SERVICES, INC.
Microbiological Testing, Research and Consulting

130 Allen Brook Ln., PO Box 515, Williston, VT 05495 USA
1.800.723.4432 / 802.878.5138 Fax: 802.878.6765
www.analyticalservices.com

February 3, 2003

Erik Petersen
Petersen Hydrologic
2695 North 600 East
Lehi, UT 84043

Dear Erik:

Enclosed please find the results of the Microscopic Particulate Analysis (MPA) performed on the sample received in our laboratory on January 16, 2003.

Thank you for using Analytical Services Inc. for your testing needs. If you have any questions or if we may be of service in the future, please do not hesitate to contact us at (800) 723-4432.

Sincerely,

ANALYTICAL SERVICES, INC.

Jessica Howlett
Staff Microbiologist

JH/lll

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Project No.: 2003-0116-009

Microscopic Particulate Analysis

Section I.

One sample from Petersen Hydrologic was analyzed using the Environmental Protection Agency's Consensus Method for Determining Ground Waters Under the Direct Influence (GWUDI) of Surface Water Using Microscopic Particulate Analysis (MPA). MPA is one parameter used to determine if a ground water source is under the direct influence of surface water. As indicated in the Guidance Manual for compliance with the Surface Water Treatment Rule, other factors, including a sanitary survey, well construction logs, hydrological criteria, distance from nearest surface water source and water quality are considered when making a GWUDI determination. Recent data indicate that factors effecting particulate movement in soil need to be taken into account in GWUDI determinations. These include the degree of hydraulic communication (timing and amount of surface water mixed with ground water), time of travel in the ground, and natural filtration.

An MPA filter is processed by first cutting the fibers from the filter core then washing them repeatedly with a stomacher. The resulting sediment is centrifuged into a pellet. Then, depending on the volume of the pellet recovered from a filter, the sediment is either purified by a gradient flotation procedure using Percoll sucrose as the levitant, or is analyzed directly. A portion of the pellet is examined for surface water "bioindicators", such as plant debris, algae, diatoms, insects, protozoa, rotifers, and other particulates that are characteristic of surface waters. The number and type of bioindicators are tabulated and used to calculate a risk rating score, which indicates the risk of surface water contamination. The MPA risk-rating table can be found in Section III of this report.

Results from the MPA indicate this sample is characteristic of ground water. There was a minimal amount of sediment recovered from the filter (0.05 mL in 458 gallons), and only a minimal amount remained after the flotation process. Low numbers of particulates and biological organisms were detected in this sample. Data from the MPA are included in Section II of the Analytical Results.

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ANALYTICAL SERVICES, INC.

Client: Petersen Hydrologic
Address: 2695 North 600 East
Lehi, UT 84043

Sampling Date: January 14, 2003
Date Received: January 16, 2003
Analyst: jh

Section II.

Analytical Results

Sample No.: 2003-0116-009

I. SAMPLE DATA		
Sample ID:	JC-1	
Sample Site:	JC-1	
Water Type:	raw/well	
Turbidity, NTU's:	S: 3.4	E: 1.1
pH:	S: 7.72	E: 7.79
Treatment:	none	
Distance From Surface Water:	100 feet	
Volume Filtered:	458 gallons	
Filter:	Commercial Honeycomb 1 μm	
Filter Color:	off-white	
Sediment Volume:	0.05 mL	
Volume Floated:	0.05 mL	
Pellet Volume After Float:	trace	
Levitant –		
type:	Percoll sucrose	
specific gravity:	1.15	

S = Start of Sampling; E = End of Sampling

II. MPA			
Numbers reported are per 100 gallons			
Detection Limit = 6.67			
Amorphous Debris:	Confluent	Crustaceans:	BDL
Vegetative Debris -		Crustacean Parts:	BDL
with chlorophyll:	BDL	Crustacean Eggs:	BDL
without chlorophyll:	BDL	Water Mites:	BDL
Diatoms -		Gastrotrichs:	BDL
with chlorophyll:	BDL	Tardigrades:	BDL
without chlorophyll:	BDL	Nematodes:	BDL
Other Algae*:	BDL	Nematode Eggs:	BDL
Rotifers:	BDL	Invertebrate Eggs:	BDL
Rotifer Eggs:	BDL	Annelids:	BDL
Fungal Spores:	BDL	Amoebae:	BDL
Pollen:	BDL	Protozoa:	BDL
Iron Bacteria**:	BDL	Insects/Larvae:	BDL

BDL = Below Detection Limit

*Algae Identifications:	NA
**Iron Bacteria:	NA
Comments:	

NA = Not Applicable

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Project No.: 2003-0116-009

Client: Petersen Hydrologic
Address: 2695 North 600 East
Lehi, UT 84043

Sampling Date: January 14, 2003
Date Received: January 16, 2003

Section III.

MPA Risk Rating Table

The risk rating for surface water influence as calculated according to the EPA Consensus Method for Microscopic Particulate Analysis is as follows:

Lab ID	Sample ID	Table 1	Table 2	Total	Risk Rating
2003-0116-009	JC-1	None Detected	NA	0	Low*

NA = Not Applicable

The tables of relative risk factors used to calculate surface water influence in the EPA Consensus Method for Microscopic Particulate Analysis are based on a limited set of data. These data are not representative of all aquifer types or well designs. Therefore, the relative risk values calculated from these tables are of limited value in determining health risks associated with surface water indicators.

*This EPA Risk Rating table classifies each sample according to the number of surface water indicating organisms per 100 gallons; however, only 15 gallons of this sample could be analyzed for MPA. The relatively small volume analyzed does not affect the validity of the results; however, the risk rating should be interpreted with caution.

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MPA References

Berk, Sharon G., John H. Gunderson. Wastewater Organisms: A Color Atlas. Lewis Publishers. Boca Raton, Florida. 1993.

Fox, J. Carl, Paul R. Fitzgerald and Cecil Lue-Hing. Sewage Organisms: A Color Atlas. Lewis Publishers. Chelsea, Michigan. 1981.

Needham, James G., Paul R. Needham. A Guide to the Study of Fresh-water Biology. McGraw-Hill, Inc. New York. 1962.

Patterson, D.J., S. Hedley. Free-Living Freshwater Protozoa. CRC Press, Inc. Boca Raton, Florida. 1992.

Pennak, Robert W. Fresh-water Invertebrates of the United States. John Wiley and Sons, Inc. New York. 1989.

Prescott, G.W. How to Know the Freshwater Algae. Wm. C. Brown Company Publishers. Dubuque, Iowa. 1978.

Smith, E. Grant. Sampling and Identifying Allergenic Pollens and Molds. Blewstone Press. San Antonio, Texas. 1990.

Standard Methods for the Examination of Water and Wastewater. APHA, AWWA, and WEF, 20th Edition. American Public Health Association, Washington, D.C. 1998.

Thorp, James H., Alan P. Couich. Ecology and classification of North American Freshwater Invertebrates. Academic Press, Inc. San Diego, California. 1991.

USEPA. Consensus Method for Determining Groundwaters Under Direct Influence of Surface Water Using Microscopic Particulate Analysis. October, 1992.

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ANALYTICAL SERVICES, INC. (ASI)
Microbiological Testing, Research and Consulting

130 Allen Brook Ln., PO Box 515, Williston, VT 05495 USA
1.800.723.4432 / 802.878.5138 Fax: 802.878.6765
www.analyticalservices.com

August 16, 2006

Erik Petersen
Petersen Hydrologic
2695 North 600 East
Lehi, UT 84043

Dear Erik:

Enclosed please find the results of the Microscopic Particulate Analysis (MPA) performed on the sample received in our laboratory on August 1, 2006.

Thank you for using Analytical Services Inc. for your testing needs. If you have any questions or if we may be of service in the future, please do not hesitate to contact us at (800) 723-4432.

Sincerely,

ANALYTICAL SERVICES, INC.

Jessica Howlett
Aquatic Biologist/Staff Microbiologist

JH/lll

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ASI Project No.: 2006-0801-001

ANALYTICAL SERVICES, INC.
Microbiological Testing, Research and Consulting

Client:	Petersen Hydrologic	**Sampling Date:**	July 31, 2006
Address:	2695 North 600 East	**Date Received:**	August 1, 2006
	Lehi, UT 84043	**Analyst:**	jh
Client Sample ID:	JC-1	**ASI Sample No.:**	2006-0801-001

Section I.

Microscopic Particulate Analysis

This sample was analyzed using the Environmental Protection Agency's Consensus Method for Determining Ground Waters Under the Direct Influence (GWUDI) of Surface Water Using Microscopic Particulate Analysis (MPA). MPA is one parameter used to determine if a ground water source is under the direct influence of surface water. As indicated in the Guidance Manual for compliance with the Surface Water Treatment Rule, other factors, including a sanitary survey, well construction logs, hydrological criteria, distance from nearest surface water source and water quality are considered when making a GWUDI determination. Recent data indicate that factors effecting particulate movement in soil need to be taken into account in GWUDI determinations. These include the degree of hydraulic communication (timing and amount of surface water mixed with ground water), time of travel in the ground, and natural filtration.

An MPA filter is processed by first cutting the fibers from the filter core then washing them repeatedly with a stomacher. The resulting sediment is centrifuged into a pellet. Then, depending on the volume of the pellet recovered from a filter, the sediment is either purified by a gradient flotation procedure using Percoll sucrose as the levitant, or is analyzed directly. A portion of the pellet is examined for surface water "bioindicators", such as plant debris, algae, diatoms, insects, protozoa, rotifers, and other particulates that are characteristic of surface waters. The number and type of bioindicators are tabulated and used to calculate a risk rating score, which indicates the risk of surface water contamination. The MPA risk-rating table can be found in Section III of this report.

There was a minimal amount of sediment recovered from the filter (0.1 mL in 701.8 gallons), and the sediment was analyzed directly without flotation. Biological particulates that contribute to the EPA Risk Rating score were not detected in this sample. Data from the MPA are included in Section II of the Analytical Results.

Iron bacteria were detected in this sample, and were identified as *Gallionella* spp. Although iron bacteria can be a nuisance, they are not uncommon in certain wells, and do not represent a risk to public health. However, a high concentration of iron bacteria sediment can interfere with analysis.

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ANALYTICAL SERVICES, INC.
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Client:	Petersen Hydrologic	**Sampling Date:**	July 31, 2006
Address:	2695 North 600 East Lehi, UT 84043	**Date Received:**	August 1, 2006
		Analyst:	jh
Client Sample ID:	JC-1	**ASI Sample No.:**	2006-0801-001

Section II.

Analytical Results

I. SAMPLE DATA		
Sample Site:	JC-1 Sampling port at well head	
Water Type:	raw/well	
Turbidity, NTU's:	S: 0.38	E: 0.30
pH:	S: 7.4	E: 7.4
Treatment:	none	
Distance From Surface Water:	75 feet	
Volume Filtered:	701.8 gallons	
Filter:	Commercial Honeycomb 1 µm	
Filter Color:	off-white	
Sediment Volume:	0.1 mL	

INP = Information Not Provided
S = Start of Sampling;
E = End of Sampling

II. MPA			
Numbers reported are per 100 gallons			
Amorphous Debris:	Uniformly distributed	**Crustaceans:**	$<4.0 \times 10^0$
Vegetative Debris -		**Crustacean Parts:**	$<4.0 \times 10^0$
with chlorophyll:	$<4.0 \times 10^0$	**Crustacean Eggs:**	$<4.0 \times 10^0$
without chlorophyll:	$<4.0 \times 10^0$	**Water Mites:**	$<4.0 \times 10^0$
Diatoms -		**Gastrotrichs:**	$<4.0 \times 10^0$
with chlorophyll:	$<6.9 \times 10^1$	**Tardigrades:**	$<4.0 \times 10^0$
without chlorophyll:	$<6.9 \times 10^1$	**Nematodes:**	$<4.0 \times 10^0$
Other Algae*:	$<6.9 \times 10^1$	**Nematode Eggs:**	$<4.0 \times 10^0$
Rotifers:	$<4.0 \times 10^0$	**Invertebrate Eggs:**	$<4.0 \times 10^0$
Rotifer Eggs:	$<4.0 \times 10^0$	**Annelids:**	$<4.0 \times 10^0$
Spores:	$<4.0 \times 10^0$	**Amoebae:**	$<4.0 \times 10^0$
Pollen:	4.0×10^0	**Protozoa:**	$<6.9 \times 10^1$
Iron Bacteria:**	Present	**Insects/Larvae:**	$<4.0 \times 10^0$

***Algae Identifications:**	ND
****Iron Bacteria:**	*Gallionella* spp.
Comments:	NA

NA = Not Applicable ND = None Detected

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ANALYTICAL SERVICES, INC.
Microbiological Testing, Research and Consulting

Client:	Petersen Hydrologic	**Sampling Date:**	July 31, 2006
Address:	2695 North 600 East Lehi, UT 84043	**Date Received:**	August 1, 2006
		Analyst:	jh
Client Sample ID:	JC-1	**ASI Sample No.:**	2006-0801-001

Section III.

MPA Risk Rating Table

The risk rating for surface water influence as calculated according to the EPA Consensus Method for Microscopic Particulate Analysis is as follows:

Table 1	Table 2	Total	Risk Rating*
None Detected	NA	0	Low**

NA = Not Applicable

The tables of relative risk factors used to calculate surface water influence in the EPA Consensus Method for Microscopic Particulate Analysis are based on a limited set of data. These data are not representative of all aquifer types or well designs. Therefore, the relative risk values calculated from these tables are of limited value in determining health risks associated with surface water indicators.

*ASI advises that the risk rating be interpreted with caution, as it was developed by the US EPA from a relatively small set of data that may not be representative of conditions throughout the U.S.

**This EPA Risk Rating table classifies each sample according to the number of surface water indicating organisms per 100 gallons; however, it was possible to read only 25 gallons of this sample at a magnification of 100X, and 1.45 gallons at 400X. The relatively small volumes analyzed do not affect the validity of the results; however, decreased volume does decrease the sensitivity of the assay.

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MPA References

Berk, Sharon G., John H. Gunderson. Wastewater Organisms: A Color Atlas. Lewis Publishers. Boca Raton, Florida. 1993.

Fox, J. Carl, Paul R. Fitzgerald and Cecil Lue-Hing. Sewage Organisms: A Color Atlas. Lewis Publishers. Chelsea, Michigan. 1981.

Needham, James G., Paul R. Needham. A Guide to the Study of Fresh-water Biology. McGraw-Hill, Inc. New York. 1962.

Patterson, D.J., S. Hedley. Free-Living Freshwater Protozoa. CRC Press, Inc. Boca Raton, Florida. 1992.

Pennak, Robert W. Fresh-water Invertebrates of the United States. John Wiley and Sons, Inc. New York. 1989.

Prescott, G.W. How to Know the Freshwater Algae. Wm. C. Brown Company Publishers. Dubuque, Iowa. 1978.

Smith, E. Grant. Sampling and Identifying Allergenic Pollens and Molds. Blewstone Press. San Antonio, Texas. 1990.

Standard Methods for the Examination of Water and Wastewater. APHA, AWWA, and WEF, 20th Edition. American Public Health Association, Washington, D.C. 1998.

Thorp, James H., Alan P. Couich. Ecology and classification of North American Freshwater Invertebrates. Academic Press, Inc. San Diego, California. 1991.

USEPA. Consensus Method for Determining Groundwaters Under Direct Influence of Surface Water Using Microscopic Particulate Analysis. October, 1992.

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PHC Addendum Vol 2
Appendix Q

Canyon Fuel Company, LLC.
A Subsidiary of Bowie Resource Holdings, LLC

SKYLINE MINE
MEMORANDUM
Gregg A. Galecki
Environmental Engineer

Date: **August 26, 2016**

To: **M&RP PHC Addendum Vol. 2 – Appendix Q**

From: Gregg Galecki

Subject: **Numeric Groundwater Flow Model Update Overview**

The following is provided as a preface to Appendix R – Update of Groundwater Flow Model, Skyline Mine Project, July 1, 2016; prepared by SRK Consulting Inc., Denver, Colorado.

The purpose of the 2002-2004 groundwater modeling exercise was to determine whether all of the groundwater being encountered in the mine during that time could be sourced from the Star Point Sandstone. Although drawdown/inflow was actively occurring during the conceptual phase, the modeling exercise determined it was possible for all the inflow being encountered to be sourced from the underlying Star Point Sandstone. The results were considered non-unique based on limited 'pre-flow' water information for the steady-state calibration, and relatively short-term inflow and drawdown data for the transient calibration.

In 2015-16, SKR Consulting, the same personnel who created the 2002-2004 model (working for a different company, SRK), were given the direction to update the model with data collected through 2015. The continuity of the personnel was critical in updating the model. The update included re-calibrating to the new data to include the flooding of the mine and the current water levels in the Star Point Sandstone formation. The modeling conclusion suggest two (2) calibrations and a combination of the two sources may be the most likely scenario. The model also indicates, 'the source of the recharge and its mechanism is not clear.'

It is important to note that an ideal numeric groundwater model initially creates a 'pre-inflow' steady-state conceptual model based on a well-defined aquifer, then models the transient model based on drawdown (or inflow data). The geology of the Blackhawk Formation and the Star Point Sandstone do not conform to this scenario. A significant challenge includes the groundwater flow from the Star Point Sandstone which is significantly influenced by faults and fractures, while the overlying Blackhawk Formation is known to be laterally and vertically discontinuous with interbedded sandstone and low-permeability shales. Empirical data suggests the Star Point Sandstone transmits water that may originate a considerable distance from the vicinity of the mine, while the Blackhawk Formation has historically not produced sustained inflows into the mine from the roof. In the absence of a well-defined aquifer, both the initial and 2015-16 work needed to make assumptions on the permeability and flow patterns of these formations. Numerically, the hydrologic assumptions made in the initial work were also reasonably applicable in the 2015-16 model, however the conclusions for both models are not unique. This is evident in the SRK 2016 model as numerous scenarios were considered during the exercise, while only two were eventually considered as plausible scenarios that calibrated to the original assumptions.

The information provided in the theoretical numeric groundwater models are a valuable tool in trying to understand the complex hydrology in the Flat Canyon area, however they are not absolute in their conclusions.

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PHC Addendum Vol. 2

Appendix R

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Update of Groundwater Flow Model
Skyline Mine Project
Utah

Report Prepared for

Dorsey & Whitney LLP

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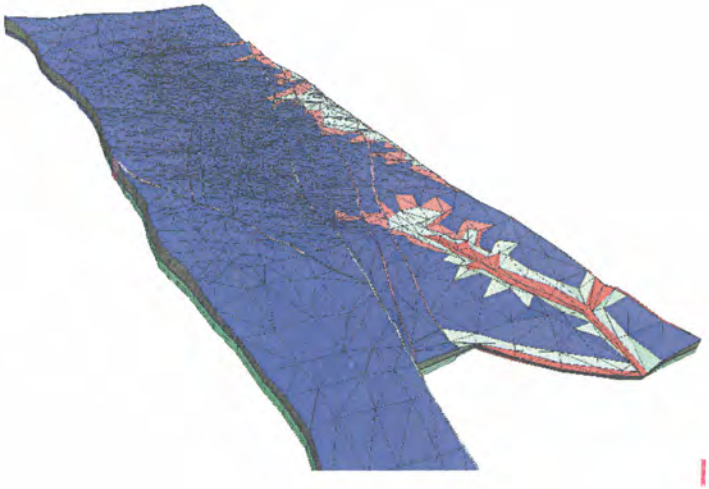

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Report Prepared by

srk consulting

SRK Consulting (U.S.), Inc.
SRK Project Number 480500.010
July 1, 2016

Update of Groundwater Flow Model
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List of Abbreviations

Abbreviation	Unit or Term
cfs	cubic feet per second
ft	foot (feet)
ft^2	square foot (feet)
gpm	gallons per minute
HSA	hydrologic study area
Kh	horizontal hydraulic conductivity
Kz	vertical hydraulic conductivity
LOB	Lower O'Connor B
UO	Upper O'Connor seam

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1 Introduction

Skyline Mine, operated by Canyon Fuel Company LLC (Canyon), is a longwall coal mine located in the northern Wasatch Plateau of central Utah. The mine began operations in the early 1980s. Large, persistent groundwater inflows were encountered in the Skyline Mine beginning in March 1999 (Figure 1). The total inflow rate to the mine from 8 major inflows reached a maximum of more than 10,000 gallons per minute (gpm) in April 2002, declined to less than 8,000 gpm by April 2003, when a comprehensive hydrogeological study was completed (HCI, 2003). Together with water chemistry, temperature, and inflow-decay data, the results of the 2003 Model suggested that the majority of water flowing into Skyline Mine workings was coming from a deep groundwater source (Starpoint Sandstones), rather than from Electric Lake, a reservoir lying above the mine workings.

1.1 Purpose of Current Study

The 2003 groundwater-flow model was based on relatively sparse water level information for a "pre-inflow" steady-state calibration, and on relatively short-term inflow and drawdown data for a transient calibration. The model results showed that it was possible for all inflows into the Skyline Mine to come from storage in the Starpoint sandstones. However, without water-level monitoring in the Starpoint, or recovery data post inflow, the model results were non-unique.

Beginning in 2004, total mine discharges were reduced, and pool elevations were allowed to rise in the underground workings. This partial recovery was reflected in the monitoring records of piezometers in the coal seams and underlying Storrs and Panther sandstones.

The current study was commissioned to update the groundwater model developed during 2001 through 2003 and recalibrate to new data, especially to recovery data related to mine flooding, and to new mining plans, as follows:

- The 2003 HCI model was converted from an older version of MINEDW to a new version of (MINEDW v. 2.11), which is commercially available;
- The time period for transient calibration was extended through the end of 2015;
- The input database of groundwater flows and water levels was updated through 2015;
- 2004 to 2015 mine plans were incorporated into the model; and
- Multi-variant model calibrations were completed for both pre-mining steady-state and mining (during 33 years) transient conditions.

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2 Hydrology of Skyline Mine and Vicinity

2.1 Surface Water and Meteorology

The hydrologic study area (HSA) is drained by three major streams:

- Fish Creek (including Gooseberry Creek), which drains the west side of the domain, flowing northward and then eastward into Scofield Reservoir.
- Mud Creek, which drains the eastern side of the domain, also flowing northward into Scofield Reservoir.
- Huntington Creek, including the Left Fork, which drains the center of the domain. The main fork of Huntington Creek flows southward through Electric Lake Reservoir.

Streamflows peak in May through June with spring runoff, and lowest flows occur in December and January. October mean flows, generally considered to represent baseflow in the western interior U.S., span wide ranges for all three major streams as a consequence of relatively wet autumns in the HSA.

Several reservoirs occur in the HSA, including Electric Lake, Huntington, Cleveland, and Lower Gooseberry Reservoirs, and Fairview Lakes (Figure 1). Miller Flats reservoir lies within the HSA, just southwest of Cleveland reservoir, but is not shown in Figure 1. At high water, Electric Lake covers about 430 acres. The remaining four reservoirs range in surface area (at high water) from about 40 to about 140 acres. Scofield Reservoir lies just outside the northeast boundary of the HSA.

Precipitation and evapotranspiration are treated more thoroughly in HCI (2003). Estimates of average annual precipitation range from 41 inch/year at an elevation of 10,000 feet (ft) to 18 inch/year at 7,800 ft near the town of Scofield. Precipitation is highest in November through March, and lowest in June through July.

2.2 Hydrogeology

The hydrostratigraphy of the study area is described in detail in HCI (2003). The general geologic units differentiated in the HSA, from shallowest to deepest, are:

- Overburden—the Blackhawk Formation shales and mudstones;
- Upper O'Connor and Lower O'Connor B (LOB) coal seams;
- Interburden between the coals and between the underlying sandstones;
- Storrs Sandstone, and Panther Sandstone;
- Starpoint Sandstone; and
- Mancos Shale.

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HCI (2003) describes each of the rock types, and provides estimates of hydraulic properties for each. Rock units are dominated by approximately 1,500 ft of Starpoint Formation sandstones and siltstones overlain by an equivalent thickness of shales and siltstones of the Blackhawk Formation. The Skyline Mine extracts coals at the boundary between these two major units. The Mancos shale is discretely represented only where it crops out in lower Huntington and Left Fork Canyons; elsewhere, it is implied as the basement to the groundwater flow system with a very low hydraulic conductivity.

Numerous faults of varying magnitude cut the rock units in the HSA, and are also described in detail in HCI (2003). The Gooseberry, Fish Creek, and Pleasant Valley Faults show displacements on the order of many hundreds to several thousand feet, and tend to influence the movement of groundwater by offsetting hydrogeologic units of significantly different hydraulic characteristics. Consequently, these model-bounding faults are assumed to prevent lateral groundwater flow, and are assumed to be no-flow boundaries. However, because of presumed brecciated zones associated with the faults, water can move vertically within the fault zones.

Small-displacement faults within the model domain include the West Mains, Gooseberry South, Diagonal, 16-Left, 14-Left, and 11-Left-a, 11-Left-b, and 11-Left-c Faults. All large, persistent groundwater inflows in the Skyline Mine to date (Figure 2) have been associated with these faults. The small-displacement faults are assigned low Kh values in their upper portions (within the Blackhawk overburden) and high Kh values (initially 1.0 ft/day) within the sandstone units below the LOB. The Diagonal Fault is assigned the highest Kh value.

2.3 Groundwater

Figure 1 shows the locations, and Table 1 lists coordinates, elevations, and screened intervals of all groundwater monitoring wells used in pre-mining simulations. Current shallow (Blackhawk overburden) groundwater level data are available from four monitoring wells (shaded in Table 1). In addition, records from shallow monitoring well 79-22-2-1 are available from 1982 through 1991.

Table 1. Monitoring Well Locations and Screen Intervals

Wells		Coordinates		Collar Elevation (ft NGVD)	Screen Depth (ft TOC)	Formation	Earliest Water Elev.		Notes
		X	Y				Date	ft (NGVD)	
Shallow	79-35-1b	2076685	480501.7	8722	180?	Blackhawk	Jul-82	8576	Burnout Canyon
	79-10-1b	2073288	499031.6	9383		Blackhawk	Jul-82	8955	Upper Huntington
	79-22-2-1	2074106	488723.5	9042		Blackhawk	Aug-83	8727	Kitchen
	79-26-1	2080363	483653.9	9019		Blackhawk	Jul-83	8964	Upper James Canyon
	79-14-2a	2080697	492230.3	9051.7		Blackhawk	Jul-83	8980	Upper Eccles Creek
Deep	79-35-1a	2076685	480501.7	8722	624	LOB	Jul-82	8572	Burnout Canyon
	98-2-1m	2078184	472145.3	9271	1251	LOB	Dec-99	8551	James Canyon
	79-14-2b	2080697	492230.3	9052	8356	LOA	Jun-86	8460	Upper Eccles Creek
	99-28-1	2069301	483077.8	9351	1890	Panther	Dec-99	8510	Swens Canyon
	99-21-1	2069643	487042.8	9348	1800	Panther	Dec-99	8421	Swens Canyon
	20-28-1	2067113	484342.8	8871	1463	LOB	Nov-00	8432	Swens Canyon
	79-22-2-2	2074106	488723.5	9042	7889	LOA/Panther	Oct-83	8596	Cascading water
	99-4-1	2066922	474560.8	8842	1302	LOB	Dec-99	8613	Boulger Canyon
	20-4-1	2066151	473228.6	8874	1560	Panther	Jan-01	8559	Boulger Canyon
	20-4-2	2066151	473228.6	9554	2080	Storrs	Jan-01	8532	Boulger Canyon
	91-26-1	2076925	513113.4	9217	1540-1600	Flat Canyon/Panther	Nov-91	7937	Woods Canyon
	91-35-1	2077062	507615.3	9224	1600-1660	Flat Canyon	Nov-91	8034	Woods/Winter Quarters
	80-13-1	2086154	491805.2	8480	314-1005	Starpoint	Sep-80	8360	Eccles Creek
	WQ-6	2083838	505568.3	8167	316-336	LOA/Aberdeen SS	Oct-80	8053	Winter Quarters
	WQ-8	2084810	505195	8121	106-126	LOA/Aberdeen SS	Nov-80	8058	Winter Quarters
	UtahFuel-7	2094137	492774.8	8080		Starpoint	recent	8045	Lower Eccles Creek
	JC-2	2077917	476521.7	8802	910-850	Storrs	Sep-01	8418	James Canyon

Note: All wells in table were used in steady-state calibration. Shaded wells used in transient calibration

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Historical deep groundwater level data are available from 17 monitoring wells (Table 1). At least half of the deep wells, however, were constructed after significant groundwater inflows had been encountered by mining, so that they are of limited use in determining a pre-mining potentiomentric surface. Eight of the seventeen provide recent water levels for the study.

Groundwater levels in monitoring wells indicate two continuous, but poorly connected groundwater systems in the vicinity of the Skyline Mine: a relatively shallow groundwater system in the Blackhawk Formation, and a deep aquifer system comprised of the Starpoint Sandstones and coals at the boundary between the Starpoint and Blackhawk Formations. Inflows to the mine and groundwater pumping since 1999 have resulted in drawdown of as much as 400 ft over a broad area in the deep aquifer, but they have not affected groundwater levels in the shallow groundwater system.

Pre-mining water-level data indicate that the potentiometric surface of the deep aquifer in the area of the mine had a regional gradient from south-southwest to north-northeast in the range of 0.03 to 0.009 ft/ft (Figure 5 in HCI, 2003). Most of the recharge to the deep aquifer probably occurs in the high country to the south of Huntington and Cleveland Reservoirs. Groundwater discharge is believed to occur in the vicinity of Scofield Reservoir, although direct evidence of the discharge has not been observed.

2.4 Mine Inflows

Beginning in 1999, mining on Level 2 (See Figure 2) encountered a number of large, persistent groundwater inflows related to a set of north- to northeast-trending normal faults of relatively small displacement. Initial discharges at individual locations might have been as large as 6,500 gpm, although discharges of about 1,000 gpm were more typical. The total mine inflow, which reached a peak of about 10,500 gpm in March 2002, decreased to about 7,500 gpm by March 2003, and to about 6,600 gpm by April 2004. Figure 2 shows the locations of the major inflows within the Level 2 mine workings, and Table 2 shows initial inflow rates and elevations of the individual occurrences. Inflow elevations ranged from about 8,000 ft to about 8,140 ft.

As described in HCI (2002), Pumping well JC-1 was completed into the Storrs sandstone beneath the 10-Left inflow in October 2001, in an attempt to reduce the rate of mine inflow. However, pumping at 4,000 gpm from JC-1 had only minor effects on the inflow rates in the mine.

Drawdown, coincident with the large mine inflows, has been observed in deep monitoring wells. Between 60 and 400 ft of drawdown was seen in coal piezometers, and between 110 and 165 ft of drawdown was seen in Panther and Storrs sandstone piezometers. No measurable drawdown was seen in overburden (Blackhawk) monitoring wells attributable to mining or to JC-1 pumping.

Mining has since been completed in most of Level 2, and beginning in January 2004, pumps were shut off and the water level in the mine workings allowed to rise. The pool level reached an elevation of approximately 8,290 ft by about August, 2004, when pumps again were used to maintain the level. The increase in head of about 150 ft to 300 ft resulted in a reduced inflow rate (as measured by the total discharge rate from the mine. By 2005, the mine-inflow rate had declined from over 6,000 gpm before the flooding to about 4,000 gpm. That rate by the end of 2015 had further declined to less than 2,000 gpm.

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Pumping well JC-1, through most of that period, has continued to pump at a fairly steady rate of 4,000 gpm. JC-1 was turned off for a short period in early in 2011, and again for an extended period in late 2011 and early 2012. During the shut-down periods, inflow rates in the mine increased measureably (Figure 3).

Groundwater levels within deep groundwater monitoring wells started to recover immediately after flooding of the mine. Recoveries have been only partial, and range from about 15 ft to over 135 ft. Water levels within shallow groundwater monitoring wells have been unchanged during both mining and mine flooding (Figure 4).

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3 Conceptual Model

HCI (2003) describes in detail the essential components of the conceptual model on which the original 2003 numerical groundwater flow model was based. The conceptual model includes eleven geologic units, all of which are included in the 2016 update. The hydrostratigraphic column is shown in Figure 5. No additional test work was done in 2016 to define hydraulic properties. Hydraulic conductivities of the hydrostratigraphic units and interior faults, shown in Tables 3 and 4 (Section 4), are based on the work described and results tabulated in HCI (2003), and on model calibration.

The conceptual model incorporates recharge to the groundwater system, including shallow-circulating groundwater that re-emerges in the surface-water system, and a much smaller component of deeply circulating groundwater. Recharge values are unchanged from the 2003 model. Because of the thick, low-permeability Blackhawk unit lying between surface recharge and the coal seams, meteoric recharge plays a very minor role in the deep groundwater flow. Perennial streams and reservoirs are represented explicitly, however, except where intersected by discrete faults, these too are of minor importance to the model.

Groundwater pumping (including mine inflows) is represented as abstractions of groundwater, based on pumping and discharge records. Historic mine workings and current mining plans are incorporated as bodies of high K and unit storage.

3.1 Model Boundaries

As in the 2003 Skyline numerical model, boundaries coincide with natural hydrologic features. On the east and west (Figure 6) the Pleasant Valley and Gooseberry Faults, respectively, bound the system. The northern boundary corresponds to the south fault of the Fish Creek graben, which lies in Fish Creek Canyon. The north, east, and west boundaries are assumed to be no-flow boundaries (i.e., there is no lateral inflow or outflow across them).

As described in HCI (2003), the southwestern model boundary is defined by a surface-water divide along the high ridge west of Joe's Valley and the divide below Paradise Creek Valley. It is assumed that the surface-water divide corresponds to a groundwater divide that also creates a no-flow groundwater condition. The southeastern model boundary follows the channel of Left Fork and is also assumed to be a no-flow boundary as a result of the Mancos shale (with very low hydraulic conductivity) being exposed in the creek bed along this reach.

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The Mancos shale constitutes a no-flow boundary at the bottom of the model.

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3.2 Sources of Mine Inflows

There are two potential sources for inflowing mine water: aquifer storage, and surface recharge. In 2003, HCI showed that the mine inflows (plus JC-1 pumping), could be fully accounted for, while balancing drawdowns in monitoring wells, by drawing on water from storage in the Storrs and underlying Starpoint Sandstones. The 2003 model could also be calibrated by drawing all inflows and pumping from Electric Lake. However, neither the lake scenario nor the sandstone scenario fully accounted for geochemical signatures in the inflowing water and in JC-1. HCI (2003) judged that about ten percent of the inflowing water originated from a modern (surface) source (Electric Lake for

convenience in their report – but possibly from a different surface source), while the remainder came from storage in the thick sandstone units.

The 2003 groundwater model was calibrated to inflow and water level data through the end of April, 2003. During that time, mine inflows were discharged to Eccles Canyon, and inflow rates remained high. Beginning in January, 2004, discharge from the mine was reduced, and the Mine #2 workings were allowed to flood. As the inflow rate decreased from about 6,000 gpm to about 4,000 gpm through the course of the year, the head in the mine workings rose as much as 300 ft, locally. Coal and sandstone piezometers showed a corresponding (in time) recovery of water levels.

In this study, a preliminary attempt to extend the calibration of the 2003 HCI model to the lower discharge rates and the rising heads, making no other changes, failed to simulate the water-level recovery in the sandstone and coal piezometers. An evaluation of model inputs determined that high storage values had been assigned to the Starpoint and Storrs Sandstones in the 2003 model (up to 10 times higher than literature values), and these resulted in the good matches obtained between simulated and measured inflows and drawdowns. Further analysis showed that the same high storage values, when used in the 2016 extended calibration, prevented the simulation of recovery in the coal and sandstone piezometers. The calibration effort showed that recovery of groundwater levels, as seen in coal and sandstone monitoring wells, can be reproduced by the model only if a significantly larger portion of the total inflows (including JC-1 pumping) comes from a source other than storage.

Other constraints on a source of the water in the mine inflows and JC-1 pumping include:

- Elevation constraints. Original mine inflow elevations range from 7,985 to 8,140 ft amsl, and at least some inflow continues at heads of about 8,290 ft. Sources of inflow, therefore, would have to be at higher potential than 8,290 ft amsl. Electric Lake average stage is at an elevation of about 8,560 ft. Conversely, the lower portions of Fish Creek lie below 7,700 ft amsl. Most of the country southwest from the mine lies at elevations higher than Electric Lake.
- Geochemical constraints. The groundwater flowing into the mine workings contains a limited concentration of tritium – consistent with about 20 to 25 percent of the water being of a recent (surface) source. Groundwater flowing into the JC-1 pumping well contains about fifty percent modern water, by tritium concentration. JC-1 appears to be somewhat more connected to a nearby surface source than are the fracture-localized inflows in the mine. Carbon-14 data suggest similar mixtures of modern water versus older water in the inflows and pumping discharge. The data together show that only a portion of the mine inflows can originate from a nearby surface source. However, a larger distal surface-water source could recharge the sandstone aquifer, without direct flow into the mine workings.
- Drawdown constraints: Not all of the water can come from a surface source; a major component still must come from storage, or piezometer water-levels would quickly level out, and inflow rates would not decline in time (e.g., from 2004 to 2015 in Figure 3).

3.3 Conceptual Model Scenarios

For the 2016 update, SRK has evaluated two possible scenarios to account for inflowing groundwater:

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- Scenario 1: A source of water originating from the South Gooseberry Fault at its connection with the North Gooseberry Fault (see Figure 6), and a source from Electric Lake connected via the Diagonal Fault primarily to JC-1, plus storage in the sandstones.
- Scenario 2: A source of surface water originating from two points along the South Gooseberry Fault plus groundwater from storage in the sandstones; no direct connection to Electric Lake.

Two scenarios that are not included among numerous possible conceptual models include 3) all water coming from storage, and 4) storage plus all surface water originating from Electric lake. As described above, the storage-only scenario fails to reproduce the observed recovery of water levels when the mine floods, and the Electric Lake-only scenario would introduce maximum concentrations of modern water (tritium concentrations) which are not seen in the sampling results.

In Scenario 1, above, the South Gooseberry fault provides simulated recharge to the sandstones, which in turn provide water to the mine-inflows. The diagonal fault supplies some mine inflow, but mostly contributes to JC-1 pumping. The diagonal fault originally (2003 model) connected the lake through the Blackhawk and down into the Panther and Storrs sandstones only, and thereby simulated water flow to the fracture zones in the mine and into JC-1 pumping well, but provided little recharge to the Starpoint. For the 2016 model, the connection was extended down into the Starpoint Sandstone, so that inflowing water could recharge that aquifer as well.

In Scenario 2, sources of water are simulated at both the northwest and southeast ends of the south Gooseberry fault, where elevations are significantly higher than the mine inflow points. At both actual locations, the fault projects under stream valleys, but no standing water (i.e., no lakes) occur. The water entering the Gooseberry Fault in the simulations is not connected directly to the mine workings, but rather, recharges the sandstone units, and thereby flows to the connecting fracture zones.

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4 Description of Numerical Model

4.1 Numerical Code Used in Study

In this report the term "code" or "numerical code" is used to refer to a computer program that solves a system of equations that describe a groundwater flow problem. The term "model" or "numerical model" refers to a specific combination of a code, a finite-element mesh, hydrologic data, and boundary conditions that describe a specific set of site conditions. The term "numerical model" should not be confused with the previously described "conceptual hydrogeologic model" which is a qualitative description of the physical groundwater flow system simulated by the numerical model.

The numerical modeling described in this report utilizes the numerical code *MINEDW*, which solves three-dimensional groundwater flow problems with an unconfined, or phreatic, surface using the finite element method (HCI, 1993). This code has been commercially available since 2012; SRK used version 2.10 for this study (Itasca Denver, 2012).

4.2 Model Grid and Discretization

The current Skyline model domain encompasses approximately 140 mi^2, and the finite-element mesh contains 33,642 nodes and 60,931 elements within 13 layers (Figures 6 through 10). The grid is most finely discretized in the area of the existing mine and Electrical Lake, in order to:

- Refine numerical solutions of hydraulic heads and flows near the area of flow convergence; and
- More reasonably represent the geometry of the mine, location of the major groundwater inflows, and the location of pumping well JC-1.

The finite-element grid has also been discretized to incorporate the key hydrogeologic features of the HSA, including the sandstone outcrops near the eastern boundary of the model, the location and orientation of faults (Figure 6), and various surface-water bodies. In the detailed mine area, the minimum horizontal dimension of an element is in the range of 600 to 800 ft (Figures 6 through 8), and the thickness of layers ranges between approximately 10 and 900 ft (Figures 9 and 10).

4.3 Model Boundaries

All of the model boundaries are assumed to be no-flow boundaries (Figure 6) as defined by:

- The trace of the Gooseberry fault to the west. This fault zone is not explicitly incorporated into the model because of the offset in the Starpoint sandstone in that area. The sandstone is the only unit that presumably would impart any significant hydraulic conductivity to the fault zone.
- The Pleasant Valley fault to the east.
- The southernmost Fish Creek fault to the north.
- A topographic divide to the southwest.
- The Left Fork of Huntington Creek to the southeast.

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Although all of the above are no-flow boundaries in terms of lateral flow, both the Pleasant Valley and Fish Creek faults are incorporated into the model as specific zones of enhanced vertical hydraulic conductivity that enable discharge from the deep aquifer system to the streams. Even though Fish

Creek and the Left Fork of Huntington Creek coincide with no-flow boundaries, the streams themselves were simulated as drain nodes within the first layer of the model, which enables groundwater discharge (described below).

The model is constructed such that all groundwater within the model domain is generated by recharge from precipitation. Most of the recharge discharges back into the streams through the uppermost (assumed to be 150-ft thick) permeable portion of the Blackhawk Formation or sandstone layers where they crop out at the ground surface. A small portion of the recharge reaches the deep aquifer system, especially at the southwestern part of the model, where:

- The upper Starpoint sandstone is relatively close to the ground surface; and
- Recharge from precipitation is relatively large due to high surface elevations.

Groundwater within the deep system flows from south to north between the Gooseberry and Connelville faults (where it is tight) and between the Gooseberry and O'Conner faults where the Connelville fault is more open. The deep groundwater system then discharges at the north-northeastern boundary where the Starpoint Sandstone is relatively close to the ground surface and there is a zone of enhanced vertical hydraulic conductivity associated with the Fish Creek and Pleasant Valley faults.

The bottom of the model is defined as the contact between the Starpoint Sandstone and the Mancos Shale with the exception of the bottom of Huntington and Left Fork Canyons, where the Mancos Shale is exposed at ground surface. This bottom boundary is defined as a no-flow boundary throughout the entire model domain.

4.4 Simulation of Hydrogeological Features

4.4.1 Simulation of Hydrogeology

In the finite-element method, hydraulic properties are assigned to elements; and hydraulic heads and fluxes are associated with nodes. Therefore, every element in the model is assigned to a model "zone" with specified values for horizontal (K_h) and vertical (K_z) hydraulic conductivity, specific storage, and specific yield (which is only utilized if the element contains the water table).

Eleven major geologic units are differentiated in the HSA, based on the original work by HCI (2003). From shallowest to deepest, they are:

- Overburden;
- Upper O'Connor seam (UO);
- Interburden 1;
- Lower O'Connor B seam (LOB);
- Interburden 2;
- Storrs Sandstone;
- Interburden 3;
- Panther Sandstone;
- Interburden 4;
- Starpoint Sandstone; and
- Mancos Shale.

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The Mancos shale is discretely represented only where it crops out in lower Huntington and Left Fork Canyons; elsewhere, it is implied as the basement to the groundwater flow system with a very low hydraulic conductivity. Furthermore, the overburden and Starpoint units are divided into multiple layers in the model. Two units from the list above were further subdivided (overburden – upper and lower parts and Starpoint Sandstone – within N-S and E-W fractures). Consequently, the model incorporates a total of 13 layers. Finally, an additional unit—Gob (above UO and LOB)—was added for predictive simulations.

There are 38 zones with different hydraulic parameters -- 14 for hydrogeologic units and 24 for faults -- incorporated into the model. The various hydrogeologic zones are shown in map view (for the uppermost layer) and in Layer 12 (Figure 8) and in east-west and north-south cross-sections (Figures 9 through 10), respectively.

The hydraulic properties of the various hydrogeologic units in the model are summarized in Table 3.

Table 3: Hydraulic Properties of Hydrostratigraphic Units Simulated in Groundwater Model

Hydrogeologic Unit		Hydraulic Conductivity (ft/day)		Specific Storage (ft^{-1})	Specific Yield ( )
		K_h	K_z		
Overburden[1]	upper part[2]	1	1		0.05
	lower part	0.001	0.0004		0.05
Upper O'Connor (UO) coal [3]		1	1		0.05
Interburden #1[4]		0.001	0.0004		0.05
Lower O'Connor B (LOB) coal		1	1		0.05
Interburden #2		0.001	0.0001		0.05
Storrs		1	1	0.000003	0.1
Interburden #3		0.001	0.0001		0.05
Panther		1	1		0.1
Interburden #4		0.001	0.0001		0.05
Starpoint	within N-S Fractures	2	0.2		0.01
	within E-W Fractures	0.75	0.075		0.01
Mancos Shale [5]		0.001	0.0001		0.05
Gob (above UO and LOB)[6]		0.01	0.004	0.00003	0.1

Notes:
(1) Includes all stratigraphic units above UO coal or LOB coal in area where UO does not exist
(2) Includes first 100 ft of weathered rock below the ground surface.
(3) Has limited distribution in the model between Diagonal and Connelville faults.
(4) Located in the model below UO only.
(5) Located in the model in area where it is exposed at the ground surface.
(6) Zone of subsidence-induced increase in hydraulic conductivity is assumed to extend 100 ft (about 8 times thickness of LOB) above coal, to have a hydraulic conductivity 10 times greater than lower part of overburden.

Some of the hydrogeologic units (e.g., the coals and the Storrs and Panther sandstones) are considered to be isotropic (i.e., $K_h = K_z$), but most of the sedimentary units have been made anisotropic with the general relationship $K_h > K_z$. This horizontal-to-vertical anisotropy is used to represent the effects of the interlayering of materials of higher and lower hydraulic conductivity.

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4.4.2 Simulation of Faults

Twelve faults are incorporated into the model (Figure 6) as discrete zones ranging from 100 to 400 ft wide:

- Diagonal;
- 14-Left;
- 16-Left;
- Flat Canyon #1;
- Flat Canyon #2;
- Connelville (northern and southern portions);
- O'Connor (northern and southern portions);
- Valentine;
- Gooseberry South;
- Fish Creek;
- Pleasant Valley; and
- West Mains.

The fault elements adjacent to the overburden and any other materials above the LOB seam—referred to as the "upper part"—are simulated with a very low hydraulic conductivity, with the general isotropic relationship of: 10 Kh = Kz. The Fish Creek and Pleasant Valley faults, however, are open within the overburden, thus allowing groundwater at the northern boundary to discharge to Fish Creek and tributaries of Mud Creek. The fault elements adjacent to all units below the top of the LOB seam (the coal, the interburden, and the sandstones—referred to as the "lower part" —are simulated differently depending on the magnitude of displacement on the fault. The intermediate-displacement faults within the model domain are simulated with very low hydraulic conductivities in both the upper and lower parts. However, the small-displacement faults within the model domain are assumed to be highly conductive where they cut relatively brittle sandstone and coal (lower part), but essentially non-conductive where they cut more plastic, fine-grained sedimentary units. The hydraulic properties of the various faults simulated in the model are summarized in Table 4.

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Table 4: Hydraulic Properties of Faults Simulated in Groundwater Model

Simulated Faults			How Simulated in Model	Hydraulic Conductivity (ft/d)		Specific Storage (1/ft)	Specific Yield ()
				Kh	Kz		
Large-Displacement	Gooseberry (main)		not explicitly included in model: trace defines no-flow boundary				
	Fish Creek	upper	ELM	1	1	3.E-06	0.005
		lower		10	10		
	Pleasant Valley	upper		0.001	1		
		lower		1	1		
Intermediate-Displacement	Connelville (North)	upper	ELM	0.001	0.01	3.E-06	0.005
		lower		1	1		
	Connelville (South)	upper		0.001	0.01		
		lower		0.001	0.01		
	O'Connor (North)	upper		0.001	0.01		
		lower		0.001	0.01		
	O'Connor (South)	upper		0.001	0.01		
		lower		1	1		
	Valentine	upper		0.001	0.01		
		lower		0.001	0.01		
Small- Displacement	Diagonal	upper	ELM	0.001	0.01	3.E-06	0.005
		lower		10	10		
	Diagonal between Lake and JC1 only (Scenario 1)			100	100		
	Gooseberry South	upper		100	100		
		lower		2	100		
	14-Left	upper		0.001	0.01		
		lower		1	1		
	16-Left	upper		0.001	0.01		
		lower		1	1		
	West Mains	upper		0.001	0.01		
		lower		1	1		
	Flat Canyon #1	upper		0.001	0.01		
		lower		1	1		
	Flat Canyon #2	upper		0.001	0.01		
		lower		1	1		
	11-Left-24	upper		0.001	0.01		
		lower		1	1		
	11-Left-40	upper		0.001	0.01		
		lower		1	1		
	11-Left-SU	upper		0.001	0.01		
		lower		1	1		
	10-Left	lower	Fault LINK (horizontal and vertical)				
	11-Left-24	lower	Fault LINK (vertical)				
	11-Left-40	lower					
	11-Left-SU	lower					
	14-Left	lower					
	16-Left	lower					
	East Mains	lower					
	Diagonal	lower					

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The 10-Left fault, which produces the largest inflow where it is intersected in the LOB, is possibly a splay of the Diagonal fault; but in any case, it is not well-defined hydrogeologically. This fault appears to be relatively well connected to the Diagonal Fault further to the south along the fault plane (based on the response of piezometer 9-Left corehole), but not so to the Diagonal Fault immediately to the west, laterally through the Storrs and Panther Formations. This complex stratigraphic/structural relationship is further demonstrated by the fact that pumping from well JC-1, which is completed into the Storrs Sandstone within or immediately adjacent to the Diagonal Fault, has not had a major effect on reducing the inflow at 10-Left. These conditions were simulated in the model using the *FAULT* subroutine of *MINEDW* that links individual nodes with a high transmissivity. In this case, the five nodes simulating the LOB along the 10-Left fault were "fault-linked" vertically to the underlying Starpoint sandstones, and then five vertical columns were linked horizontally between each other and to the Diagonal fault to the south.

Fault linking was also used to simulate the seven inflows at 11-Left-x24, 11-Left-x40, 11-Left-SU, East Mains, Diagonal, 14-Left, and 16-Left by a single node column.

4.4.3 Simulation of Recharge

Recharge to the groundwater system from precipitation was applied to each element on the top layer of the model by using the empirical relationship between recharge and surface elevation shown below:

$$R = (0.00045 \cdot z) - 3.66 \quad (1)$$

where:

R = long-term average annual recharge to groundwater (ft/year), and

z = average elevation of land surface (ft, NGVD).

In both the steady-state and transient modes, long-term average precipitation was simulated (i.e., precipitation was not varied with time to reflect either seasonal or longer-term variations).

4.4.4 Simulation of Surface-Water Bodies

Streams and springs in the HSA are simulated using drain nodes along the courses of the streams with discharge calculated from the relationships:

$$Q = C_L (H_s - H_c) \quad if\ H_c > H_s \quad (2a)$$

or

$$Q = 0 \quad if\ H_c \leq H_s \quad (2b)$$

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where:

Q = groundwater discharge to the stream or spring (cubic feet per second (cfs)),

H_S = specified elevation of stream (ft),

H_C = model-calculated elevation of water table (ft), and

C_L = leakance factor for the stream/spring node (ft^2/s).

The model incorporated 488 drain nodes to simulate Fish Creek, Mud Creek and Huntington Creek, and their numerous tributaries. Another 31 drain nodes were incorporated into the model to simulate springs along the Starpoint Sandstone/Mancos Shale contact along Huntington and Left Fork Creeks in the areas where the Mancos Shale crops out at the ground surface.

The drain nodes for both the streams and springs were assigned elevations based on the USGS topographic maps of the area. The fluxes from these drain nodes (calculated by either Equation 2a or 2b) are then summed to obtain a value for groundwater discharges to the various streams that can be compared to the measured baseflow data. As indicated in Equation 2b, the drain nodes representing streams and springs, which can only discharge from the groundwater system, are "turned off" when the calculated water table falls below their specified elevation.

Electric Lake is simulated in the model with constant-head nodes. The use of constant-head nodes instead of drain nodes allows the lake to gain groundwater if the calculated water table in the adjacent formations exceeds the lake elevation and to lose water if the water table is below the lake elevation. Electric Lake was simulated with 57 such constant-head nodes with a long-term average lake stage of 8,560 ft amsl.

4.5 Simulation of Mining

Groundwater inflow induced by mining is simulated by assigning drain nodes characteristics to the nodes representing the bottom of the coal seam (either the UO or LOB) in the area being mined and simulating groundwater discharge by using Equations 2a and 2b. Each drain node has a leakance factor calculated by:

$$C_L = \frac{K_m \cdot L \cdot w}{b} \quad (3)$$

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where:

K_m = hydraulic conductivity of material (ft/day);

L = dimension of element (ft);

w = width of area (ft); and

b = thickness of "membrane" (ft).

The value of K_m is an input value, L is a function of the grid discretization, and w/b (the so-called "connectivity factor") is a value obtained through transient calibration. Development of the three mining areas since 1982 was incorporated into the model with 652 such drain nodes. The calibrated connectivity factor for the mining nodes was 0.003.

In the numerical simulations longwall operations were simulated in addition to turning on drain nodes. Open voids and fracturing due to mining were simulated by increasing of the hydraulic conductivity values as follows:

- From 1 ft/day to 3,000ft/day within 15-ft coal seam; and
- By factor of 10 within the approximately 100-ft thick subsidence zone above a mined panel.

The longwall operations are represented by 1,096 elements in the model (half for excavated coal seam and half for subsidence zone above) and are simulated on a yearly basis according to the provided mine plans. The simulated Mine Plan through end of 2015 is shown in Figure 13.

4.6 Simulation of Pumping and Major Groundwater Inflows

Pumping from well JC-1 is simulated explicitly in the model by a pumping node located on the Diagonal Fault in the Panther Sandstone layer. It should be noted that JC-1 was actually completed into the Storrs Sandstone within or immediately adjacent to the Diagonal Fault. In the model, the very large hydraulic conductivity (10 ft/day) in the fault zone puts the Storrs and Panther sandstones in direct hydraulic connection. Therefore, the pumping node has been assigned to the lower Panther Sandstone interval). During the predictive runs, the pumping node is converted to a constant head node when the calculated water level reaches the elevation of the top of the Panther sandstone. This numerical approach enables the reduction in the pumping rate of JC-1 due to dewatering of the deep groundwater system to be replicated.

Well JC-2 was not incorporated into the model due to its insignificant pumping rate and short period of operation. Pumping from JC-3, which is simply removing water that has already flowed into the flooded underground workings in the 10-Left areas, has no significant effect on the calculations of groundwater inflow. Consequently JC-3 is also not simulated in the model.

The major groundwater inflows are all explicitly simulated by specific drain nodes along the appropriate faults incorporated into the model (Figure 13). The East Mains, 11-Left-x24, 11-Left-x40, and 11-Left-SU inflows were simulated as discharges from four localized and separate faults that were incorporated into the model by single columns of "fault-linked" nodes with high transmissivity hydraulically connecting the LOB coal with Starpoint Sandstones. The calibrated connectivity factors (described by Equation 4) for each of these drain nodes are summarized in the Table 5, below:

Table 5. Mine Inflow Connectivity Factors

Inflow	Connectivity Factor
14-Left	incrementally decreased from 0.9 to 0.5
16-Left	incrementally decreased from 0.4 to 0.3
Diagonal	incrementally decreased from 0.4 to 0.3
10-Left	100
East Mains	0.5
11-Left-x24	0.6
11-Left-x40	0.9
11-Left-SU	0.7

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It should be noted that to replicate the 14-Left and 16-Left inflows, their connectivity factors were slightly decreased in time. The East Mains, 11-Left-x24, 11-Left-x40, and 11-Left-SU inflows were replicated reasonably well using constant connectivity factors.

To replicate the largest groundwater inflow, the 10-L inflow, the leakance factor defined by Equation 4 was slightly modified to:

$$C'_L = \frac{C_L}{\sqrt{\Delta h}} \quad (4)$$

Where:

C_L = leakance factor from Equation 3, and

Δh = magnitude of change in hydraulic head dynamically calculated by model.

Equation 4 is valid for large groundwater flows that are "throttled" by either non-Darcian flow or by convergence of flow to a small diameter drainhole or fracture that intersects this flow (Azrag et al., 1998). The model-calculated discharge at 10-Left was calibrated to the measured inflow by using Equation 4 with a connectivity factor of 100.

4.7 Simulation of Mine Flooding

Flooding in Level 2 Mine (starting at the end of 2002) was simulated by modifying drain nodes representing the flooded portion of the mine with groundwater discharges:

$$Q = C_L \left(H_c - H_s\right) \quad (5)$$

where:

Q = groundwater discharge to the node (cfs);

H_S = specified elevation of node equal to pool level for the flooded portion of the mine (ft);

H_C = model-calculated elevation of water leve (ft); and

C_L = leakance factor for node (ft^2/s).

The specified head (H_s) for each drain node within the flooded portion of the mine was changed from the original underground elevation to the elevations of different pool levels at the respective times described below:

Date	Pool Level, ft
January 2003	8,100
April 2004	8,130

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August 2004	8,230
September 2004	8,250
January 2005	8,290

Leakance factors, which had been derived from calibration to measured inflow before the flooding were left unchanged. The total number of drain nodes used to simulate the flooded portion of Level 2 Mine is 94.

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5 Model Calibration

The model was calibrated first to steady-state (pre-mining) conditions and then to transient (i.e., time dependent) conditions observed during mining. The steady-state calibration consisted of adjusting the model input data, primarily the recharge and hydraulic conductivity values, until the calculated groundwater elevations and groundwater discharges to streams reasonably replicated the known or assumed conditions prior to any major mining or pumping stresses. The water levels or hydraulic heads calculated in the steady-state calibration were then used as the initial heads for the subsequent transient calibration. During the transient calibration, the values of the model input data (especially the storage and hydraulic conductivity values) were then further refined until predicted water-level changes reasonably replicated measured water level changes resulting from the hydraulic stresses (e.g., pumping, mine inflows).

5.1 Steady-State Calibration

For the steady-state calibration of the model, the elevation-dependent long-term average recharge (described in Section 3.0) was applied to all nodes at the top of the uppermost layer in the model. The primary criterion for steady-state calibration was the matching of modeled pre-mining water levels to measured values, and matching stream baseflows to measured or estimated values. Since there were no pre-mining measurements of water levels in much of the HSA, the more general criterion for steady-state calibration in much of the HSA was that the calculated water table should be below ground surface. The hydraulic properties of the thin uppermost layer were adjusted until these criteria were met. Figure 11 shows a comparison of modeled to limited measured pre-mining water levels in shallow and deep monitoring wells for Scenarios 1 and 2. Figure 12 shows simulated pre-mining water levels in Upper Starpoint Formation (Layer 12) and the direction of groundwater flow for both simulated scenarios.

It should be noted that the hydraulic conductivity of the thin surface layer and the recharge comprise a non-unique combination to replicate the water table elevations and the baseflows of the various streams and springs. In the conceptual model, the thin uppermost layer represents a near-surface zone of weathered and broken rock whose thickness and hydraulic properties have not been measured and, even if they were, would be highly variable. The assumed hydraulic conductivity is then "coupled" with the assumed recharge to produce reasonable water levels and baseflows. SRK believes that the combination of hydraulic conductivity of the near-surface zone and recharge used in this investigation is reasonable.

An estimate of the recharge factor to the deep aquifer system was obtained during calibration of the model by varying the vertical hydraulic conductivity of the Blackhawk Formation layers in the model. Model simulations were run until measured average streamflows in each sub-basin were matched. The resulting vertical hydraulic conductivity of the upper model layers were used in all further modeling to ensure reasonable recharge to the deep groundwater system. The steady-state calibration also included adjusting the hydraulic properties of the sandstone units and the faults until a reasonable representation of deep groundwater levels and hydraulic gradients was obtained. The model-calculated pre-mining water levels in the upper Starpoint Formation derived by the steady-state calibration are shown in Figure 12.

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The water budget, alternatively referred to as the water balance or hydrologic budget, for the entire model domain at any instant in time can be described by the relationship:

$$I + R - Et \pm SW - O \pm \Delta S \approx 0 \quad (6)$$

where:

I = groundwater inflow,

R = recharge to groundwater system,

SW = *net surface-water flow to/from groundwater system,*

O = groundwater outflow, and

ΔS = change in groundwater storage.

The recharge (R) is assumed to be the remainder of precipitation less evapotranspiration and runoff. In the case of steady-state flow, ΔS is equal to zero. The values for the various components of the water budget obtained during the average, long-term, pre-mining ("steady-state") calibration of the Skyline model are shown in Table 6 for both evaluated scenarios.

Table 6: Simulated Groundwater Budget for Pre-Mining Conditions

Inflow (cfs)	Scenario 1	Scenario 2	Outfow (cfs)	Scenario 1	Scenario 2
Recharge from Precipitation	54.63	54.63	GW Boundary Outflow	0	0
GW Boundary Inflow	0	0	GW Discharge to SW		
Recharge to GW from Electric Lake	0.05	0.05	a) Mud Creek	13.70	13.68
SW Recharge through S Gooseberry Fault	2.05	0.81	b) Fish Creek	7.98	8.00
GW Storage	0	0	c) Huntington Creek/Electric Lake	19.89	18.76
			d) Left Fork of Huntington Creek	15.16	15.05
			Sub Total	56.73	55.49
Total	**56.73**	**55.49**	**Total**	**56.73**	**55.49**

Table 7 is a comparison of modeled vs. measured and estimated stream baseflows.

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Table 7: Gaged and Estimated Baseflows vs. Modeled Discharge to Streams

Stream Gage Location	Mean Elevation[1] Total Drainage	Approximate Area Modeled (acres)	Gaged BaseFlow Total Drainage (cfs)	Estimated Shallow Recharge[2] Modeled Drainage (cfs)	Simulated Discharge to Drainage - Including Springs (cfs)	
					Scenario 1	Scenario 2
Fish Creek above Reservoir	8,500	27,712	11.49	6.6	7.98	8.00
Boardinghouse Creek at mouth	9,200	1,300	1.18		1.61	1.65
Eccles Canyon near Scofield, UT	9,000	3,520	1.80		3.73	3.76
Winter Quarters Canyon	8,900	4,000		1.9	5.55	5.57
Woods Canyon	8,800	3,100		1.3	1.88	1.88
Green Canyon	8,800	1,300		0.6	0.74	0.74
Mud Creek below Winter Quarters	8,400	18,624	7.33		13.70	13.68
Mud Creek excluding Eccles, Green, Woods, and Winter Quarters	9,000	3,900		2.1	2.54	3.61
Huntington above Dam			13.0[3]		10.24	9.04
Huntington below Dam, above Left Fork	9,100	10,240		6.3	9.65	9.65
Total Huntington Drainage				19.3	19.89	18.76
Left Fork	9,200	26,000		17.5	15.16	15.05

Notes:
(1) Average elevation of drainages estimated from USGS topographic maps.
(2) Baseflow estimated from recharge (ft/year) based on: R = 0.00045 - 3.66
(3) Average October-January discharge from dam, 1971 to 2002

The volume of simulated groundwater discharge to surface streams cannot easily be calibrated to gaged baseflow of the streams. For example, the model-calculated value for Fish Creek of 8 cfs does not compare well with the long-term average measured value of 11.5 cfs until it is recognized that only about half of the Fish Creek drainage is represented in the model. Furthermore, the value for all of Huntington Creek as far as the Left Fork confluence (19 to 20 cfs) and the value for Left Fork (15 cfs) cannot be directly calibrated because reservoir operations make it impossible to gage baseflow in those streams. Based on the size and elevations of the two large basins and on long-term average October discharge from Electric Lake, the values in Table 7 appear to be reasonable.

The discharge to Mud Creek (13.7 cfs) calculated during steady-state calibration of the model also initially appears to be a poor replication. The baseflow of Mud Creek below Winter Quarters is only 7.3 cfs, but only about 80 percent of the drainage is represented in the model. The source of the large simulated discharge to Mud Creek is the deep aquifer system, discharging at outcrops of the Starpoint Sandstone and faults in lower Eccles Creek (3.7 cfs vs. a gaged 1.8 cfs), Winter Quarters Canyon (5.6 cfs vs. an estimated 1.9 cfs), and Woods and Green Canyons (2.6 cfs, combined, vs. an estimated 1.9 cfs). The model simulates discharge of deep groundwater into these drainages as a result of fault-defined no-flow boundaries and the very simplified near-surface occurrences of the Starpoint Sandstone units. In reality, the structure and stratigraphy are much more complicated around Scofield Reservoir; and deep groundwater discharge is probably much more diffuse than can be simulated in a model. When the anomalous flows to Woods, Green, Eccles and Winter Quarters Creeks are factored out (Table 7), the remaining modeled discharges to Mud Creek calibrates well to the estimated and gaged baseflows.

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Results of the steady state calibration (Figure 11) indicate that the model can be calibrated to both scenarios equally.

5.2 Transient Calibration

The goal of the transient calibration was to replicate the existing data on historic water level changes and mine inflows. For this step of the calibration, the average recharge was again applied to all elements at the nodes at the top of the uppermost layer in the model. During the calibration process, the hydraulic properties of the various hydrogeologic units, the transmissivity of the various faults, and the connectivity factors for the drain nodes were adjusted until a reasonable representation of groundwater inflows and water levels was obtained.

A comparison of the results of the transient calibration of the model to the measured inflows to the Skyline Mine is shown in Figures 14 through 17. Figures 14 and 15 show that both scenarios reasonably replicate the mine inflow rates, with scenario 2 slightly lower than measured. The source of the inflow and pumping discharge is different in the two scenarios, as shown in Figures 16 and 17. Scenario 1, which simulates a surface source at Electric Lake, also draws much more groundwater from storage than does Scenario 2, which simulates surface recharge from Gooseberry fault.

Figures 18 through 19 provide a comparison of calibrated to measured water level changes in the various monitoring wells and piezometers. The results show that the two scenarios result in simulated water levels about equally-well matched to measured water levels.

SRK believes this transient calibration reasonably matches the measured and computed groundwater flows and water level changes in the model area. Table 8 includes the values of the simulated groundwater budget for mining conditions as of December 31, 2015 for both Scenarios 1 and 2.

Table 8: Simulated Groundwater Budget for Current Mining Conditions (December 31, 2015)

Inflow (cfs)	Scenario 1	Scenario 2	Outfow (cfs)	Scenario 1	Scenario 2
Recharge from Precipitation	54.63	54.63	GW Boundary Outflow	0	0
GW Boundary Inflow	0	0	GW Discharge to SW		
Recharge to GW from Electric Lake	3.95	0.15	a) Mud Creek	11.65	11.72
SW Recharge through S Gooseberry Fault	5.67	8.94	b) Fish Creek	7.42	7.42
GW Storage	3.39	3.47	c) Huntington Creek/Electric Lake	17.00	17.88
			d) Left Fork of Huntington Creek	15.72	14.77
			Sub Total	51.78	51.79
			Pumping from JC-1	9.25	9.25
			Mine Inflow	6.61	6.15
Total	**67.64**	**67.19**	**Total**	**67.64**	**67.19**

The comparison of groundwater discharges to streams calculated during the transient calibration to gaged stream baseflows were similar and have the same limitations as described above for the steady-state calibration.

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Figures 20 and 21 show the model-calculated groundwater levels and drawdowns, respectively, in the upper Starpoint Formation (model layer 12, Figure 8) as of end of December 2015 for both simulated scenarios.

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6 Conclusions

- Groundwater inflows to the Skyline mine, beginning in 1999, reached a peak of about 10,500 gpm in March 2002. The inflows decreased to about 7,500 gpm by March 2003, and to about 6,600 gpm by April 2004. Pumping well JC-1 was completed into the Storrs Sandstone beneath the mine in October 2001, in an attempt to reduce the rate of mine inflow. However, pumping at 4,000 gpm from JC-1 had only minor effects on the inflow rates in the mine.
- Beginning in 2004, portions of the Skyline Mine were allowed to flood, thus raising the hydraulic heads and decreasing inflow rates; discharge from the JC-1 pumping well was held constant for most of the time since 2004. The total groundwater withdrawal (inflows plus pumping) has decreased from about 8,000 gpm in 2004 to about 6,000 gpm in 2015. The total includes 4,000 gpm pumped from JC-1, and just 2,000 gpm from mine inflows
- Water levels in deep (coal and Storrs/Panther Sandstone) monitoring wells partially recovered in response to the lower discharge rates; water levels in shallow (Blackhawk Formation) monitoring wells showed no response, either to mining-related drawdowns or to the ensuing partial recovery.
- In 2003, HCI conducted groundwater-flow modeling of the Skyline coal mine, and showed that mine inflows and pumping at JC-1, and the associated drawdowns in deep groundwater levels, could be attributed in full to release of groundwater from storage in the thick sequence of Starpoint Sandstones below the mine.
- The numerical groundwater-flow model created in 2003 by HCI has been updated with additional mining plans, and with mine-inflow, pumping, and water level records over 12 years.
- This study shows that the numerical groundwater flow model, as constructed in 2003, cannot be calibrated to the new "recovery" data drawing only from groundwater storage. Recharge to the groundwater system from a surface source is needed in order to match both drawdown and recovery data. Surface water is also required to approximate geochemical data that suggests a combination of old (deep) and modern (shallow) water entering the mine and pumped from JC-1.
- A recharge to the deep groundwater at a rate of up to 4,000 to 4,500 gpm, in addition to groundwater storage, allows a calibration of the model to measured inflows and to recovery during mine flooding. (Geochemical data suggest that only a portion of the recharge comes directly from a surface-water source.)
- The source of the recharge and its mechanism is not clear. The updated groundwater-flow model demonstrates that possible sources of the recharge could include:
  - Vertical recharge through South Gooseberry fault from the shallow groundwater system;
  - Electric Lake, via a splay of the Diagonal Fault
- Results of the transient calibration indicate that the model can be calibrated to Scenario 1 or 2 equally well. A combination of the two sources may be the most likely scenario.

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8 Date and Signature Page

Signed on this 1st Day of July, 2016.

Prepared by

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Vladimir Ugorets, PhD, MMSAQP, Principal Consultant (Hydrogeology)

Prepared by

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Roger Howell, PG, Principal Consultant (Hydrogeologist)

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted industry practices.

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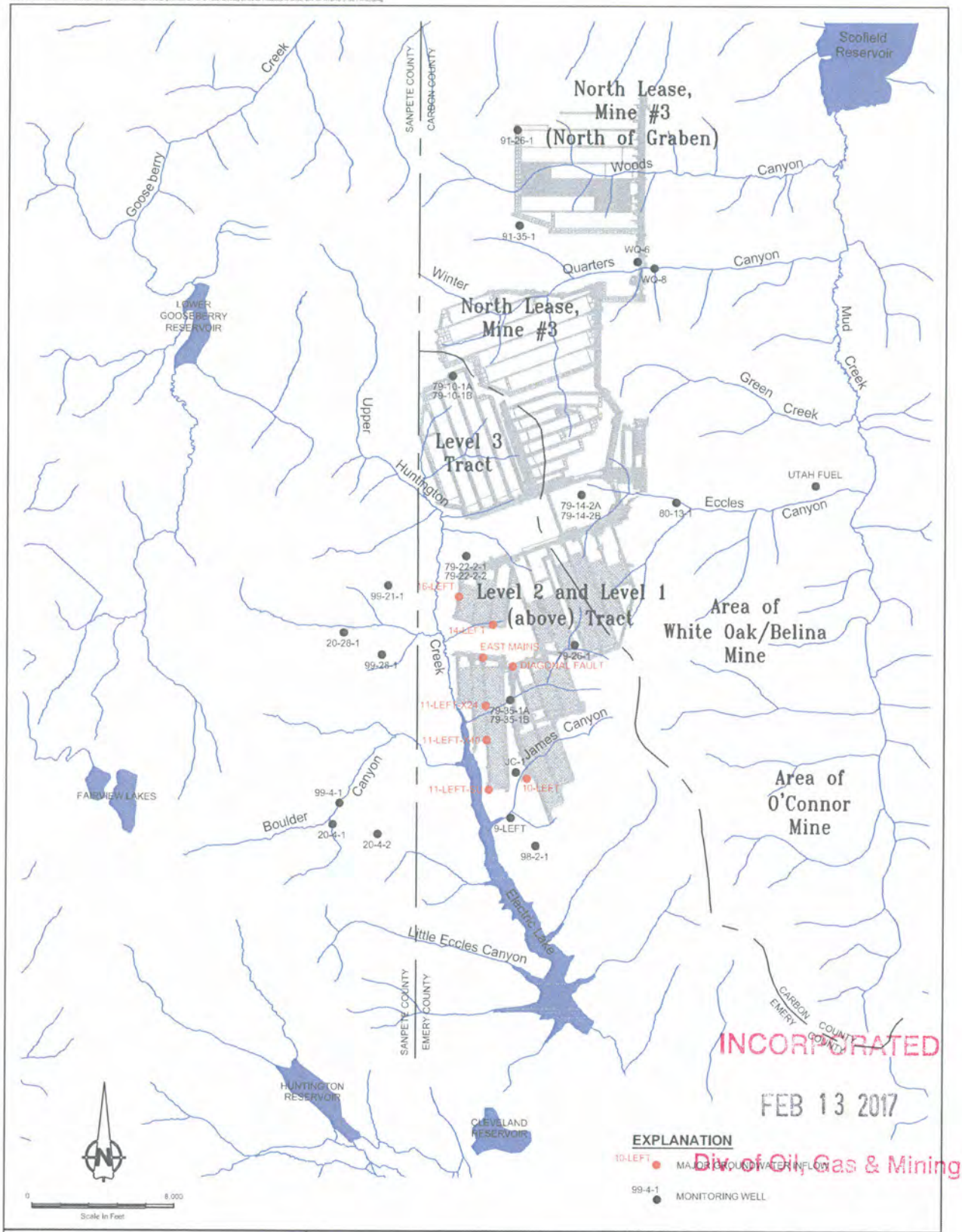

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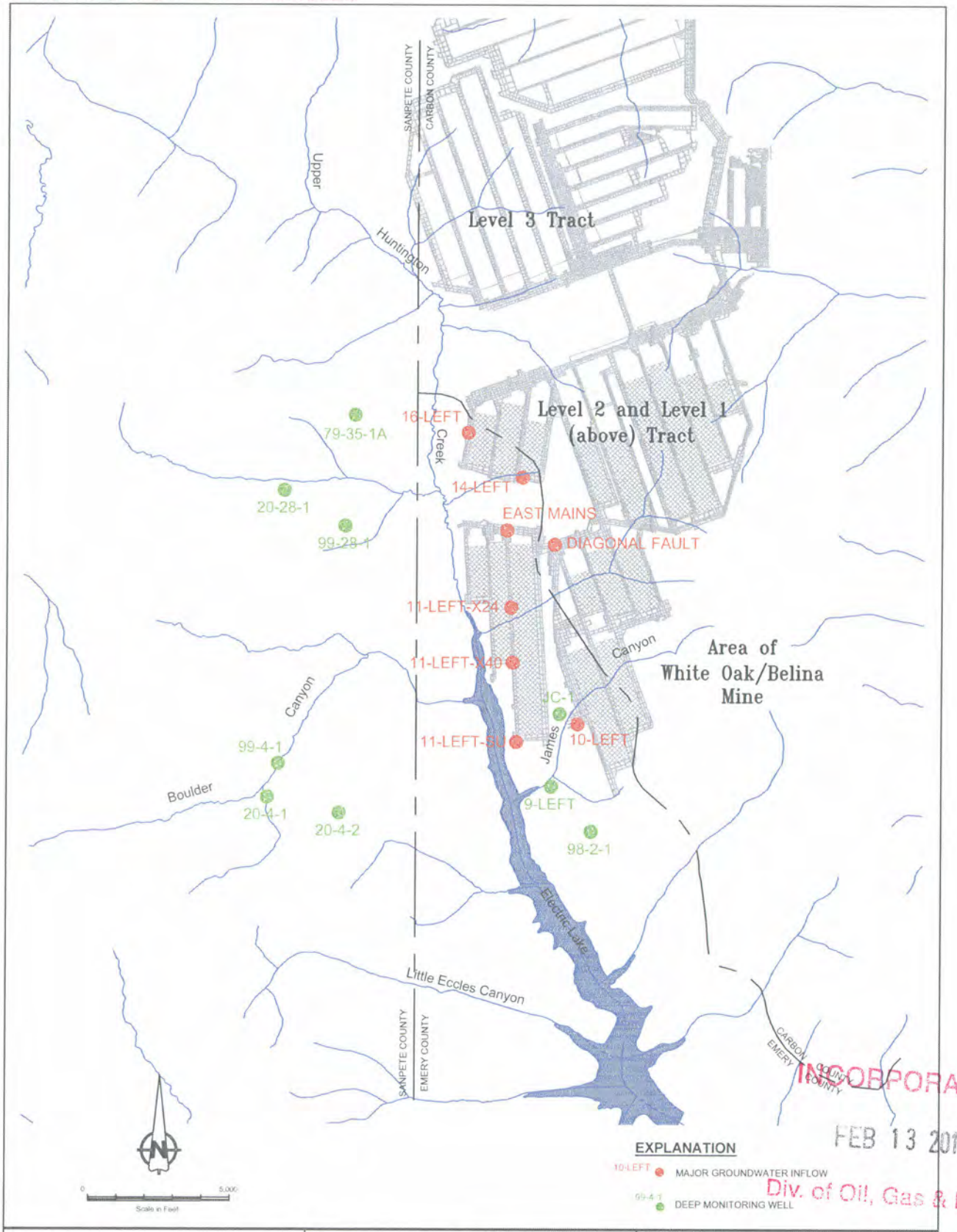
srk consulting	DORSEY always ahead	PROJECT: RESULTS OF GROUNDWATER FLOW MODEL UPDATE FOR SKYLINE MINE, UTAH
	BASE MAP OF HYDROGEOLOGIC STUDY AREA	ISSUED FOR: DORSEY & WHITNEY LLP
SRK JOB NO.: 460100.070		DRAWING NO.: FIGURE 1 — REVISION NO.: A
FILE NAME: FIG 1 460500.010 BASE MAP OF HYDRO STUDY AREA.dwg		SRK JOB NO.: 460100.070



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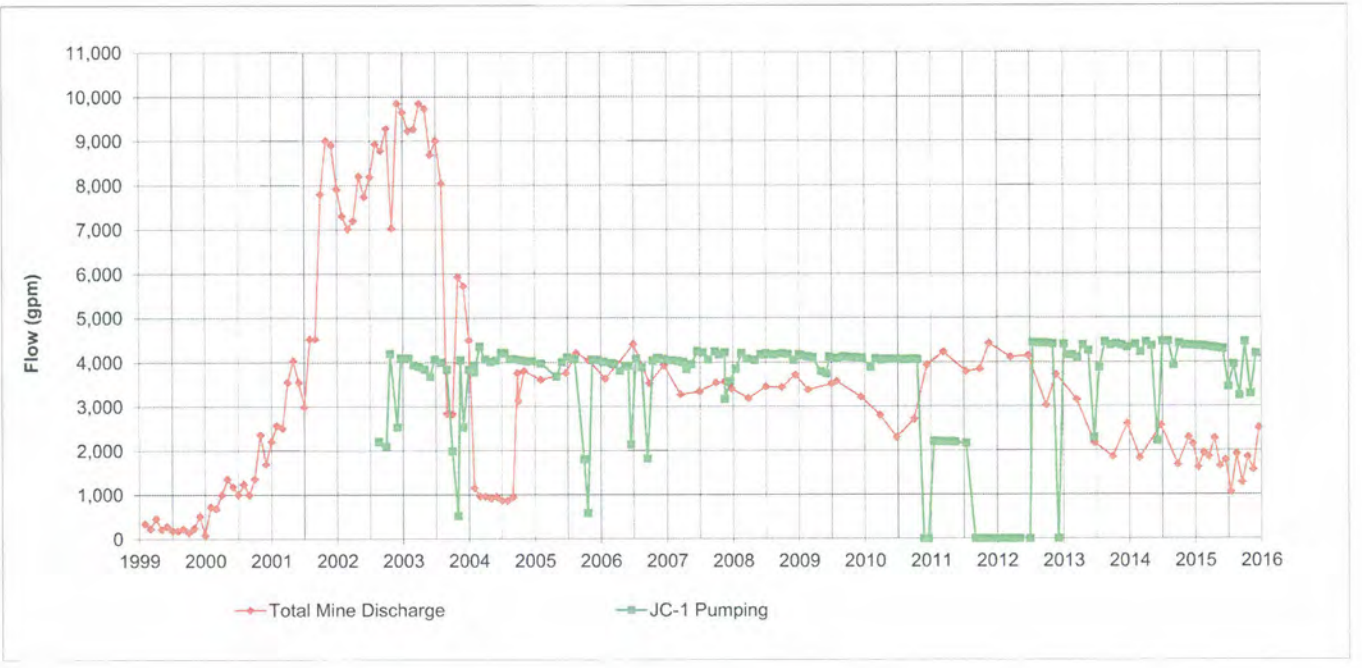
	DEEP MONITORING WELLS, MINE WORKINGS AND HISTORIC INFLOW POINTS	ISSUED FOR: DORSEY & WHITNEY LLP
SRK JOB NO: 460100.070		DRAWING NO. FIGURE 2
FILE NAME: FIG 2 460500.010 DEEP MONITORING WELLS.dwg		SRK JOB NO. 460100.070
		REVISION NO: A



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RECORD OF TOTAL MINE DISCHARGE AND JC-1 PUMPING, 1999 - 2015

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FILE NAME: FIG 3.dwg

PROJECT: RESULTS OF GROUNDWATER FLOW MODEL UPDATE FOR SKYLINE MINE, UTAH

ISSUED FOR: DORSEY & WHITNEY LLP

DRAWING NO.: FIGURE 3

SRK JOB NO.: 460100.070

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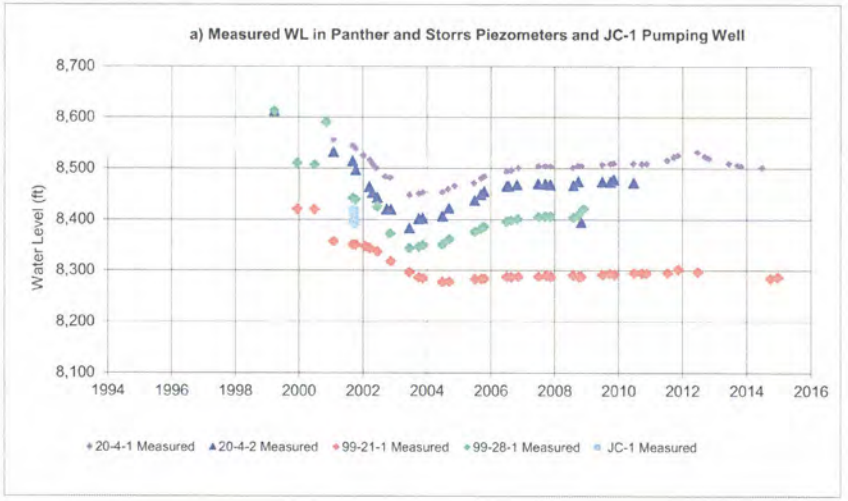

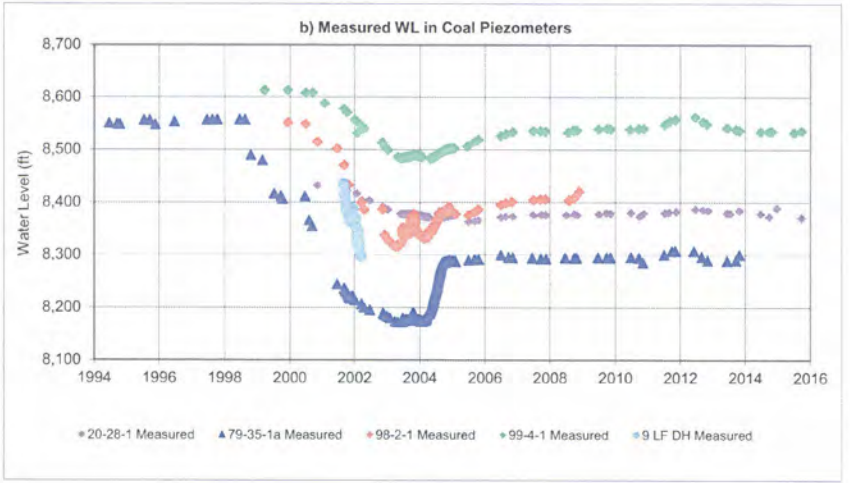

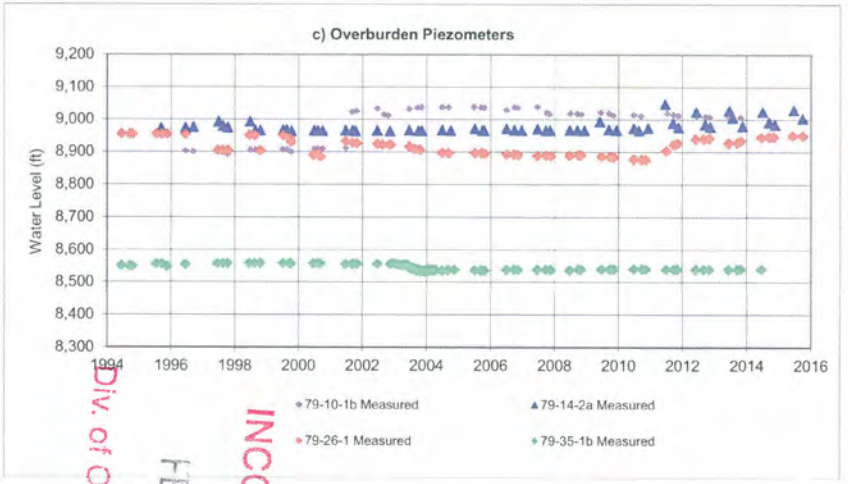

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WATER LEVEL CHANGES IN PIEZOMETERS, 1994 - 2015

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DRAWING NO.: FIGURE 4

SRK JOB NO.: 460100.070

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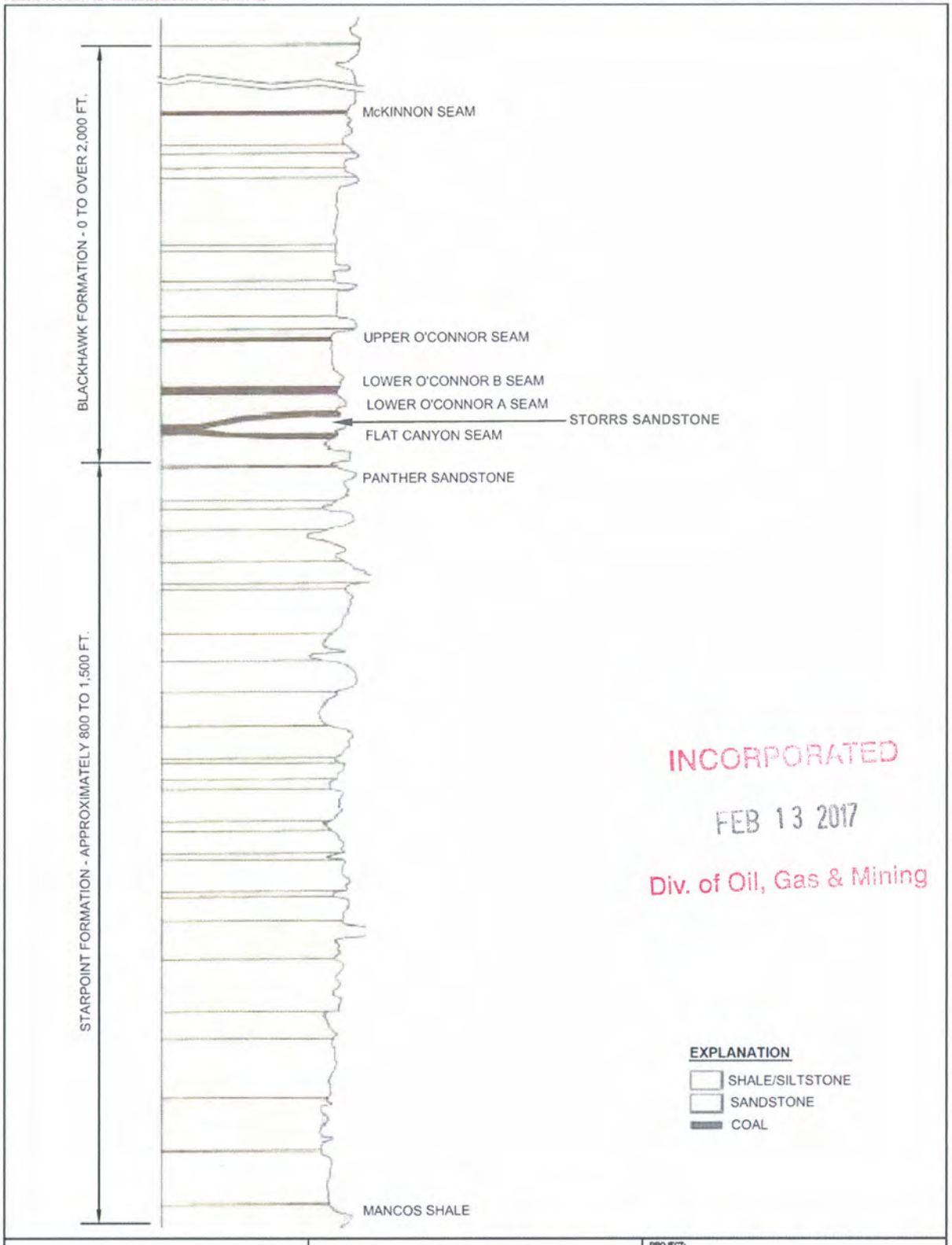
E:\BowieResources_4605\460500.010_Skyline_GroundwaterModeling\AutoCAD\ACAD FIGURES\May 2016\FIG 4.dwg



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GENERAL HYDROSTRATIGRAPHIC COLUMN

DRAWING NO. FIGURE 5

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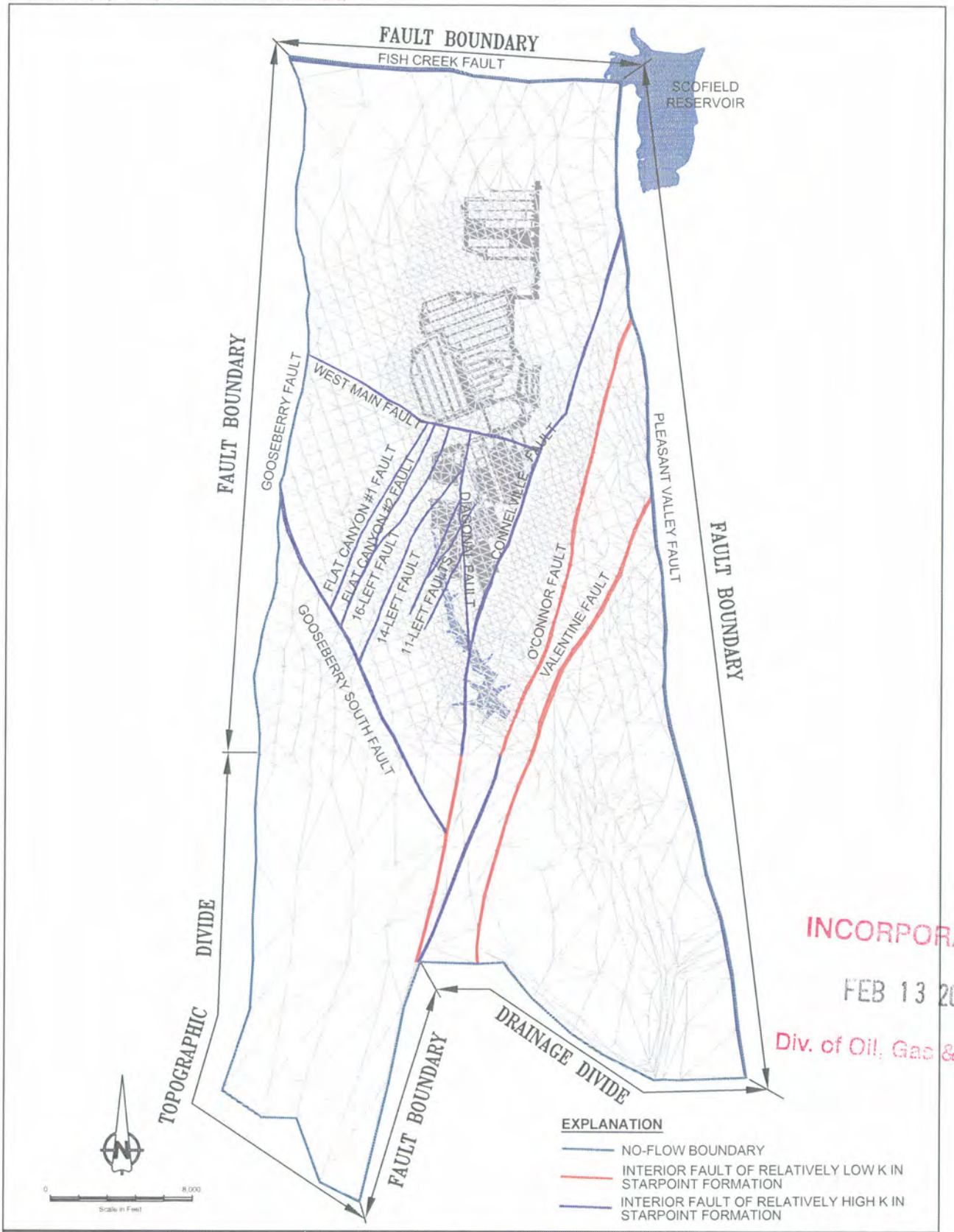

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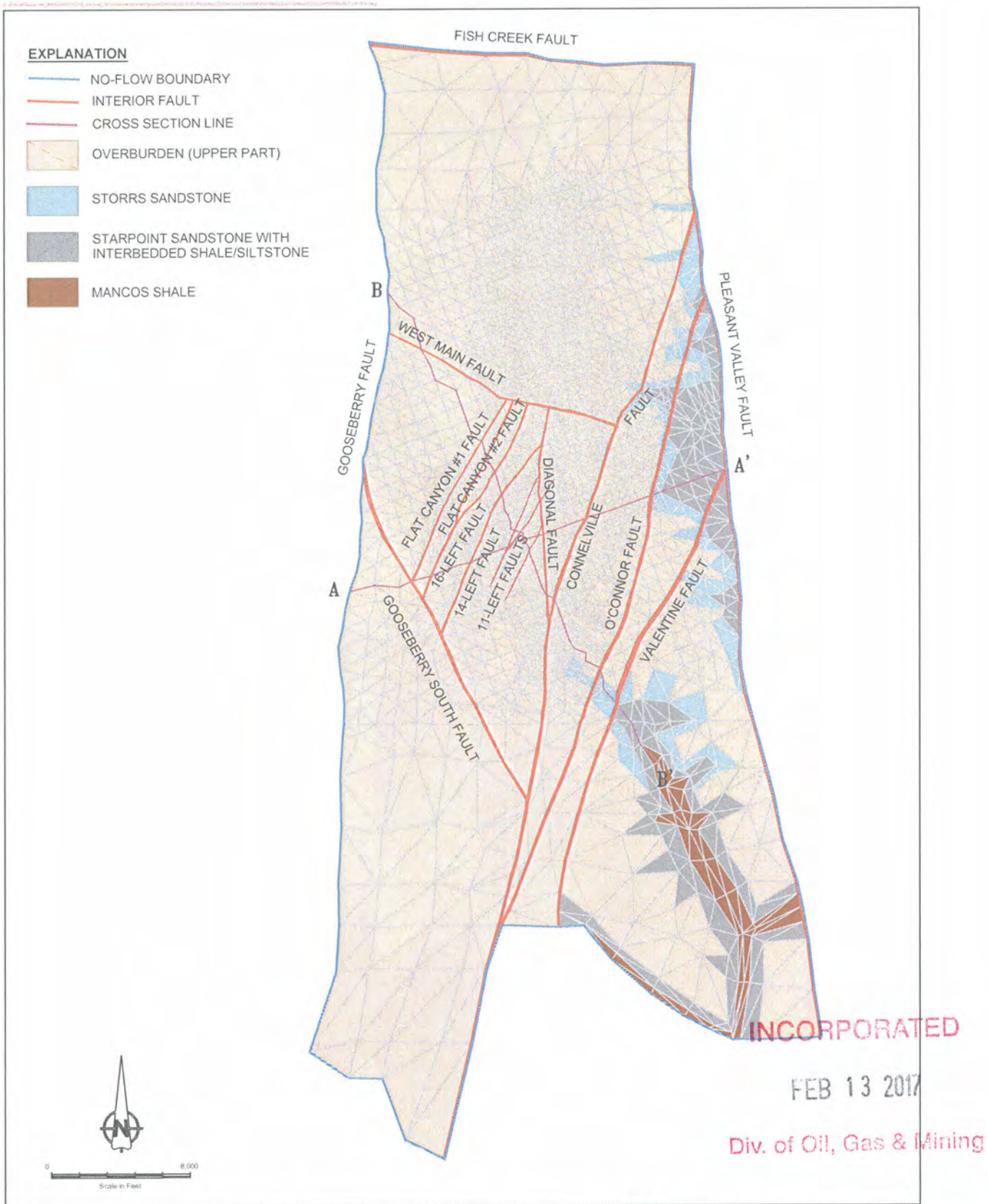
MAP VIEW OF NUMERICAL GROUNDWATER MODEL SHOWING FINITE-ELEMENT MESH AND BOUNDARY CONDITIONS

DRAWING NO. FIGURE 6

REVISION NO. A

SRK JOB NO. 460100.070

FILE NAME: FIG 6 480500.010 MAP VIEW FINITE MESH.dwg



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	GEOLOGY SIMULATED IN UPPERMOST LAYER (BLACKHAWK FORMATION) OF NUMERICAL MODEL	ISSUED FOR: DORSEY & WHITNEY LLP
SRK JOB NO: 460100.070		DRAWING NO.: FIGURE 7
FILE NAME: FIG 7 460500.010 GEOLOGY SIMULATED UPPERMOST LAYER.dwg		SRK JOB NO.: 460100.070
		REVISION NO.: A

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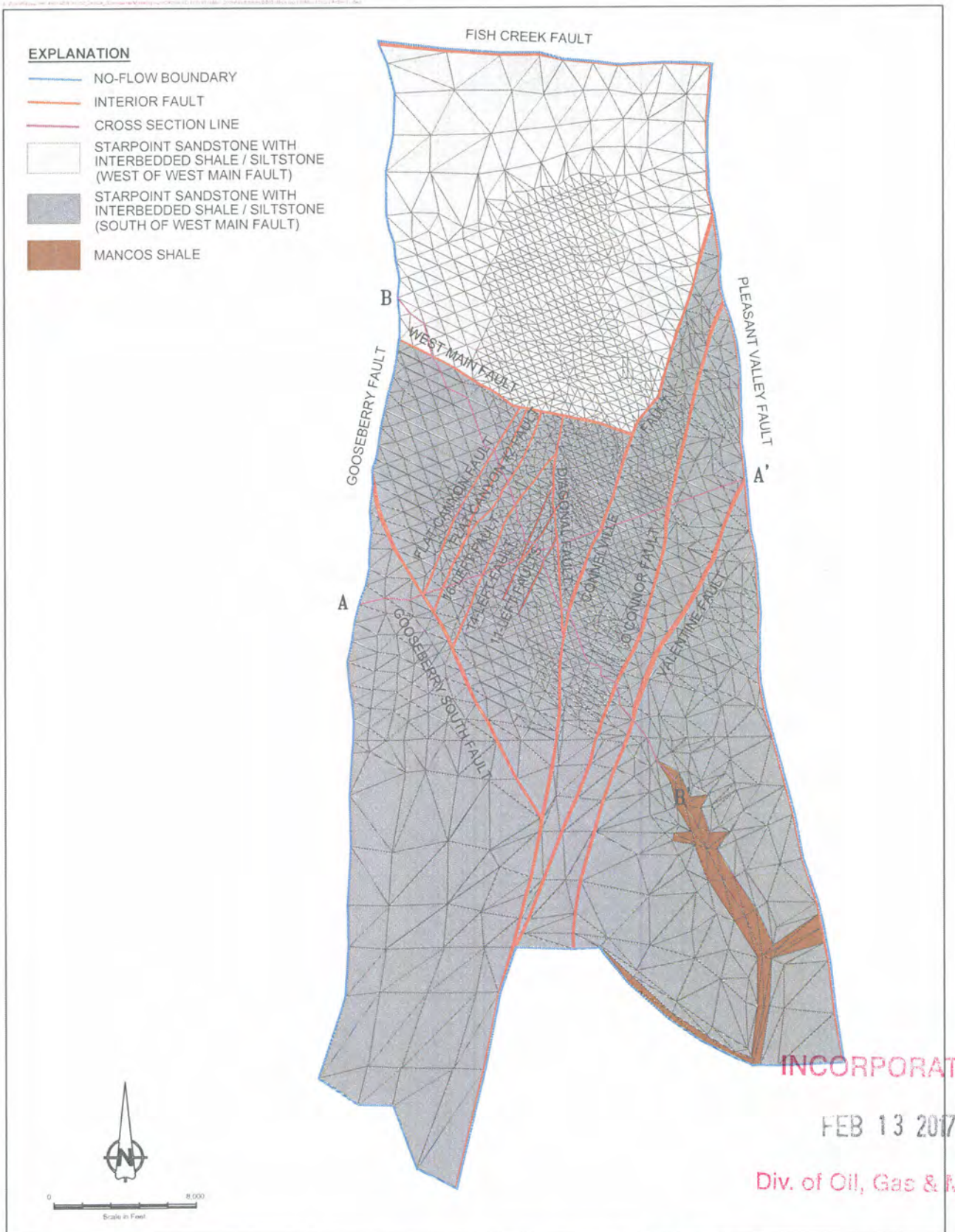

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	GEOLOGY SIMULATED IN LAYER 12 (STARPOINT FORMATION) OF NUMERICAL MODEL	ISSUED FOR: DORSEY & WHITNEY LLP
SRK JOB NO: 460100.070		DRAWING NO.: FIGURE 8
FILE NAME: FIG 8 460500.010 GEOLOGY SIMULATED LAYER 12.dwg		SRK JOB NO.: 460100.070
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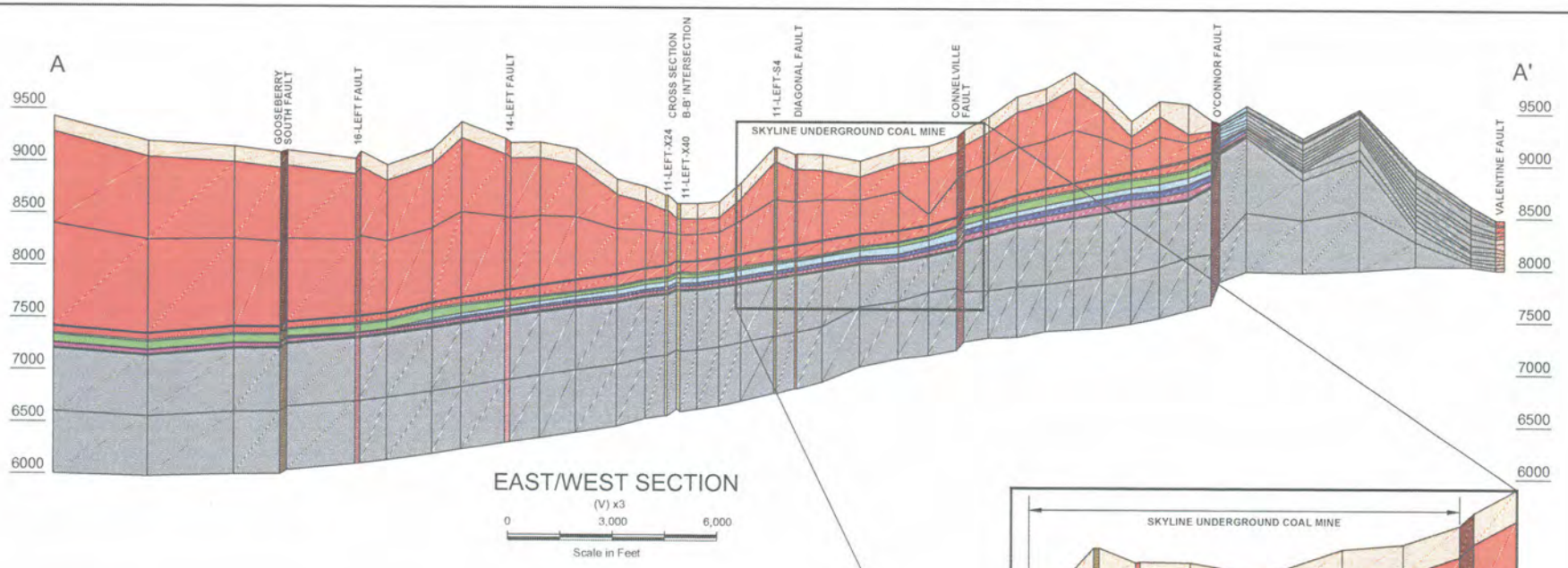
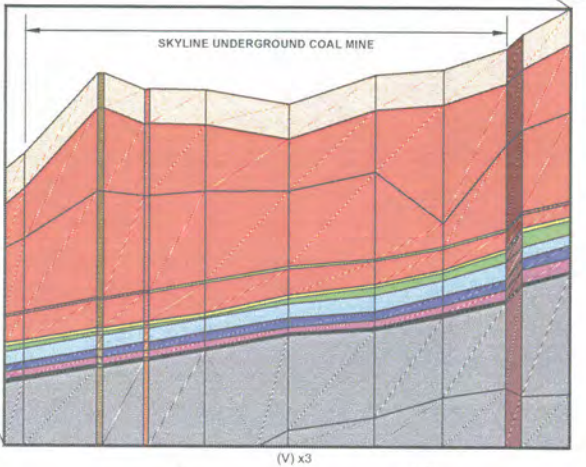


EAST/WEST SECTION

(V) x3

0 3,000 6,000

Scale in Feet



(V) x3

0 1,500 3,000

Scale in Feet

LEGEND

GEOLOGICAL UNITS (ZONES)

- OVERBURDEN (UPPER PART)
- OVERBURDEN (LOWER PART)
- UPPER O'CONNOR COAL
- INTERBURDEN #1
- LOWER O'CONNOR B COAL
- INTERBURDEN #2
- STARS SANDSTONE
- INTERBURDEN #3
- PANTHER SANDSTONE
- INTERBURDEN #4
- STARPOINT SANDSTONE WITH INTERBEDDED SHALE/SILTSTONE
- FAULT (UPPER PART)
- FAULT (LOWER PART)

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EAST-WEST CROSS SECTION OF GROUNDWATER MODEL

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DRAWING NO. FIGURE 9 | REVISION NO. A

SRK JOB NO. 460100.070

E:\BowieResources_4805\460500.010_Skyline_GroundwaterModeling\AutoCAD\ACAD FIGURES\May 2016\FIG 9 EW Cross Section.dwg

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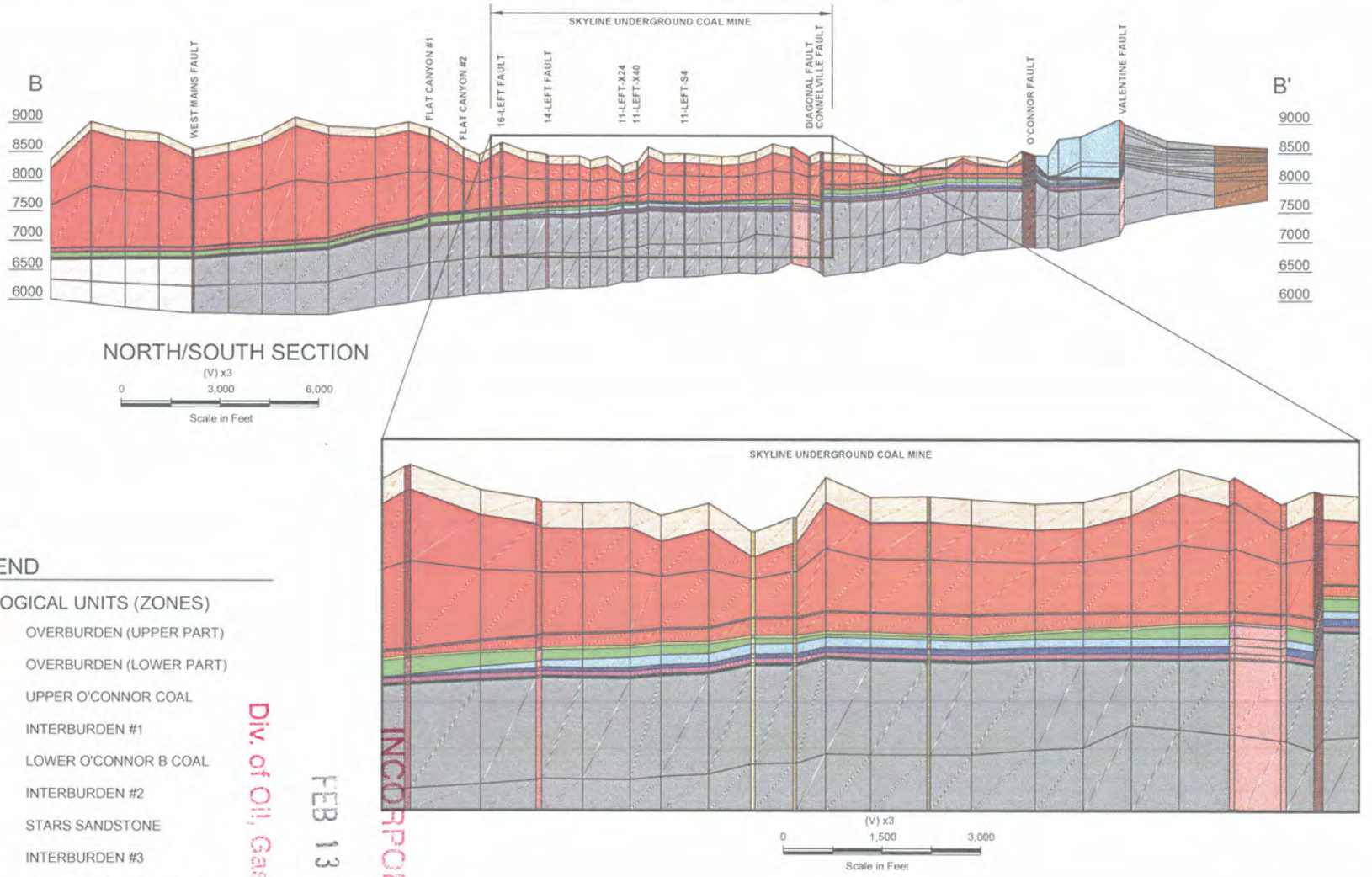

LEGEND

GEOLOGICAL UNITS (ZONES)

- OVERBURDEN (UPPER PART)
- OVERBURDEN (LOWER PART)
- UPPER O'CONNOR COAL
- INTERBURDEN #1
- LOWER O'CONNOR B COAL
- INTERBURDEN #2
- STARS SANDSTONE
- INTERBURDEN #3
- PANTHER SANDSTONE
- INTERBURDEN #4
- STARPOINT SANDSTONE WITH INTERBEDDED SHALE/SILTSTONE
- FAULT (UPPER PART)
- FAULT (LOWER PART)

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	NORTH-SOUTH CROSS SECTION OF GROUNDWATER MODEL	ISSUED FOR: DORSEY & WHITNEY LLP
		DRAWING NO.: FIGURE 10 — REVISION NO.: A
		SRK JOB NO.: 460100.070

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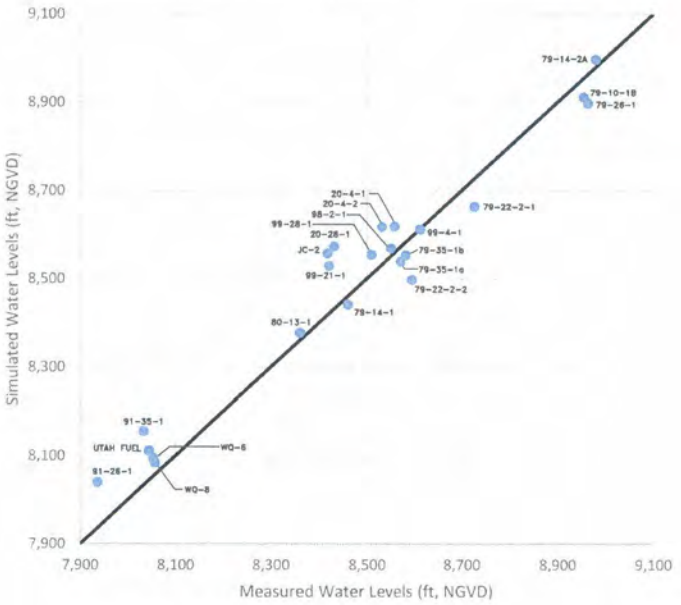
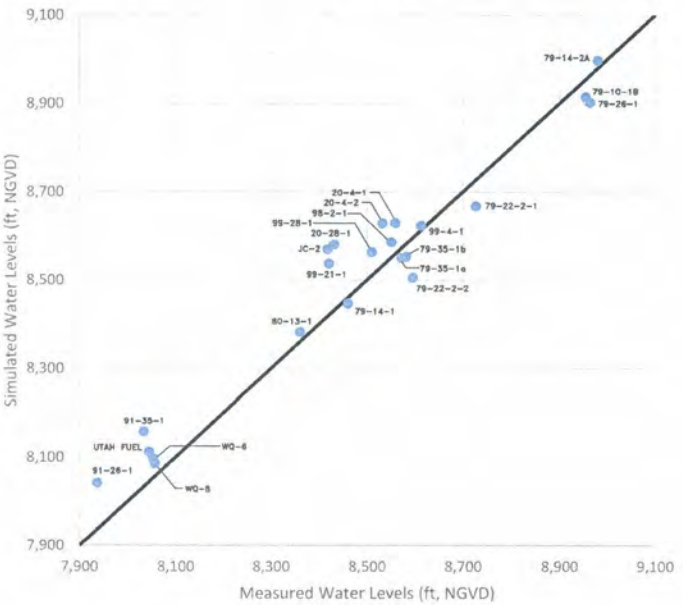
a) Scenario 1



b) Scenario 2



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	COMPARISON OF MODELED TO MEASURED PRE-MINING WATER LEVELS IN MONITORING WELLS	ISSUED FOR: DORSEY & WHITNEY LLP
		DRAWING NO.: FIGURE 11
		SRK JOB NO.: 460100.070
		A

E:\BowieResources_4605\460500.010_Skyline_GroundwaterModeling\AutoCAD\ACAD FIGURES\May 2016\FIG 11.dwg

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a) SCENARIO 1

b) SCENARIO 2

EXPLANATION

- NO-FLOW BOUNDARY
- INTERIOR FAULT
- 6000 SIMULATED WATER LEVEL (FT NGVD)
- SIMULATED GROUNDWATER FLOW DIRECTION
- JC1 PUMPING WELL
- UNDERGROUND MINE

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SIMULATED PRE-MINING WATER LEVELS IN UPPER STARPOINT FORMATION

PROJECT: RESULTS OF GROUNDWATER FLOW MODEL UPDATE FOR SKYLINE MINE, UTAH

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DRAWING NO. FIGURE 12

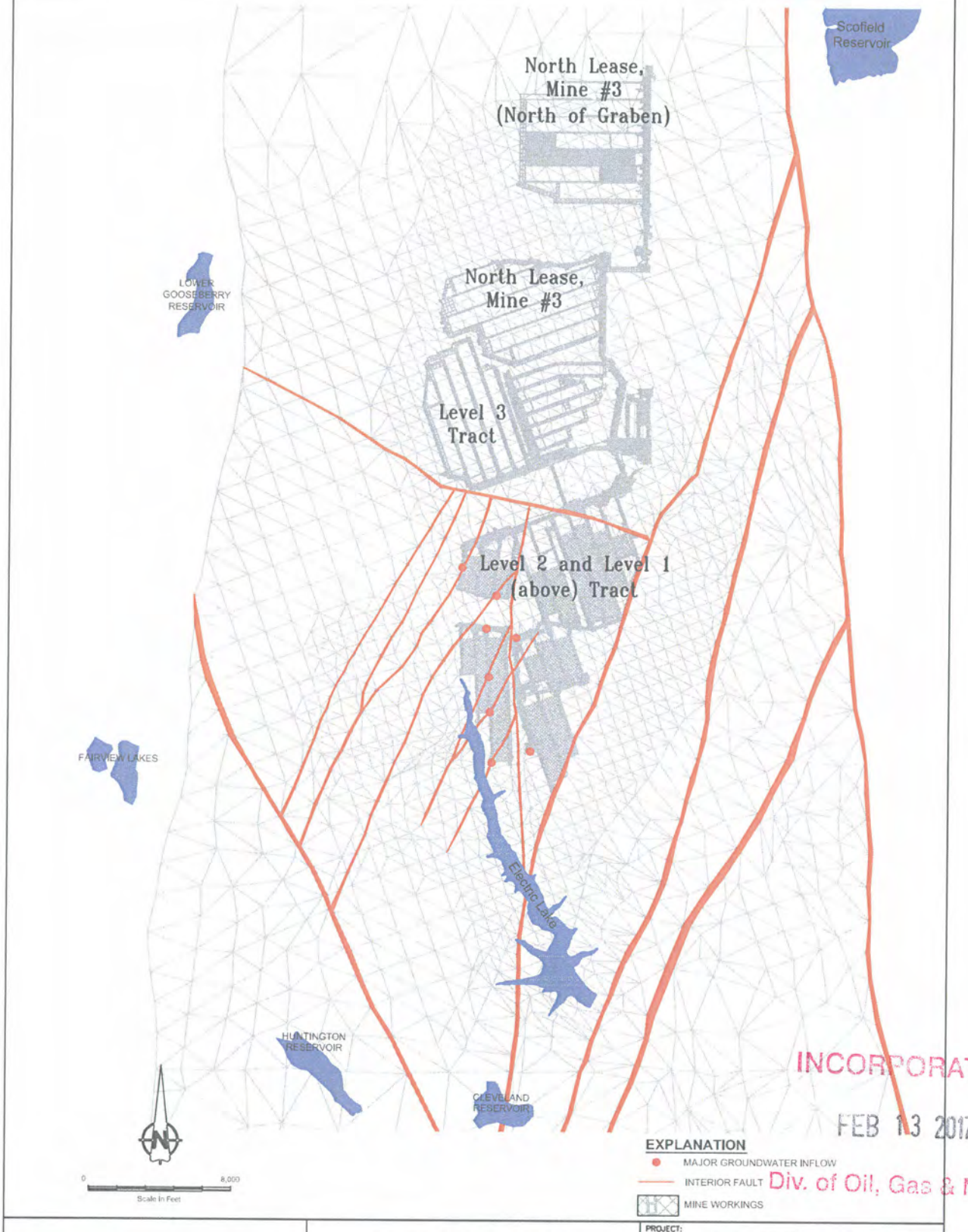
SRK JOB NO. 460100.070

REVISION NO. A

DRN: JOB NO: 460100.070

FILE NAME: FIG 12 460500.010 Simulated pre-mining wtr lvls uppermost formation.dwg

E:\BowieResources_48051\460500.010_Skyline_GroundwaterModeling\AutoCAD\ACAD FIGURES\dwg 2016\FIG 12 460500.010 Simulated pre-mining wtr lvls uppermost formation.dwg



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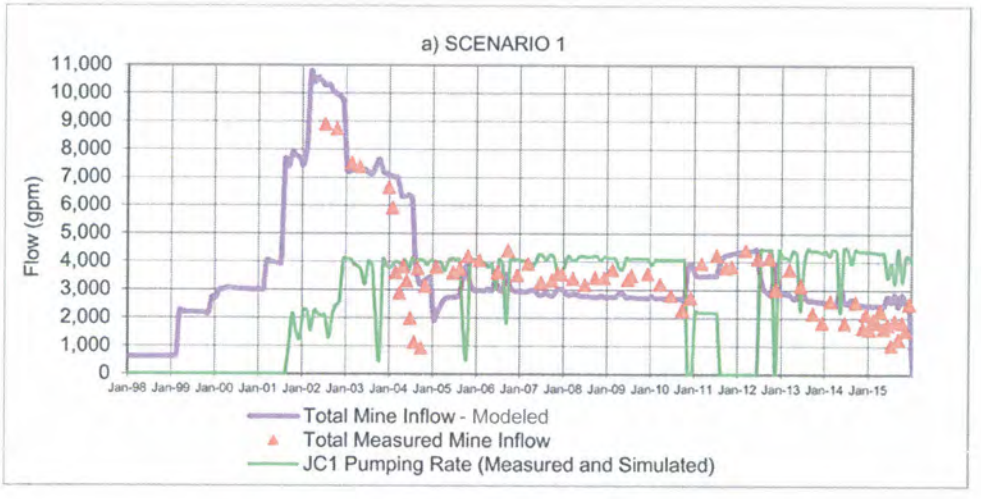
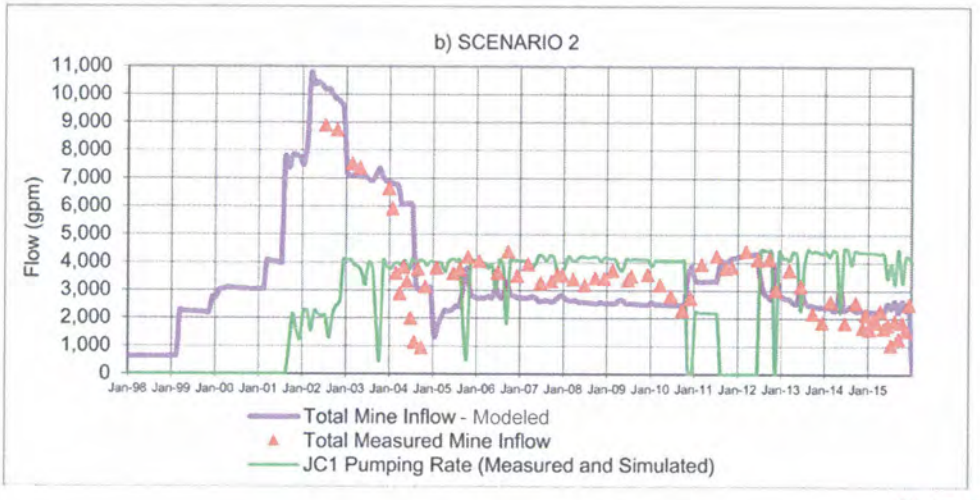
SRK JOB NO.: 460100.070	SIMULATED MINE PLAN THROUGH END OF 2015	ISSUED FOR: DORSEY & WHITNEY LLP
FILE NAME: FIG 13.dwg		DRAWING NO.: FIGURE 13 / REVISION NO.: A
		SRK JOB NO.: 460100.070





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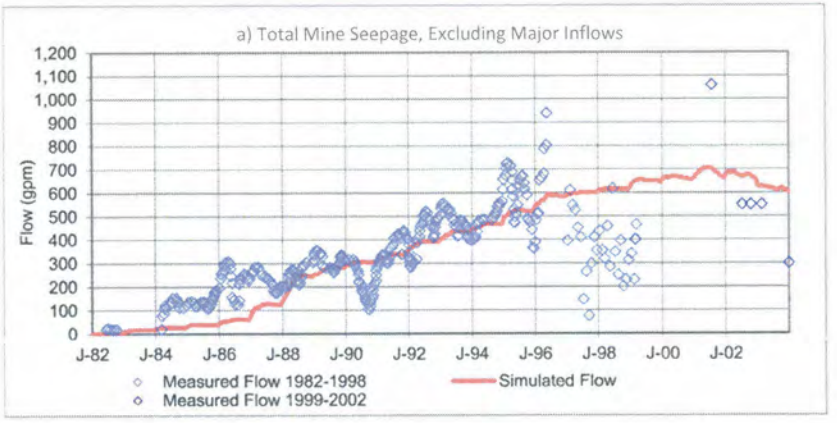
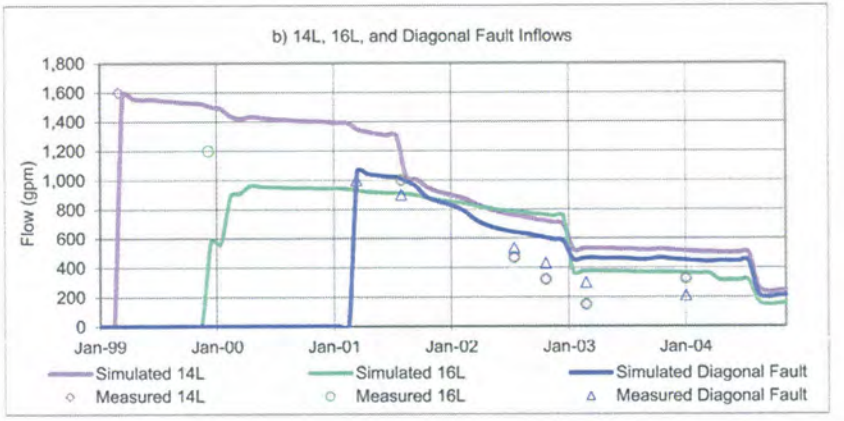
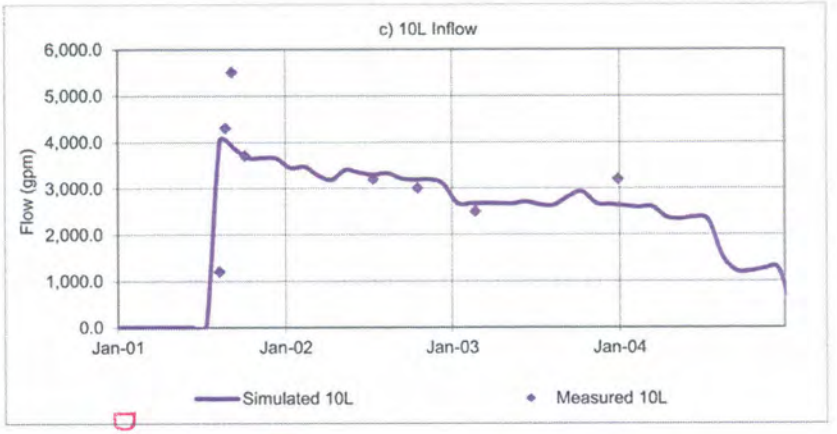
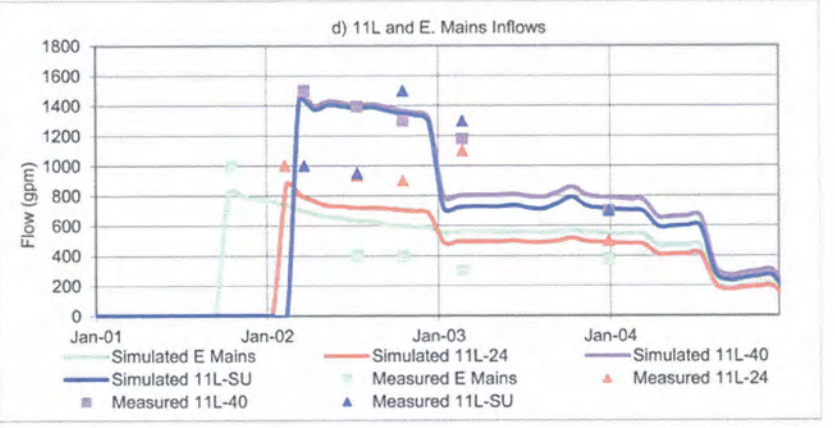
	COMPARISON OF MODELED VS. MEASURED TOTAL INFLOW TO SKYLINE MINE	ISSUED FOR: DORSEY & WHITNEY LLP
SRK JOB NO: 460100.070		DRAWING NO.: FIGURE 14 — REVISION NO: A
FILE NAME: FIG 14.dwg		SRK JOB NO.: 460100.070









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SRK JOB NO: 460100.070

FILE NAME: FIG 15.dwg

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COMPARISON OF MODELED VS. MEASURED MINE INFLOW RATES AT DIFFERENT LOCATIONS (SCENARIO 1)

PROJECT: RESULTS OF GROUNDWATER FLOW MODEL UPDATE FOR SKYLINE MINE, UTAH

ISSUED FOR: DORSEY & WHITNEY LLP

DRAWING NO.: FIGURE 15

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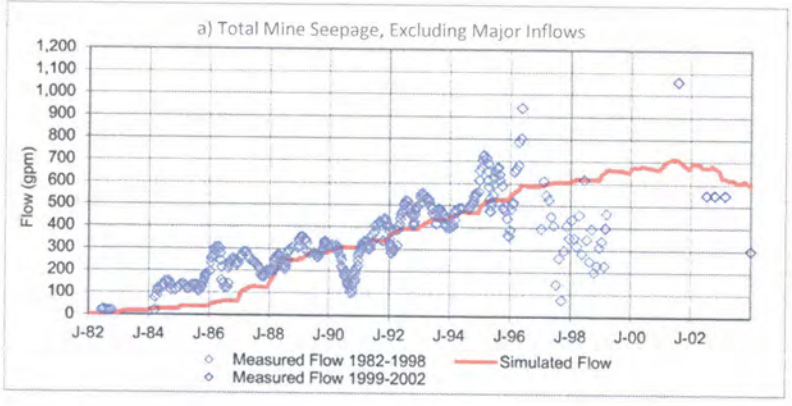
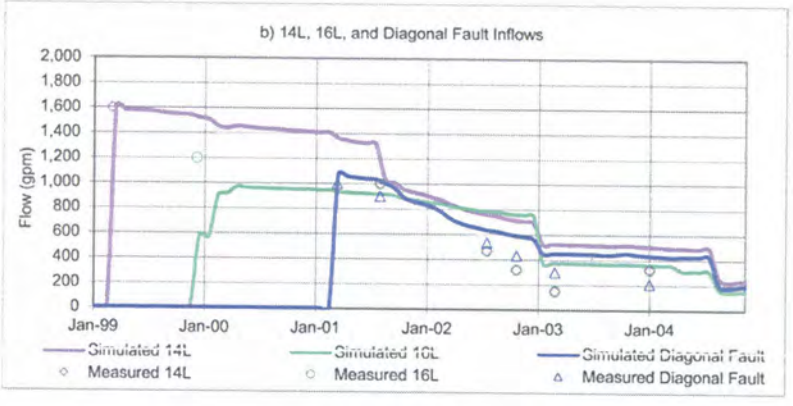
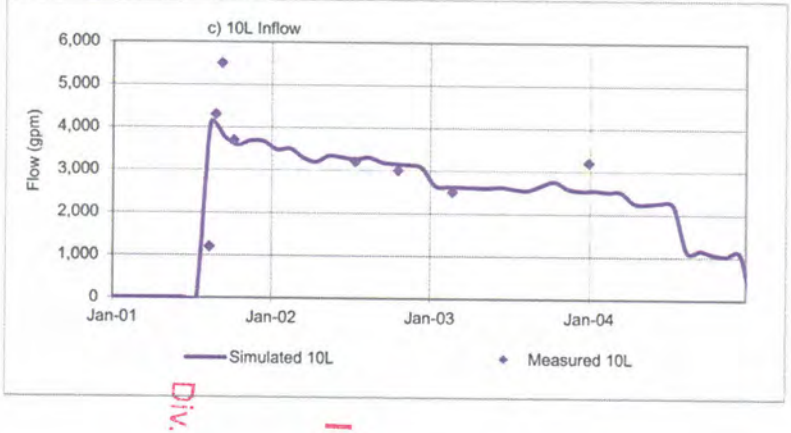
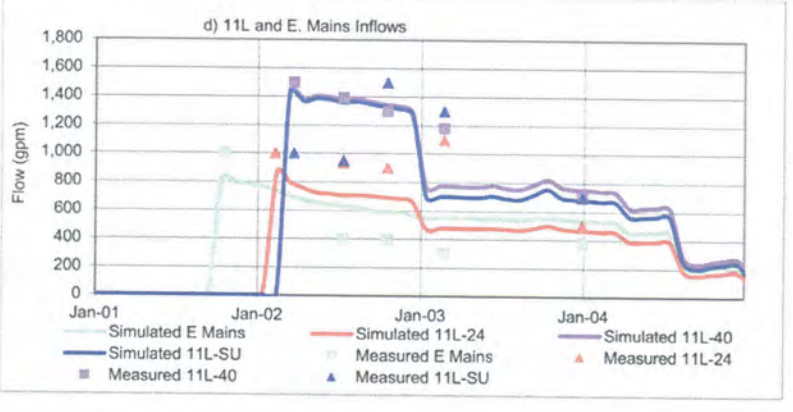
SRK JOB NO.: 460100.070









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SRK JOB NO 460100.070

FILE NAME FIG 16.dwg

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COMPARISON OF MODELED VS. MEASURED MINE INFLOW RATES AT DIFFERENT LOCATIONS (SCENARIO 2)

PROJECT: RESULTS OF GROUNDWATER FLOW MODEL UPDATE FOR SKYLINE MINE, UTAH

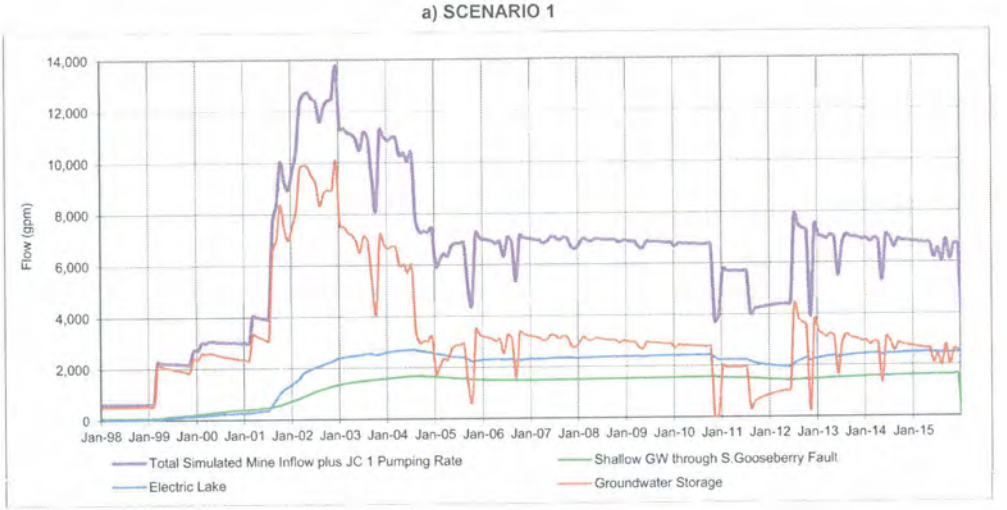
ISSUED FOR: DORSEY & WHITNEY LLP

DRAWING NO. FIGURE 16

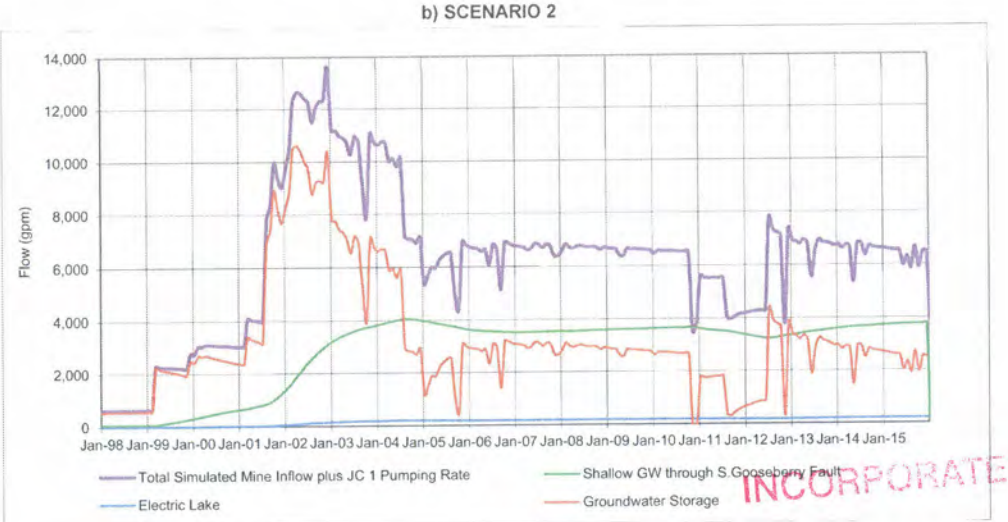
REVISION NO. A

SRK JOB NO. 460100.070

a) SCENARIO 1



b) SCENARIO 2



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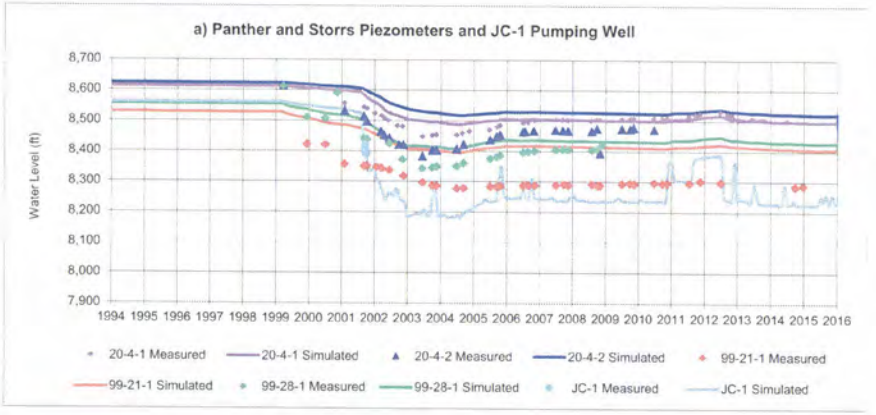
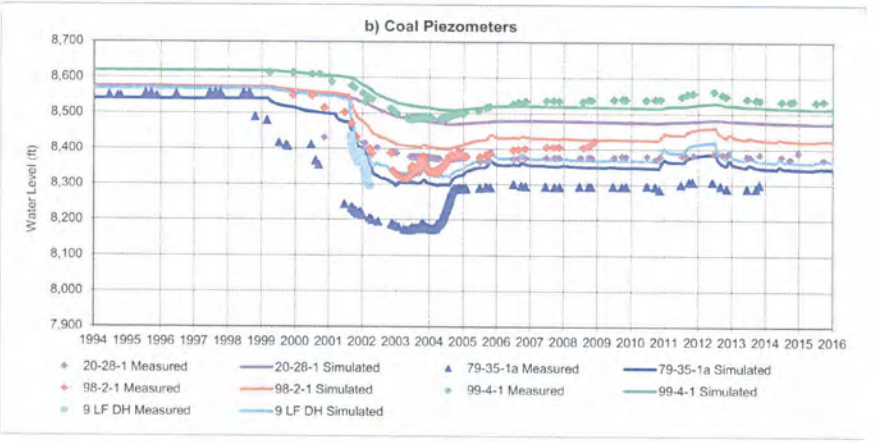
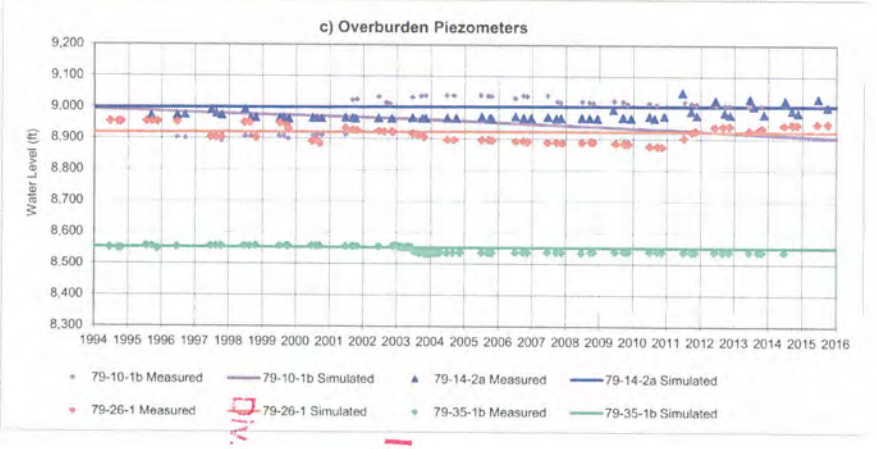
srk consulting	DORSEY always ahead	PROJECT: RESULTS OF GROUNDWATER FLOW MODEL UPDATE FOR SKYLINE MINE, UTAH
	SIMULATED SOURCES OF TOTAL MINE INFLOW PLUS JC 1 PUMPING RATE	ISSUED FOR: DORSEY & WHITNEY LLP
SRK JOB NO.: 460100.070		DRAWING NO.: FIGURE 17 — REVISION NO: A
FILE NAME: FIG 17.dwg		SRK JOB NO.: 460100.070







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	COMPARISON OF MODELED TO MEASURED WATER LEVEL CHANGES IN MONITORING WELLS DURING MINING (SCENARIO 1)	ISSUED FOR: DORSEY & WHITNEY LLP
DRN. JOB NO. 460100.070		DRAWING NO. FIGURE 18
FILE NAME: FIG 18.dwg		SRK JOB NO. 460100.070
		REVISION NO. A

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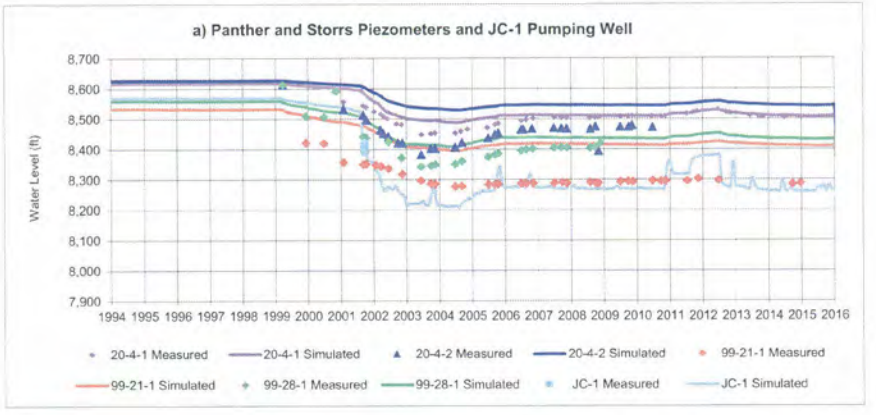

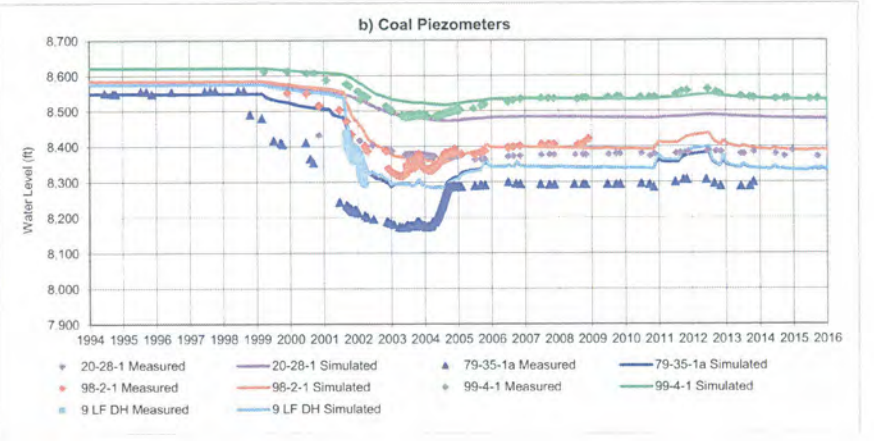

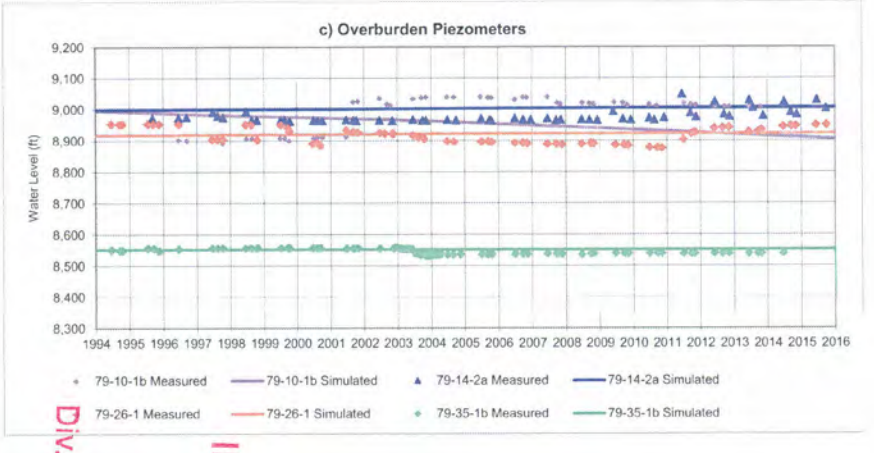

srk consulting	DORSEY always ahead	PROJECT: RESULTS OF GROUNDWATER FLOW MODEL UPDATE FOR SKYLINE MINE, UTAH
SRK JOB NO.: 460100.070	COMPARISON OF MODELED TO MEASURED WATER LEVEL CHANGES IN MONITORING WELLS DURING MINING (SCENARIO 2)	ISSUED FOR: DORSEY & WHITNEY LLP
FILE NAME: FIG 19.dwg		DRAWING NO.: FIGURE 19 — REVISION NO.: A
		SRK JOB NO.: 460100.070

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a) SCENARIO 1

b) SCENARIO 2

EXPLANATION

- NO-FLOW BOUNDARY
- INTERIOR FAULT
- 8000 SIMULATED WATER LEVEL (FT NGVD)
- SIMULATED GROUNDWATER FLOW DIRECTION
- JC1 PUMPING WELL
- UNDERGROUND MINE

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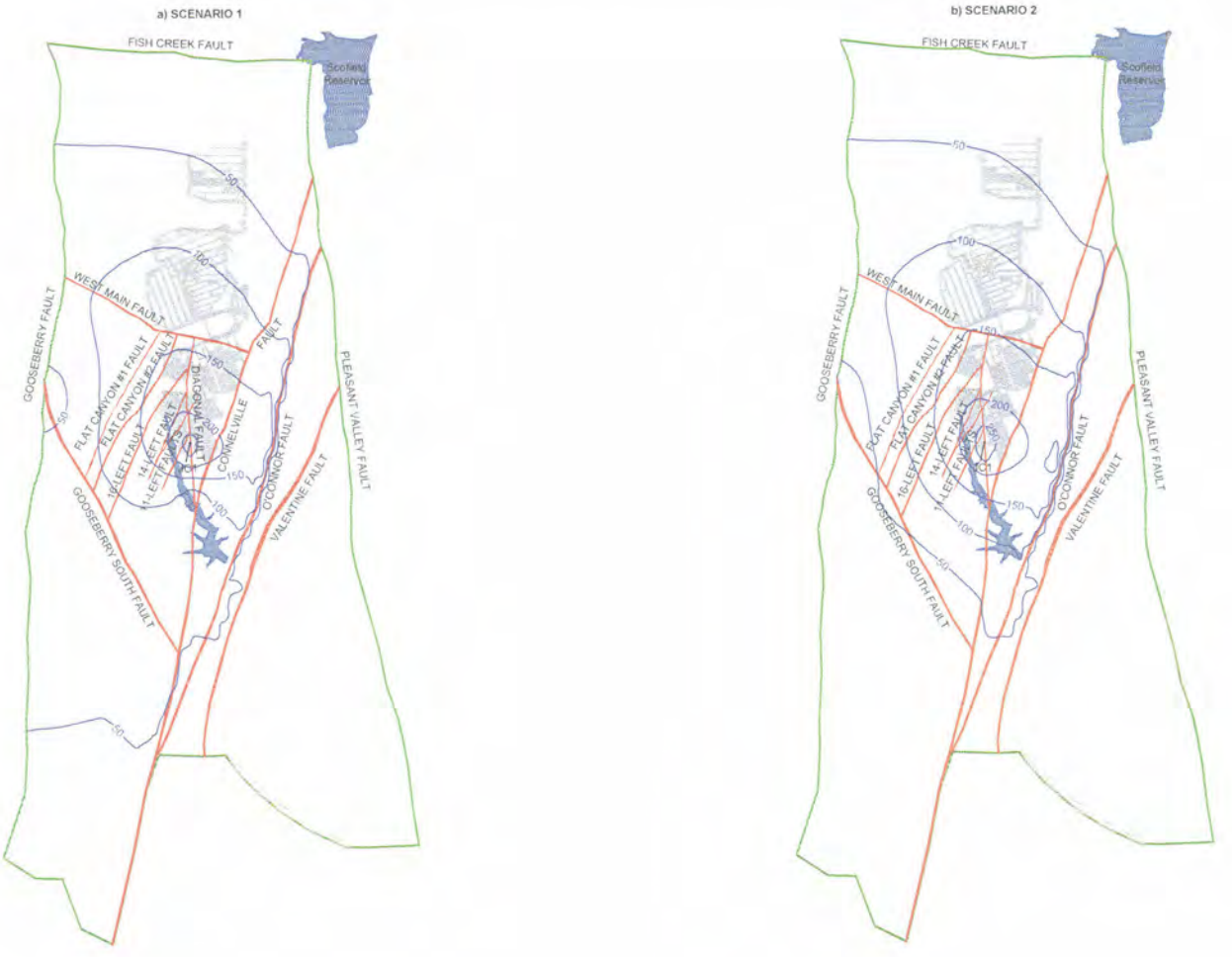
	SIMULATED WATER LEVELS IN UPPERMOST STARPOINT FORMATION AS OF DECEMBER 2015	ISSUED FOR: DORSEY & WHITNEY LLP
		DRAWING NO. FIGURE 20
		SRK JOB NO. 460100.070
		REVISION NO. A

E:\Bowiellesources_4805\460500.010_Skyline_GroundwaterModeling\AutoCAD\ACAD FIGURES\May 2016\FIG 20.dwg



EXPLANATION
- NO-FLOW BOUNDARY
- INTERIOR FAULT
- -50- SIMULATED DRAWDOWN CONTOUR (FT)
- JC1 • PUMPING WELL
- UNDERGROUND MINE

srk consulting	DORSEY always ahead	PROJECT: RESULTS OF GROUNDWATER FLOW MODEL UPDATE FOR SKYLINE MINE, UTAH
	SIMULATED DRAWDOWN IN UPPERMOST STARPOINT FORMATION AS OF DECEMBER 2015	ISSUED FOR: DORSEY & WHITNEY LLP
		DRAWING NO.: FIGURE 21
		SRK JOB NO.: 460100.070
		REVISION NO.: A

E:\Boise\Resources_480$\480100.010_Skyline_Groundwater\Modeling\AutoCAD\ACAD FIGURES\May 2016\FIG 21.dwg

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Appendix S

In Mine Water Volume Calculation

In the four tables below you will find the available water storage capacity in gallons for mine 3, old mine 3, mine 2, and mine 4 respectively. I calculated the storage capacity for mine 3 (based on 45% void space for the gob and 85% void space for entries) then computed a gallons/ft^2 factor I then applied that factor to the remaining sumps.

Mine 3 (8100)	
111,019,400	ft2
2,995,431,697	Gallons
27	Gallons/ft2

Old Mine 3. (8040)	
51,247,831	ft2
1,382,725,697	Gallons

Mine 2. (8500)	
74,823,124	ft2
2,018,814,354	Gallons

Mine 4. (8500)	
143,524,846	ft2
3,872,466,196	Gallons

Mine #3 = 9192.6 ac-ft

Old Mine #3 = 4243.4 ac-ft

Mine #2 = 6195.5 ac-ft

Mine #4 = 11884.2 ac-ft

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Appendix S

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27	Gallons/ft2

Old Mine 3. (8040)	
51,247,831	ft2
1,382,725,697	Gallons

Mine 2. (8500)	
74,823,124	ft2
2,018,814,354	Gallons

Mine 4. (8500)	
143,524,846	ft2
3,872,466,196	Gallons

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Old Mine #3 = 4243.4 ac-ft

Mine #2 = 6195.5 ac-ft

Mine #4 = 11884.2 ac-ft

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Canyon Fuel Company, LLC
A Subsidiary of Bowie Resource Holdings, LLC

Skyline Mine
Corey Heaps
HC35, Box 380
Helper, Utah 84526
(435) 448-2619
Fax (435) 448-2632

May 1, 2017

Price Field Office
Bureau of Land Management
Attn.: Mandy Dimmick
125 South 600 West
Price, Utah 84501

RE: Tonnage Report for April 2017

Dear Mandy:

With this letter there are partial mine maps showing APRIL 2017 mining progress and a copy of the surveyor's mine maps. The volumetric tonnage was calculated using the average widths and heights on the surveyor's mine map. The tonnage listed below is the volumetric tonnage. This tonnage will be used as actual tonnage.

By Section	Computed Volumetric
7 Left Tailgate	30,948 tons
7 Left Headgate	27,259 tons
West Mains	25,784 tons
15 Left Longwall	321,267 tons
Total	**405,258 tons**

By Lease

Lease No.: UTU-67939 (SK-006/SK-026-1)	58,207 tons
Lease No.: UTU-67939 Mod (SK-006-1)	321,267 tons
Lease NO.: U-044076	25,784 tons
Total	**405,258 tons**

Sincerely,

Corey Heaps
General Manager

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Appendix S

In Mine Water Volume Calculation

In the four tables below you will find the available water storage capacity in gallons for mine 3, old mine 3, mine 2, and mine 4 respectively. I calculated the storage capacity for mine 3 (based on 45% void space for the gob and 85% void space for entries) then computed a gallons/ft^2 factor I then applied that factor to the remaining sumps.

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111,019,400	ft2
2,995,431,697	Gallons
27	Gallons/ft2

Old Mine 3. (8040)	
51,247,831	ft2
1,382,725,697	Gallons

Mine 2. (8500)	
74,823,124	ft2
2,018,814,354	Gallons

Mine 4. (8500)	
143,524,846	ft2
3,872,466,196	Gallons

Mine #3 = 9192.6 ac-ft

Old Mine #3 = 4243.4 ac-ft

Mine #2 = 6195.5 ac-ft

Mine #4 = 11884.2 ac-ft

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Appendix A-1 Vol. 2

Results of the 2015 Geomorphic Evaluation of Eccles Creek

Canyon Fuel Company
Skyline Mine
Helper, Utah

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October 2015

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EarthFax EarthFax Engineering Group, LLC

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CHAPTER 2 – FIELD DATA COLLECTION METHODS 2

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LIST OF APPENDICES

Appendix A – Reference Site Photographs

Appendix B – Copy of Filed Log Book

Appendix C –Survey Tabulations with Individual Cross Section and Profile Drawings

RESULTS OF THE 2015 GEOMORPHIC EVALUATION OF ECCLES CREEK

CHAPTER 1
INTRODUCTION

In early August 2001, the advancing face of the Skyline Mine encountered fractured sandstone, resulting in a significant inflow of water to the mine. From early September 2001 through July 2003, this water was discharged from the mine to Eccles Creek at rates ranging from about 7,000 and 10,000 gallons per minute ("gpm"), compared with an average discharge for the 30 months prior to August 2001 of about 1,500 gpm. Except for a period of lower discharge (less than about 1,000 gpm) in the first two-thirds of 2004, the discharge from the mine since July 2003 has typically ranged from about 3,000 to 5,000 gpm.

From 2001 through 2006, EarthFax Engineering conducted detailed evaluations of the impact of the mine-water discharge on geomorphic conditions in three reference reaches in Eccles Creek. The purpose of this document is to present the results of data collection from the same reference reaches in September 2015 and to compare the current results with prior data.

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CHAPTER 2
FIELD DATA COLLECTION METHODS

The locations of reference sites previously established on Eccles Creek are shown on Figure 2-1. Monitoring of the reference sites was conducted on September 23 and 30, 2015 in general conformance with the recommendations of Harrelson et al. (1994) and included the following:

- Attempting to locate previously established benchmarks at each site. It having been 9 years since the last survey, soil and vegetation had accumulated over the benchmarks at each location, In spite of lengthy attempts, including the use of a metal detector, only one benchmark could be located (at cross section EC-1). However, end stakes were found at each cross section, and the bases of these end stakes were used for comparing prior elevation data collected from each reference reach.
- Photographing each site, as recommended by Harrelson et al. (1994), looking upstream, downstream, and across the channel at each cross section location (see Appendix A).
- Locating previously established cross sections. The endpoints of each cross section were previously marked with 4-foot long, 1/2-inch diameter steel reinforcing bars that were driven approximately 3.5 feet into the ground.
- Surveying the channel cross section at each site. A measuring tape was stretched between the cross section monuments and surveying was performed using a Sokkia survey level and rod. Elevations were shot at each change in elevation (e.g., slope breaks, channel banks, etc.). The readings were recorded in the field log book (see Appendix B).
- Surveying the longitudinal profile at each site. The profiles extended a distance of approximately 20 times the channel width (half upstream and half downstream from the cross section location). Data were collected to indicate the elevation of the channel bottom at the thalweg, the water surface, and indications of bankfull stage. Measurements were collected on intervals approximately equal to the channel width. Data were collected using a Leica Rugby 82 laser level with receiver and rod, with the location of the starting and endpoints being measured as noted above. Data readings were recorded in the field log book (see Appendix B).

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CHAPTER 3
RESULTS SUMMARY

Cross section and selected profile spreadsheets and drawings are provided in Appendix C. These data were plotted for 2006 and 2015 to visually assess the effect of the mine discharge on geomorphic conditions within Eccles and Mud Creeks. These plots are presented in Figures 3-1 through 3-9.

In steep, cobble-bedded streams such as Eccles Creek, several of the survey measurements are subjective and difficult to replicate from year to year. If the survey rod is set on top of a cobble one year and to the side of that cobble the next year, the apparent channel bottom may vary by several inches, even though no appreciable change has occurred. Furthermore, although cross section locations are fixed, the profile points are re-established each year as recommended by Harrelson et al. (1994), resulting in some variation in location from year to year. Finally, some measurements (e.g., the location of bankfull stage) are highly subjective. In Eccles Creek, which is cut into a steep canyon, it is frequently difficult to discern between the bankfull stage and the adjacent hillside. All of these factors may contribute to reduced data quality within the survey area.

Notwithstanding the survey difficulties noted above, Figures 3-1 through 3-3 indicate that the following conclusions can be drawn with respect to changes in the reference site profiles and cross-sections between 2006 and 2015:

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- All reaches were flowing at bankfull stage at the time of the September 2015 survey. Rosgen (1996) indicates that bankfull discharge is that discharge which is most effective in channel maintenance. Hence, the rate at which mine water was discharging should not adversely affect channel stability and maintenance.
- The channel has aggraded slightly since 2006 in portions of reaches EC-1 and EC-2, while aggradation was less evident in reach EC-3. Much of this aggradation appeared to be the result of the natural accumulation of sediment upstream from deadfall. Sediment has also naturally accumulated upstream from moss and other macrophytes that are growing on the deadfall, cobbles, and similar obstructions.
- No areas of substantial stream-channel degradation or bank instability were noted in any of the reaches.

Thus, the 2015 survey data and visual observations of the reference reaches indicate that mine-water discharges have not substantially impacted geomorphic conditions in Eccles Creek.

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CHAPTER 4

REFERENCES

Harrelson, C.C., C.L. Rawlins, and J.P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. General Technical Report RM-245. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, Colorado.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado.

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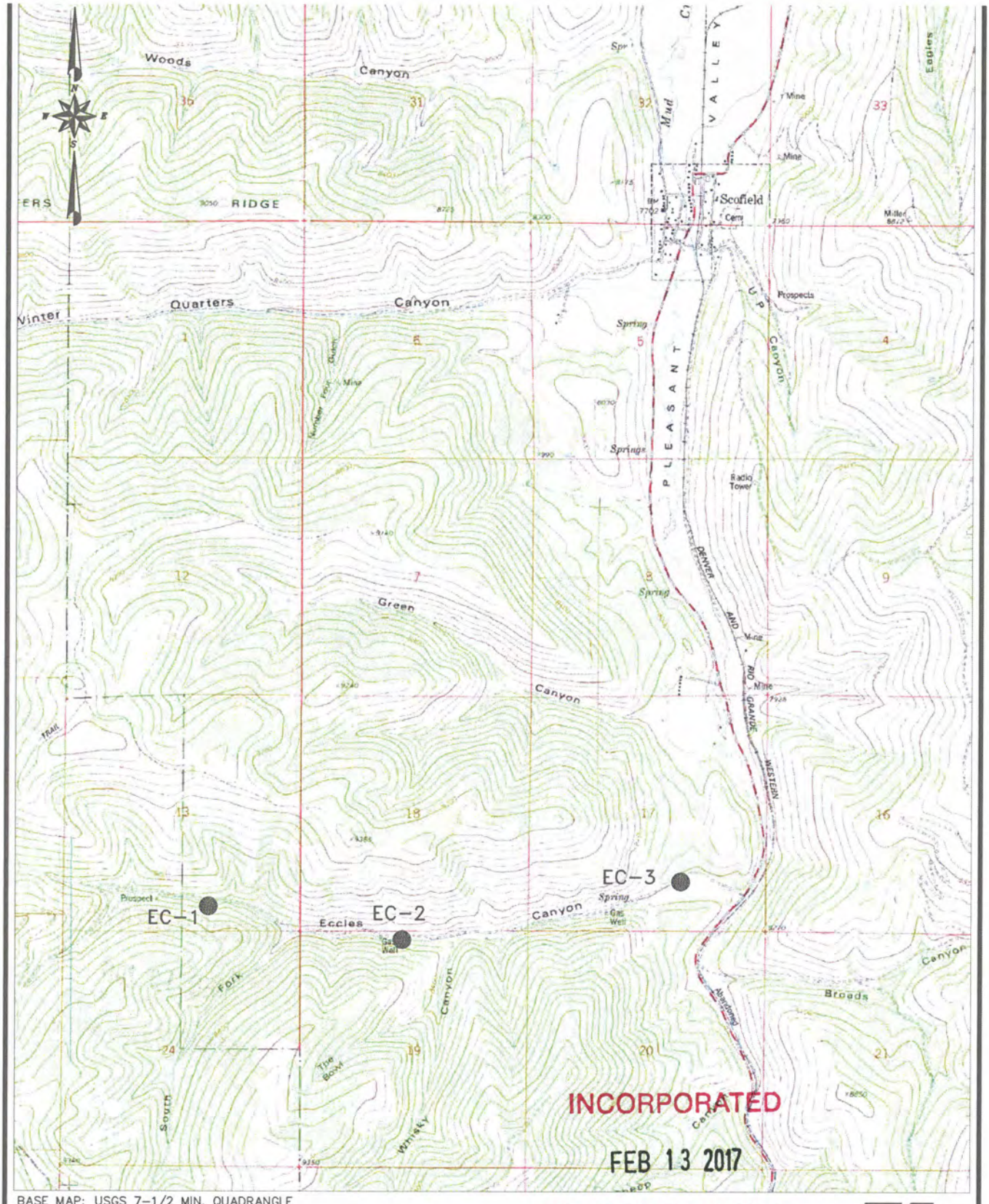

BASE MAP: USGS 7-1/2 MIN. QUADRANGLE
SCOFIELD, UTAH (1979)

FIGURE 2-1. LOCATION OF REFERENCE SITES

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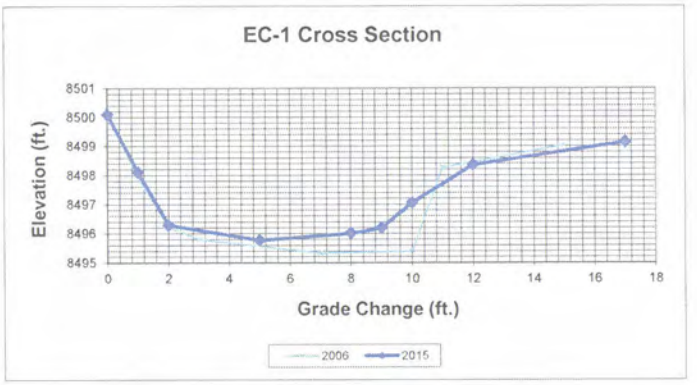
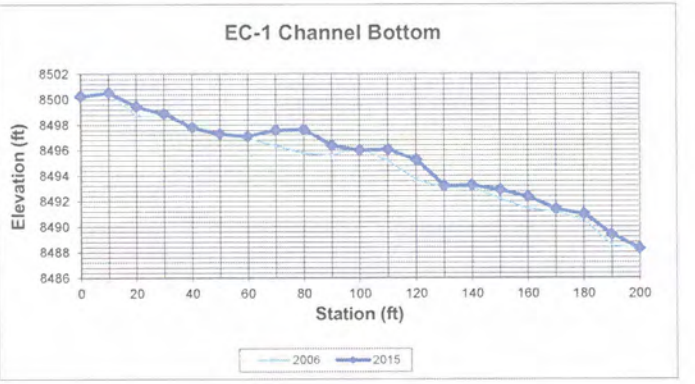
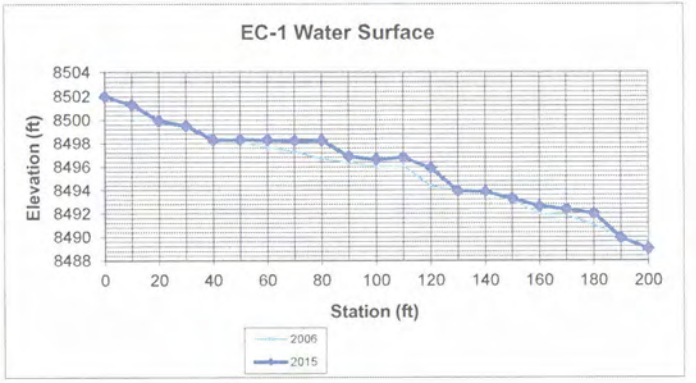
G:\UC794123 - 2015 Eccles Creek geomorph survey\FIG-2-1.dwg, 10/6/2015 2:35:38 PM







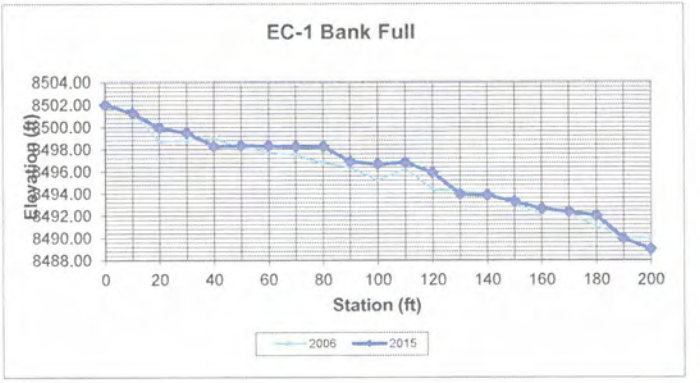


FIGURE 3-1. EC-1 CROSS-SECTION AND PROFILES

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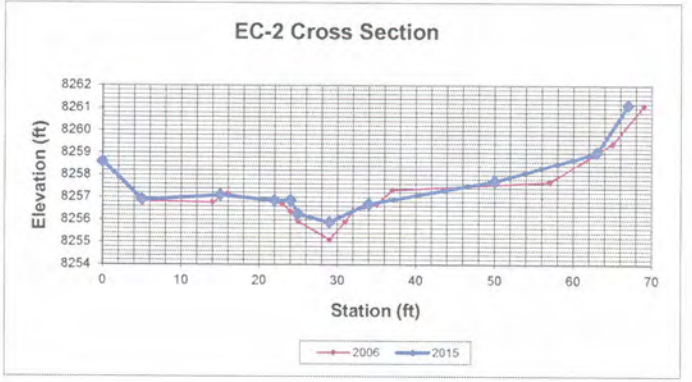

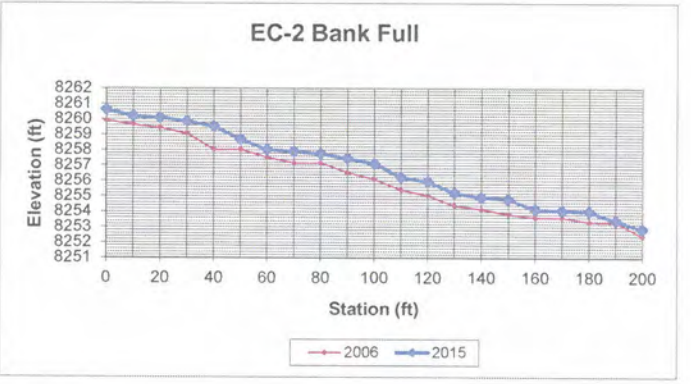

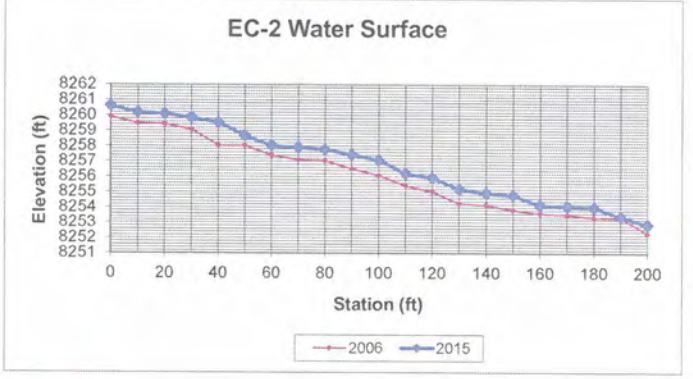

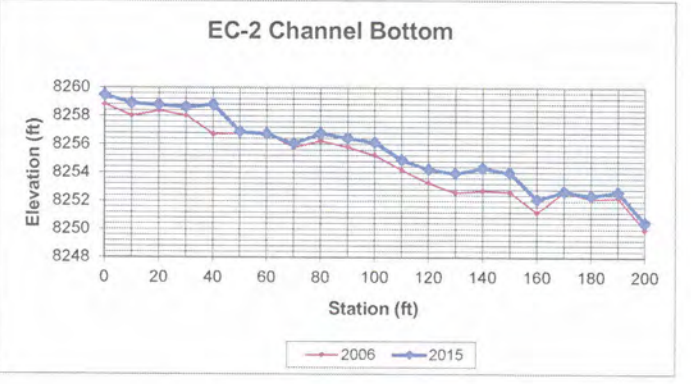

FIGURE 3-2. EC-2 CROSS-SECTION AND PROFILES

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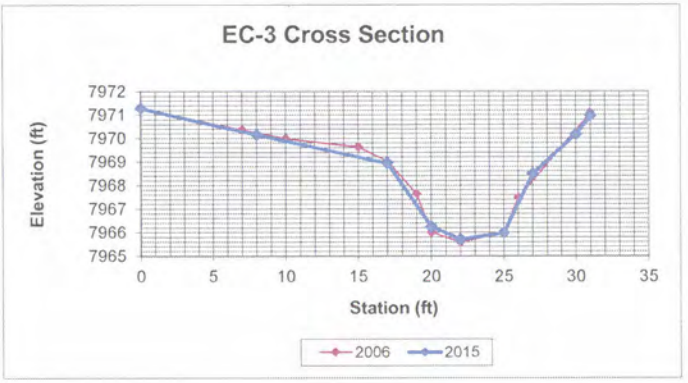
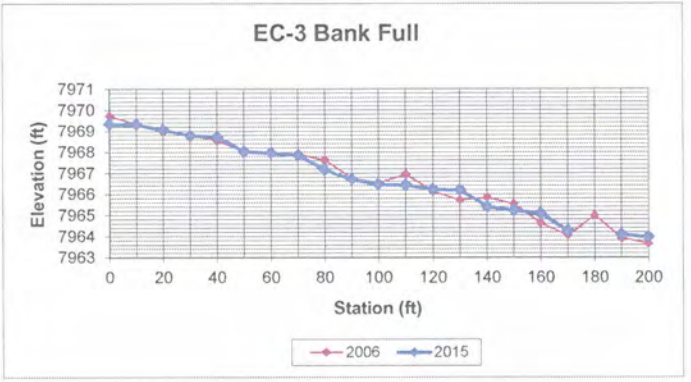
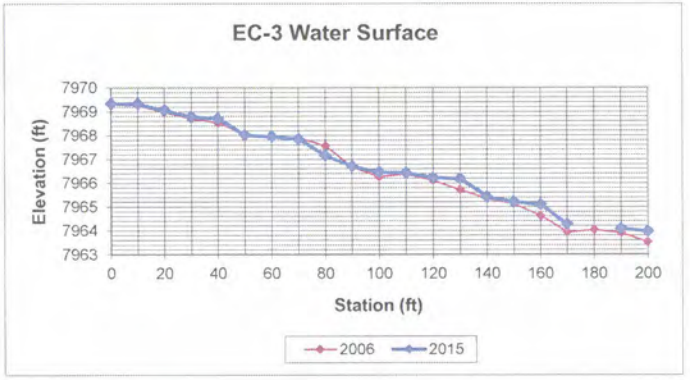
UC794-23







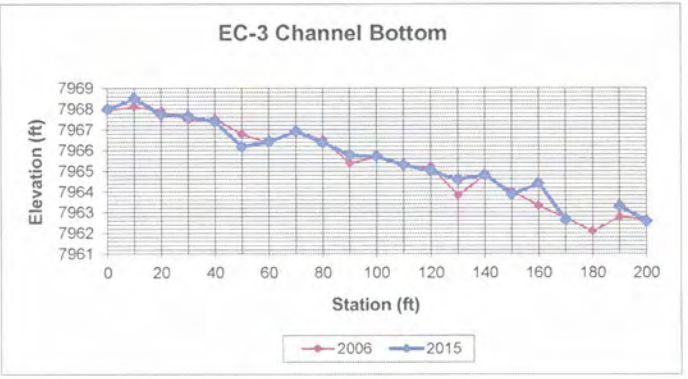


FIGURE 3-3. EC-3 CROSS-SECTION AND PROFILES

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APPENDIX A

Reference Site Photographs

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EC-1 cross section

EC-1 upstream view

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EC-1 downstream view

EC-2 cross section

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EC-2 lower upstream view

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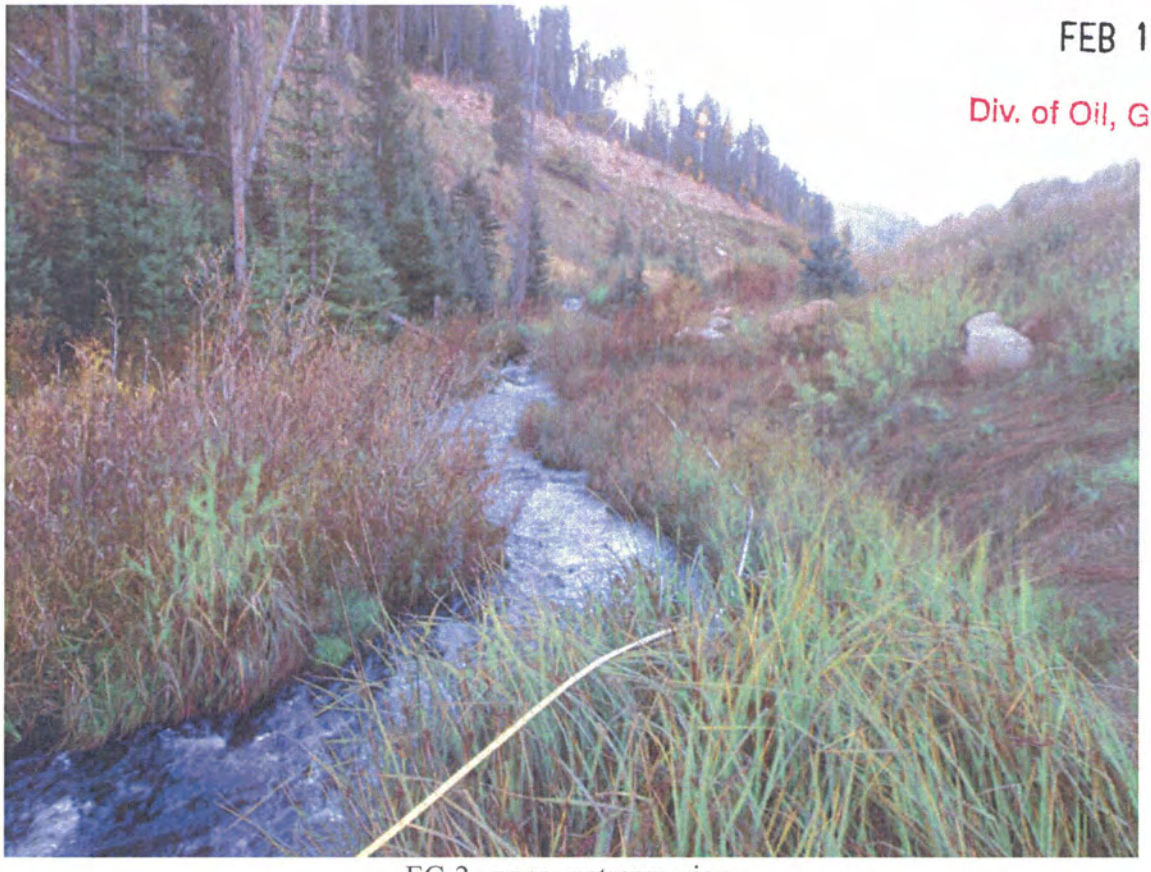

EC-2 upper upstream view

EC-2 upper downstream view

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EC-2 lower downstream view

EC-3 cross section

EC-3 lower upstream view

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EC-3 upper upstream view

EC-3 downstream view

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APPENDIX B

Copy of Field Log Book

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2

EC-1 Profile 23 Sep 2015

BM = 3.85

Sta	WS	Bottom	Backfill
0+00	1.00	2.72	@ WS
0+10	1.71	2.46	"
0+20	3.09	3.55	"
0+30	3.50	4.12	"
0+40	4.73	5.18	"
0+50	4.67	5.69	"
0+60	4.69	5.88	
0+70	4.78	5.41	
0+80	4.75	5.36	
0+90	6.11	6.63	
1+00	6.35	6.99	
1+10	6.20	6.94	
1+20	7.12	7.74	
1+30	9.08	9.78	
1+40	9.15	9.75	
1+50	9.72	10.10	
1+60	10.38	10.63	
1+70	10.65	11.60	
1+80	11.01	11.99	
1+90	13.08	13.61	
2+00	14.00	14.70	

3

EC-1 Cross section

BM = 2.47

Sta	Elev.
0+00	1.51
0+01	3.50
0+02	5.31
0+05	5.83
0+08	5.60
0+09	5.42
0+10	4.55
0+12	3.25
0+17	2.47

Survey instrument → Leica Rugby 82 Laser level

Rite in the Rain

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4

EC-2 Profile

23 Sep 2015

Sta	WS	Bottom	Backfill
0+00	2.34	3,48	@ WS
0+10	2.76	4,06	
0+20	2,80	4,16	
0+30	3,10	4,33	
0+40	3,42	4,15	
0+50	4,28	6,07	
0+60	4,92	6,22	
0+70	5.05	6,90	
0+80	5,18	6,18	
0+90	5,49	6,50	
1+00	5,86	6,83	
1+10	6,74	8,05	
1+20	7,01	8,68	
1+30	7,75	8,99	
1+40	8,02	8,62	
1+50	8,15	8,95	
1+60	8,80	10,85	
1+70	8,87	10,27	
1+80	8,94	10,58	
1+90	9,53	10,30	
2+00	10,09	12,48	

5

EC-2 Cross Sectio

Sta	Elev	
0+00	4,36	Base of south stake
0+05	6,06	
0+15	5,85	
0+22	6,09	
0+24	6,09	
0+25	6,71	
0+29	7,06	
0+34	6,25	
0+50	5,23	
0+63	3,94	
0+67	1,81	Base of north stake

Bench mark not found. Used elev at base of stakes for BM.

Rite in the Rain

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EC-3 Profile

30 Sep 2015

Sta	WS	Bottom	Backfill @ WS
0+00	6.55	7.90	
0+10	6.56	7.39	
0+20	6.82	8.17	
0+30	7.10	8.24	
0+40	7.17	8.50	
0+50	7.86	9.71	
0+60	7.93	9.47	
0+70	8.04	8.97	
0+80	8.73	9.53	
0+90	9.18	10.11	
1+00	9.42	10.17	
1+10	9.45	10.60	
1+20	9.66	10.88	
1+30	9.70	11.30	
1+40	10.48	11.07	
1+50	10.67	12.02	
1+60	10.80	11.50	
1+70	11.62	13.27	
1+80	Huge deadfall tree blocking sight.		
1+90	11.80	12.60	
2+00	11.92	13.33	

7

EC-3 Cross section

Sta	Elev.	
0+00	4.61	Base of south stake
0+08	5.73	
0+17	6.94	
0+20	9.64	
0+22	10.17	
0+25	9.90	
0+27	7.40	
0+30	5.72	
0+31	4.93	Base of north stake

Could not locate bench mark. Used base of cross section stakes for reference.

Rite in the Rain

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APPENDIX C

Survey Tabulations with
Individual Cross Section and Profile Drawings

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Profile: EC-1

Benchmark elevation (ft): 8499.13 Survey date: 9/23/2015
Rod reading at benchmark (ft): 3.85

	Water Surface (ft)		Channel Bottom (ft)		Water Surface Calculations			Bankfull (ft)	
Station	Rod Reading	Elevation	Rod Reading	Elevation	Elev change	Distance	Slope (fraction)	Rod Reading	Elevation
0	1.00	8501.98	2.72	8500.26				1.00	8501.98
10	1.71	8501.27	2.46	8500.52	0.71	10.00	0.071	1.71	8501.27
20	3.09	8499.89	3.55	8499.43	1.38	10.00	0.138	3.09	8499.89
30	3.50	8499.48	4.12	8498.86	0.41	10.00	0.041	3.50	8499.48
40	4.73	8498.25	5.18	8497.80	1.23	10.00	0.123	4.73	8498.25
50	4.67	8498.31	5.69	8497.29	-0.06	10.00	-0.006	4.67	8498.31
60	4.69	8498.29	5.88	8497.10	0.02	10.00	0.002	4.69	8498.29
70	4.78	8498.20	5.41	8497.57	0.09	10.00	0.009	4.78	8498.20
80	4.75	8498.23	5.36	8497.62	-0.03	10.00	-0.003	4.75	8498.23
90	6.11	8496.87	6.63	8496.35	1.36	10.00	0.136	6.11	8496.87
100	6.35	8496.63	6.99	8495.99	0.24	10.00	0.024	6.35	8496.63
110	6.20	8496.78	6.94	8496.04	-0.15	10.00	-0.015	6.20	8496.78
120	7.12	8495.86	7.74	8495.24	0.92	10.00	0.092	7.12	8495.86
130	9.08	8493.90	9.78	8493.20	1.96	10.00	0.196	9.08	8493.90
140	9.15	8493.83	9.75	8493.23	0.07	10.00	0.007	9.15	8493.83
150	9.72	8493.26	10.10	8492.88	0.57	10.00	0.057	9.72	8493.26
160	10.38	8492.60	10.63	8492.35	0.66	10.00	0.066	10.38	8492.60
170	10.65	8492.33	11.60	8491.38	0.27	10.00	0.027	10.65	8492.33
180	11.01	8491.97	11.99	8490.99	0.36	10.00	0.036	11.01	8491.97
190	13.08	8489.90	13.61	8489.37	2.07	10.00	0.207	13.08	8489.90
200	14.00	8488.98	14.70	8488.28	0.92	10.00	0.092	14.00	8488.98

Max. Water Surface Slope (fraction): 0.207
Min. Water Surface Slope (fraction): -0.015
Avg. Water Surface Slope (fraction): 0.065

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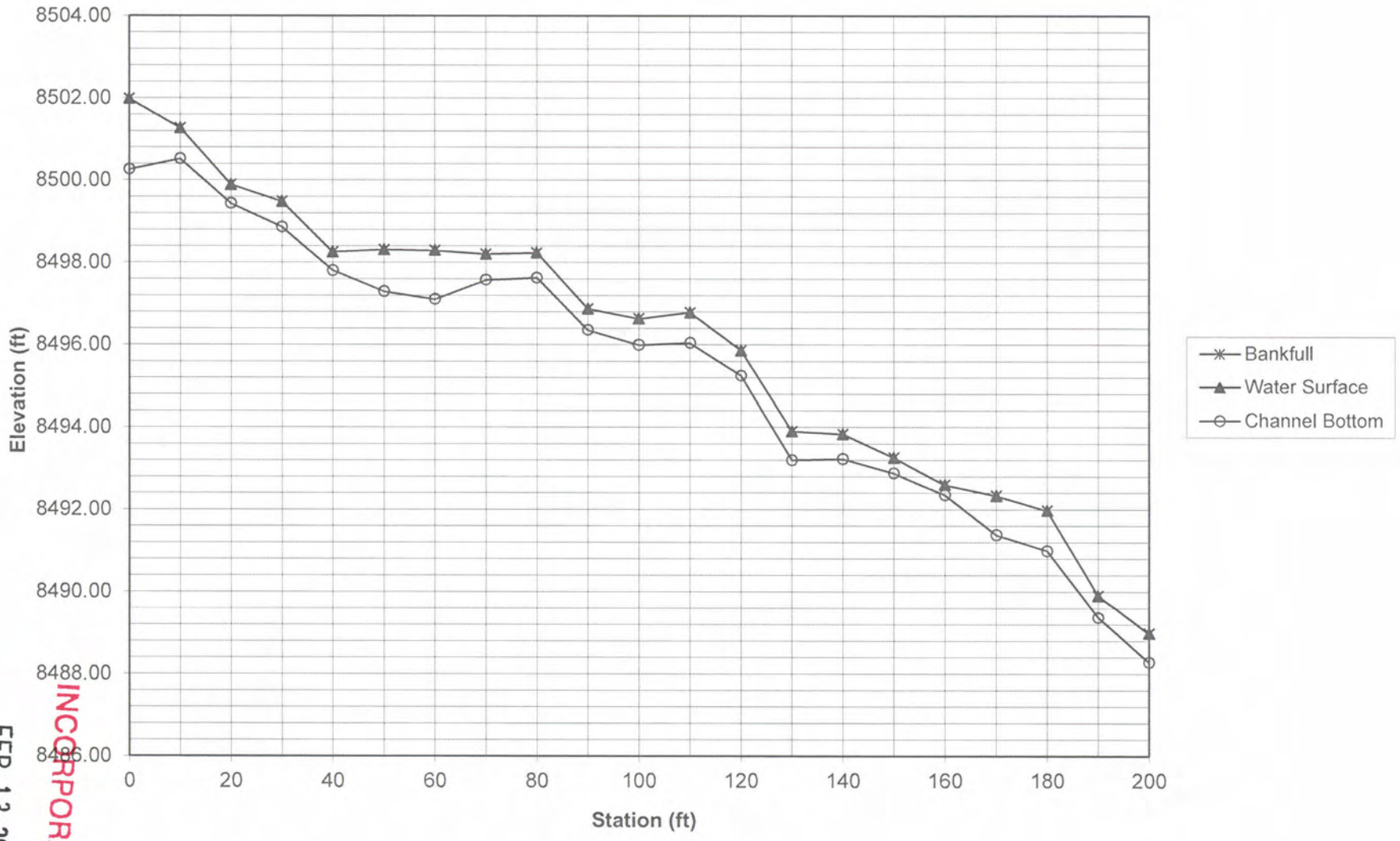
2015 Profile EC-1



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Cross Section: EC-1

Benchmark elevation: 8499.13 Survey Date: 9/23/2015
BenchMark Rod Reading: 2.47

Station	Rod Reading	Elevation
0	1.51	8500.09
1	3.50	8498.10
2	5.31	8496.29
5	5.83	8495.77
8	5.60	8496.00
9	5.42	8496.18
10	4.55	8497.05
12	3.25	8498.35
17	2.47	8499.13

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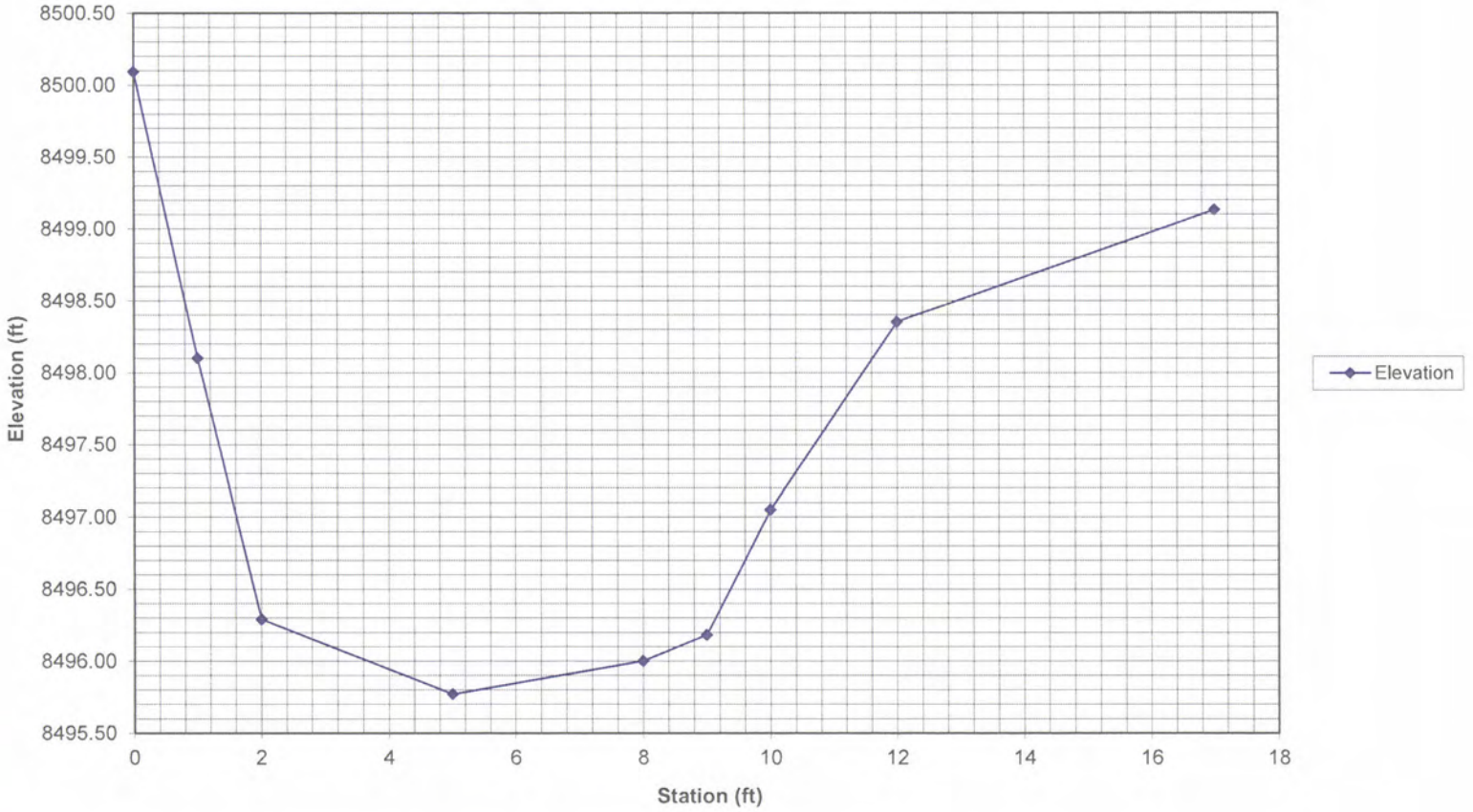
2015 Cross Section EC-1



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Profile: EC-2

Benchmark elevation (ft): 8257.72 Survey date: 9/23/2015
Rod reading at benchmark (ft): 5.22 (Note: Benchmark not found. 2015 Rod reading at benchmark based on 2006 elevation difference between benchmark and cross section station 0+00)

	Water Surface (ft)		Channel Bottom (ft)		Water Surface Calculations			Bankfull (ft)	
Station	Rod Reading	Elevation	Rod Reading	Elevation	Elev change	Distance	Slope (fraction)	Rod Reading	Elevation
0	2.34	8260.60	3.48	8259.46				2.34	8260.60
10	2.76	8260.18	4.06	8258.88	0.42	10.00	0.042	2.76	8260.18
20	2.86	8260.08	4.16	8258.78	0.10	10.00	0.010	2.86	8260.08
30	3.10	8259.84	4.33	8258.61	0.24	10.00	0.024	3.10	8259.84
40	3.42	8259.52	4.15	8258.79	0.32	10.00	0.032	3.42	8259.52
50	4.28	8258.66	6.07	8256.87	0.86	10.00	0.086	4.28	8258.66
60	4.92	8258.02	6.22	8256.72	0.64	10.00	0.064	4.92	8258.02
70	5.05	8257.89	6.90	8256.04	0.13	10.00	0.013	5.05	8257.89
80	5.18	8257.76	6.18	8256.76	0.13	10.00	0.013	5.18	8257.76
90	5.49	8257.45	6.50	8256.44	0.31	10.00	0.031	5.48	8257.46
100	5.86	8257.08	6.83	8256.11	0.37	10.00	0.037	5.86	8257.08
110	6.74	8256.20	8.05	8254.89	0.88	10.00	0.088	6.74	8256.20
120	7.01	8255.93	8.68	8254.26	0.27	10.00	0.027	7.01	8255.93
130	7.75	8255.19	8.99	8253.95	0.74	10.00	0.074	7.75	8255.19
140	8.02	8254.92	8.62	8254.32	0.27	10.00	0.027	8.02	8254.92
150	8.15	8254.79	8.95	8253.99	0.13	10.00	0.013	8.15	8254.79
160	8.80	8254.14	10.85	8252.09	0.65	10.00	0.065	8.80	8254.14
170	8.87	8254.07	10.27	8252.67	0.07	10.00	0.007	8.87	8254.07
180	8.94	8254.00	10.58	8252.36	0.07	10.00	0.007	8.94	8254.00
190	9.53	8253.41	10.30	8252.64	0.59	10.00	0.059	9.53	8253.41
200	10.08	8252.86	12.48	8250.46	0.55	10.00	0.055	10.08	8252.86

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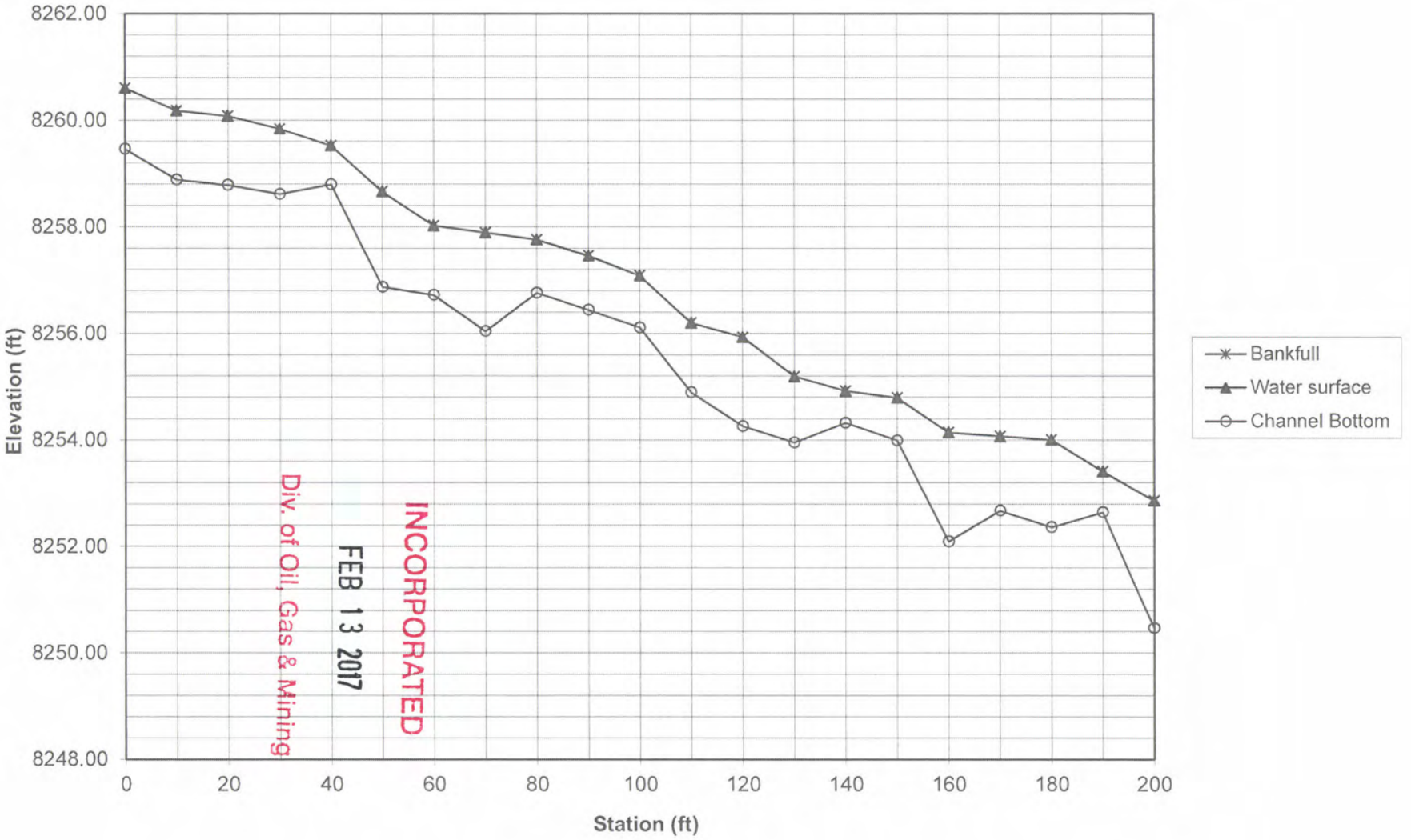
Max. Water Surface Slope (fraction): 0.088
Min. Water Surface Slope (fraction): 0.007
Avg. Water Surface Slope (fraction): 0.039

2015 Profile EC-2



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Cross Section: EC-2

Benchmark elevation: 8257.72
BenchMark Rod Reading: 5.22

Survey Date: 9/23/2015
(Note: Benchmark not found. 2015 Rod reading at benchmark based on 2006 elevation difference between benchmark and cross section station 0+00)

Station	Rod Reading	Elevation
0	4.36	8258.58
5	6.06	8256.88
15	5.85	8257.09
22	6.09	8256.85
24	6.09	8256.85
25	6.71	8256.23
29	7.06	8255.88
34	6.25	8256.69
50	5.23	8257.71
63	3.94	8259.00
67	1.81	8261.13

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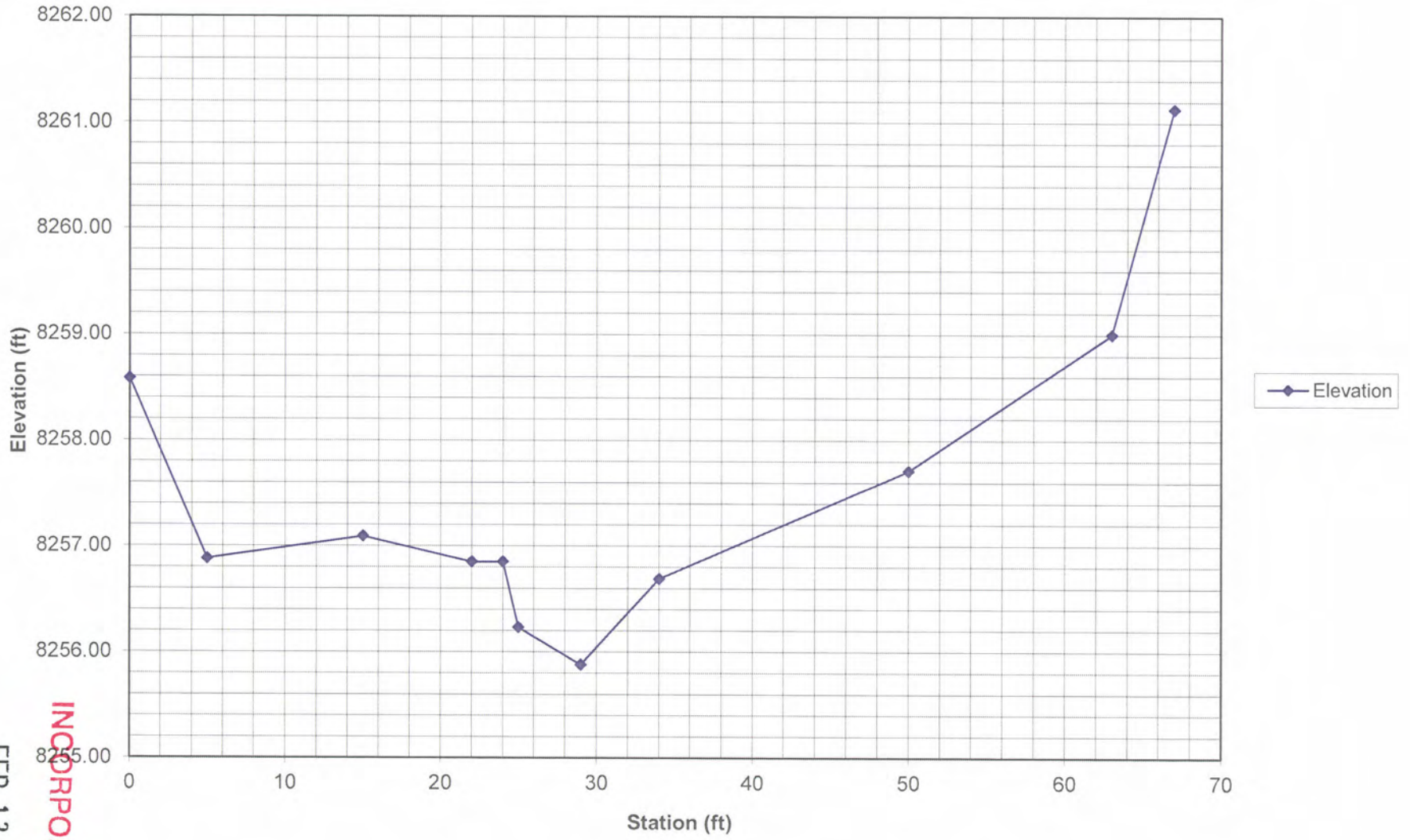
2015 Cross Section EC-2



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Profile: EC-3

Benchmark elevation (ft): 7971.59 Survey date: 9/30/2015
Rod reading at benchmark (ft): 4.29 (Note: Benchmark not found. 2015 Rod reading at benchmark based on 2006 elevation difference between benchmark and cross section station 0+00)

	Water Surface (ft)		Channel Bottom (ft)		Water Surface Calculations			Bankfull (ft)	
Station	Rod Reading	Elevation	Rod Reading	Elevation	Elev change	Distance	Slope (fraction)	Rod Reading	Elevation
0	6.55	7969.33	7.90	7967.98				6.55	7969.33
10	6.56	7969.32	7.39	7968.49	0.01	10.00	0.001	6.56	7969.32
20	6.82	7969.06	8.17	7967.71	0.26	10.00	0.026	6.82	7969.06
30	7.10	7968.78	8.24	7967.64	0.28	10.00	0.028	7.10	7968.78
40	7.17	7968.71	8.50	7967.38	0.07	10.00	0.007	7.17	7968.71
50	7.86	7968.02	9.71	7966.17	0.69	10.00	0.069	7.86	7968.02
60	7.93	7967.95	9.47	7966.41	0.07	10.00	0.007	7.93	7967.95
70	8.04	7967.84	8.97	7966.91	0.11	10.00	0.011	8.04	7967.84
80	8.73	7967.15	9.53	7966.35	0.69	10.00	0.069	8.73	7967.15
90	9.18	7966.70	10.11	7965.77	0.45	10.00	0.045	9.18	7966.70
100	9.42	7966.46	10.17	7965.71	0.24	10.00	0.024	9.42	7966.46
110	9.45	7966.43	10.60	7965.28	0.03	10.00	0.003	9.45	7966.43
120	9.66	7966.22	10.88	7965.00	0.21	10.00	0.021	9.66	7966.22
130	9.70	7966.18	11.30	7964.58	0.04	10.00	0.004	9.70	7966.18
140	10.48	7965.40	11.07	7964.81	0.78	10.00	0.078	10.48	7965.40
150	10.67	7965.21	12.02	7963.86	0.19	10.00	0.019	10.67	7965.21
160	10.80	7965.08	11.50	7964.38	0.13	10.00	0.013	10.80	7965.08
170	11.62	7964.26	13.27	7962.61	0.82	10.00	0.082	11.62	7964.26
180	No measurements taken at this station. Large deadfall tree is blocking sight across channel.								
190	11.80	7964.08	12.60	7963.28	0.18	20.00	0.009	11.80	7964.08
200	11.92	7963.96	13.33	7962.55	0.12	10.00	0.012	11.92	7963.96

Max. Water Surface Slope (fraction): 0.082
Min. Water Surface Slope (fraction): 0.001
Avg. Water Surface Slope (fraction): 0.028

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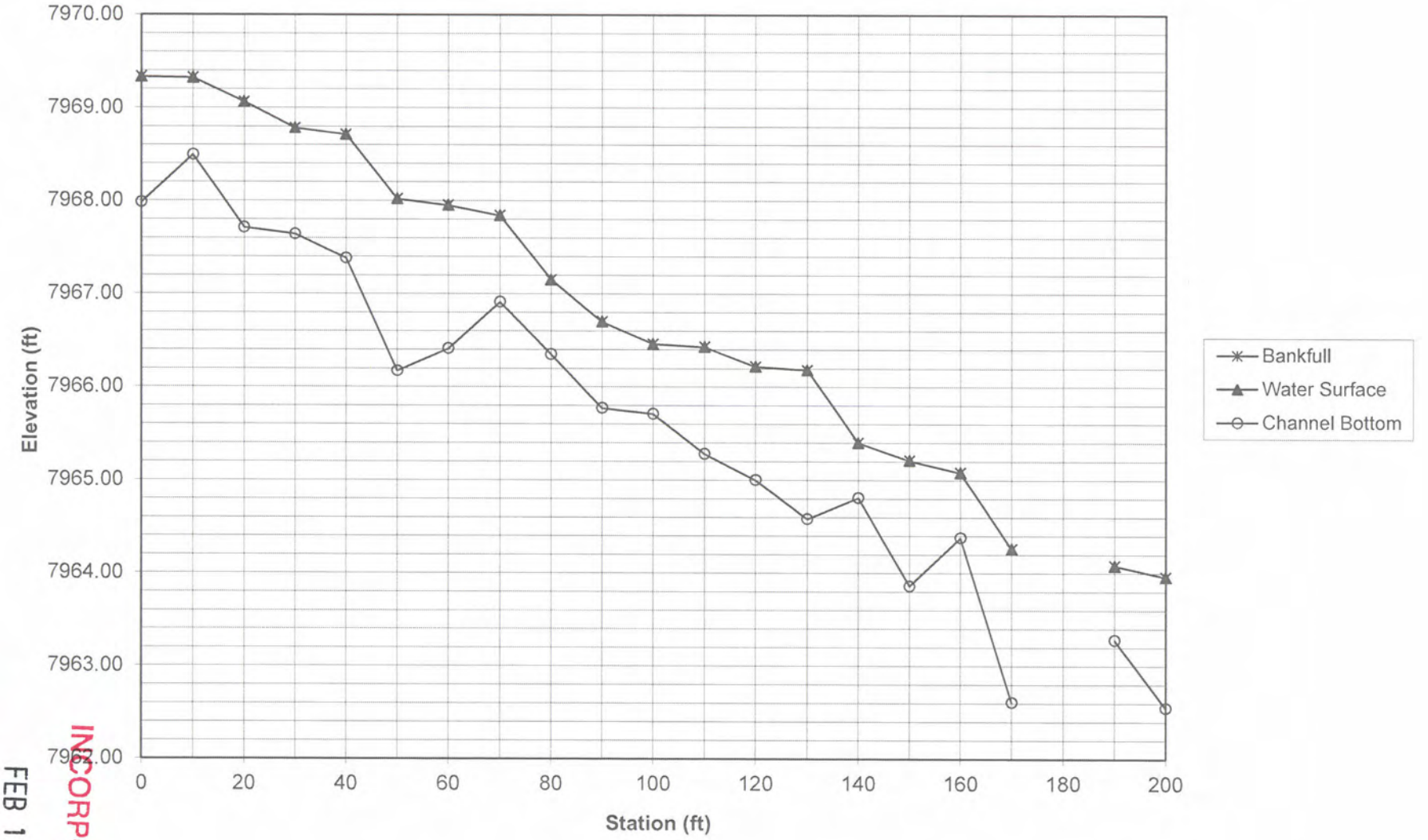
2015 Profile EC-3



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Cross Section: EC-3

Benchmark elevation: 7971.59
BenchMark Rod Reading: 4.29

Survey Date: 9/30/2015
(Note: Benchmark not found. 2015 Rod reading at benchmark based on 2006 elevation difference between benchmark and cross section station 0+00)

Station	Rod Reading	Elevation
0	4.61	7971.27
8	5.73	7970.15
17	6.94	7968.94
20	9.64	7966.24
22	10.17	7965.71
25	9.90	7965.98
27	7.40	7968.48
30	5.72	7970.16
31	4.93	7970.95

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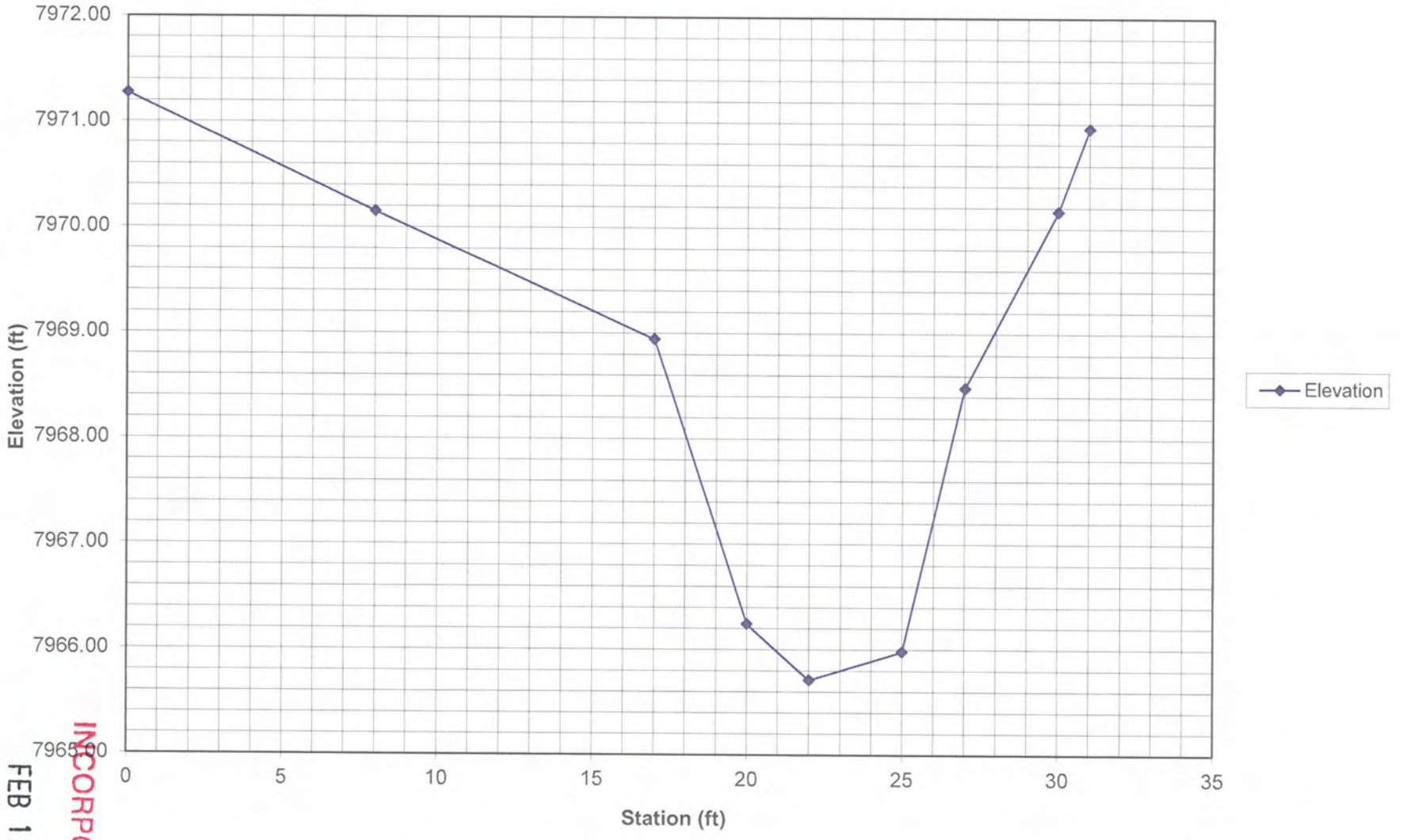
2015 Cross Section EC-3



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Lease UTU – 77114 Baseline Water Quality Data of Proposed Additional Water Monitoring Sites

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Lease UTU – 77114
Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
-Field Data-

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Lease UTU-77114 Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
2nd Quarter 2014

Site	Date	Time	T (°C)	pH	Cond (µS)	Q (gpm)	COC?	Initials	Sampler	Comment
S4-173 (SW4-173)	24-Jun-14	11:00	4	7.25	162	0.6		ECP	Eric Petersen	
S4-429 (SW4-429)	24-Jun-14	11:30	4.6	7	136	3.2		ECP	Eric Petersen	
C-8 (CS-30)	24-Jun-14	12:00	9.3	8.33	299	1730.0		ECP	Eric Petersen	
S33-268 (SW33-268)	24-Jun-14	12:30	4.2	7.42	63	0.8		ECP	Eric Petersen	plus 1.45 gpm in pipe below in grass (not typical)
32-277 (SW32-277)	24-Jun-14	13:00	5.2	7.46	204	2.2		ECP	Eric Petersen	
C-6 (CS-29)	24-Jun-14	13:30	14.4	8.81	177	204.0		ECP	Eric Petersen	
Girls Camp (CS-27)	24-Jun-14	14:15	4.2	7.39	293	10.3		ECP	Eric Petersen	
Swens upper sheep camp (CS-28)	24-Jun-14	16:00	4.7	7.29	476	103.0		ECP	Eric Petersen	

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Lease UTU-77114 Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
3rd Quarter 2014

Site		Date	Time	T (°C)	pH	Cond (µS)	Q (gpm)	COC?	Initials	Sampler	Comment
S33-268	Lab	9/16/2014	1230	6.2	6.62	106	0.82	Y	GG		
S32-277	Lab	9/16/2014	1320	7.4	7.14	239	0.33	Y	GG		
S4-429	Lab	9/16/2014	1420	6.9	6.83	174	1.2	Y	GG		
S4-173	Lab	9/25/2014	1010	5.3	7.42	287	0.52	Y	GG/JA		
CS-30	Lab	9/25/2014	1040	5.8	8.44	304	445.65	Y	GG/JA		
CS-29	Lab	9/25/2014	1110	8.3	7.72	280	136.34	Y	GG/JA		
CS-28	Lab	9/25/2014	1230	6.7	8.56	329	133.33	Y	GG/JA		
CS-27	Lab	9/25/2014	1330	6.2	8.42	337	9.87	Y	GG/JA		

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Lease UTU-77114 Baseline Water Quality Data of Proposed Additional Water Monitoring Sites

4th Quarter 2014

Site		Date	Time	T (°C)	pH	Cond (µS)	Q (gpm)	COC?	Initials	Sampler	Comment
S33-268	Lab	11/12/2014	1030	2.5	7.25	11.3	0.82	YES	JA	J.Armstrong	
S32-279	Lab	11/12/2014	940	0.5	7.94	2.46	2.17	YES	JA	J.Armstrong	
S4-429	Lab	11/12/2014	1205	4.7	7.81	163	1.13	YES	JA	J.Armstrong	
S4-173	Lab	11/12/2014	1115	3.2	7.75	274	0.35	YES	JA	J.Armstrong	
CS-30	Lab	11/12/2014	1245	0.6	8.67	309	501.4	YES	JA	J.Armstrong	
CS-29	Lab	11/12/2014	1325	0.1	8.16	309	103.5	YES	JA	J.Armstrong	
CS-28	Lab	11/12/2014	1540	-0.7	8.53	360	100.3	YES	JA	J.Armstrong	
S28-110	Field										
CS-27	Lab	12/2/2014	1010	-0.4	8.61	334	30.52		JA	J.Armstrong	

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Lease UTU-77114 Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
2nd Quarter 2015

Site		Date	Time	T (°C)	pH	Cond (µS)	Q (gpm)	COC?	Initials	Sampler	Comment
S33-268	Lab	6/3/2015	930	3.6	7.62	72	3.5	y	JA	J.Armstrong	
S32-279	Lab	6/3/2015	835	5	7.37	223	5.3	y	JA	J.Armstrong	
S4-429	Lab	6/3/2015	1035	4.1	7.42	165	10.9	y	JA	J.Armstrong	
S4-173	Lab	6/3/2015	1110	4	7.06	931	1.8	y	JA	J.Armstrong	
CS-30	Lab	6/6/2015	910	5.0	8.69	342	3653	y	JA	J.Armstrong	
CS-29	Lab	6/6/2015	830	5.3	8.74	191	1032.6	y	JA	J.Armstrong	
CS-28	Lab	6/6/2015	1030	7.4	8.71	312	1349.8	y	JA	J.Armstrong	
CS-27	Lab	6/11/2015	1235	14.2	8.55	278	255	y	JA	J.Armstrong	
CS-31	Lab	6/29/2015	1300	11.3	8.78	410	594.8	y	JA	J.Armstrong	

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Lease UTU-77114 Baseline Water Quality Data of Proposed Additional Water Monitoring Sites

3rd Quarter 2015

Site		Date	Time	T (°C)	pH	Cond (µS)	Q (gpm)	COC?	Initials	Sampler	Comment
SW33-268	Lab	9/10/2015	9:15				NOF		JA	J.Armstrong	
SW32-279	Lab	9/10/2015	9:55	6.3	7.46	318	0.65	Y	JA	J.Armstrong	
SW4-429	Lab	9/10/2015	12:25				NOF		JA	J.Armstrong	
SW4-173	Lab	9/10/2015	11:40	5.1	7.54	284	0.39	Y	JA	J.Armstrong	
CS-30	Lab	9/15/2015	8:30	6.2	8.68	308	531.4	Y	JA	J.Armstrong	
CS-29	Lab	9/15/2015	9:15	7.6	8.23	267	91	Y	JA	J.Armstrong	
CS-28	Lab	9/9/2015	12:40	7.6	8.47	322	107	Y	JA	J.Armstrong	
CS-27	Lab	9/15/2015	10:30	6.5	8.47	346	27.03	Y	JA	J.Armstrong	
CS-31	Lab	8/28/2015	1155	8.6	8.58	423	79.9	Y	JA	J.Armstrong	
SW5-590	LAB	8/28/2015	1050	3.6	7.47	268	24	Y	JA	J.Armstrong	

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Lease UTU-77114 Baseline Water Quality Data of Proposed Water Monitoring Sites
4th Quarter 2015

Site		Date	Time	T (°C)	pH	Cond (µS)	Q (gpm)	Depth (ft)	DO	ISOTOPE	COC?		Initials	Sampler	Comment
SW33-268	NOF	11/24/2015	10:35				0				NOF		JA	J.Armstrong	
SW32-277	Lab	11/24/2015	9:40	7.2	7.24	234	0.63				Y		JA	J.Armstrong	
SW4-429	NOF	11/24/2015	12:35				0				NOF		JA	J.Armstrong	
SW4-173	Lab	11/24/2015	13:15	3.2	7.24	277	0.29				Y		JA	J.Armstrong	
CS-30	Lab	12/7/2015	13:20	2.4	8.63	341	395.9				Y		JA	J.Armstrong	
CS-29	Lab	12/7/2015	13:35	0.8	8.05	301	54.7				Y		JA	J.Armstrong	
CS-28	Lab	11/19/2015	13:00	11.7	8.63	346	67.1				Y		JA	J.Armstrong	
CS-27	NOF	11/19/2015	12:15				0				N		JA	J.Armstrong	
CS-31	Lab	12/18/2015	11:10	3.4	8.45	334	122.14				Y		JA	J.Armstrong	
SW5-590	LAB	12/18/2015	10:35	3.1	7.51	284	5.5				Y		JA	J.Armstrong	

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Lease UTU-77114 Baseline Water Quality Data of Proposed Water Monitoring Sites
2nd Quarter 2016

Site		Date	Time	T (°C)	pH	Cond (µS)	Q (gpm)	Depth (ft)	DO	ISOTOPE	COC?		Initials	Sampler	Comment
SW33-268	Lab	6/9/2016	8:45	5.6	7.63	768	5				Y		JA	J.Armstrong	
SW32-277	Lab	6/9/2016	9:40	5.8	7.45	201	4.46				Y		JA	J.Armstrong	
SW4-429	Lab	6/9/2016	11:30	5	7.58	148	10.5				Y		JA	J.Armstrong	
SW4-173	Lab	6/9/2016	10:30	4.8	7.66	86.1	1.27				Y		JA	J.Armstrong	
CS-30	Lab	6/8/2016	8:40	6.4	8.29	279	7139.4				Y		JA	J.Armstrong	
CS-29	Lab	6/8/2016	8:05	5.9	8	158.2	888.4				Y		JA	J.Armstrong	
CS-28	Lab	6/8/2016	13:00	12.6	8.65	271	1408.5				Y		JA	J.Armstrong	
CS-27	Lab	6/8/2016	13:25	15.7	8.78	233	1145.5				Y		JA	J.Armstrong	
CS-31	Lab	6/9/2016	13:30	10.5	8.58	331	2506.1				Y		JA	J.Armstrong	
SW5-590	LAB	6/9/2016	12:35	4.3	7.46	251	37.5				Y		JA	J.Armstrong	

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Lease UTU-77114 Baseline Water Quality Data of Proposed Water Monitoring Sites
3rd Quarter 2016

Site		Date	Time	T (°C)	pH	Cond (µS)	Q (gpm)	Depth (ft)	DO	ISOTOPE	COC?		Initials	Sampler	Comment
SW33-268	Lab	9/26/2016	12:25	8	7.4	107.8	0.65				Y		JA	J.Armstrong	
SW32-277	Lab	9/26/2016	9:45	7.7	7.43	308	0.5				Y		JA	J.Armstrong	
SW4-429	Lab	7/14/2016	12:35	6.2	7.6	192.8	1.86				Y		JA	J.Armstrong	
SW4-173	Lab	7/14/2016	13:15	5.2	7.83	237	0.45				Y		JA	J.Armstrong	
CS-30	Lab	7/14/2016	13:45	13.5	8.74	301	1408.1				Y		JA	J.Armstrong	
CS-29	Lab	7/14/2016	14:15	17.0	8.93	227	176.1				Y		JA	J.Armstrong	
CS-28	Lab	7/14/2016	9:50	6.1	8.53	370	259.7				Y		JA	J.Armstrong	
CS-27	Lab	7/14/2016	8:20	6.1	8.52	329	53.86				Y		JA	J.Armstrong	
CS-31	Lab	7/14/2016	11:15	9.8	8.75	443	468.5				Y		JA	J.Armstrong	
SW5-590	LAB	7/14/2016	10:45	5.6	7.59	279	28.3				Y		JA	J.Armstrong	

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Lease UTU-77114 Baseline Water Quality Data of Proposed Water Monitoring Sites
4th Quarter 2016

Site		Date	Time	T (°C)	pH	Cond (µS)	Q (gpm)	Depth (ft)	DO	ISOTOPE	COC?		Initials	Sampler	Comment
SW33-268	Lab	10/10/2016	12:15	5	6.55	107	0.49				Y		GG	G.Galecki	
SW32-277	Lab	10/10/2016	11:30	1.6	7.63	132	0.33				Y		GG	G.Galecki	
SW4-429	Lab	10/10/2016	13:30	7.3	7.51	185	0.61				Y		GG	G.Galecki	
SW4-173	Lab	10/10/2016	14:00	5.1	7.48	281	0.38				Y		GG	G.Galecki	
CS-30	Lab	10/18/2016	12:10	4.1	8.82	301	412.9				Y		JA	J.Armstrong	
CS-29	Lab	10/18/2016	11:40	3.9	8.43	285	154.8				Y		JA	J.Armstrong	
CS-28	Lab	10/18/2016	11:00	3	8.75	369	71.2				Y		JA	J.Armstrong	
CS-27	Lab	10/18/2016	10:15	3.5	8.54	369	9.8				Y		JA	J.Armstrong	
CS-31	Lab	10/28/2016	10:05	4.1	8.42	454	40.67				Y		JA/GG	J.Armstrong	
SW5-590	LAB	10/28/2016	9:55	4.3	7.6	278	20.59				Y		JA/GG	J.Armstrong	

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Lease UTU – 77114
Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
-Lab Data-
Site: SW33-268

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SGS

Analysis Report

October 13, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	S33-268	Sample ID By:	Skyline Mine
Date Sampled:	Sep 16, 2014	Sample Taken At:	S33-268
Date Received:	Sep 18, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1230
		Time Received:	1555
		Mine:	21
		Field - pH:	6.62 pH
		Field - Flow:	0.82 GPM
		Field - Conductivity:	106 umhos/cm
		Field - Temperature:	6.2 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1426156-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	40	mg/L	SM2340-B	1	2014-10-07	12:22:35	DI
Anions	0.76	meq/L	SM1030E	0	2014-10-07	12:22:35	DI
Balance	7.78	%	SM1030E	-10	2014-10-07	12:22:35	DI
Cations	0.88	meq/L	SM1030E	0	2014-10-07	12:22:35	DI
Alkalinity, mg CaCO3/L (pH 4.5)	30	mg/L	SM2320-B	5	2014-09-22	17:04:00	HF
Bicarbonate Alkalinity as CaCO3	30	mg/L	SM2320-B	5	2014-09-22	17:04:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-09-22	17:04:00	HF
Total Dissolved Solids	66	mg/L	SM2540-C	30	2014-09-22	15:50:00	AL
Total Suspended Solids	<5	mg/L	SM2540-D	5	2014-09-22	15:50:00	AL
Nitrate + Nitrite as Nitrogen	<0.05	mg/L	EPA 300.0	0.05	2014-09-28	10:10:00	DI
Chloride, Cl	1	mg/L	EPA 300.0	1	2014-09-23	21:44:00	DI
Sulfate, SO4	5	mg/L	EPA 300.0	1	2014-09-23	21:44:00	DI
Phosphorus, Total	0.09	mg/L	SM4500-P E	0.05	2014-09-19	06:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	12.41	mg/L	EPA 200.7	0.03	2014-09-23	21:28:00	HF
Iron, Fe - Total	0.05	mg/L	EPA 200.7	0.05	2014-09-25	07:31:00	HF
Magnesium, Mg - Dissolved	2.12	mg/L	EPA 200.7	0.01	2014-09-23	21:28:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2014-09-25	07:31:00	HF
Potassium, K - Dissolved	0.63	mg/L	EPA 200.7	0.14	2014-09-23	21:28:00	HF

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Div. of Oil, Gas & Mining

Lab Supervisor
Domenic Ibanez
Lab Supervisor

SGS North America Inc. | Minerals Services Division
2035 North Airport Road Huntington UT 84528 t (435) 653-2311 f (435)-653-2436 www.sgs.com/minerals

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Analysis Report

October 13, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	S33-268	Sample ID By:	Skyline Mine
Date Sampled:	Sep 16, 2014	Sample Taken At:	S33-268
Date Received:	Sep 18, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1230
		Time Received:	1555
		Mine:	21
		Field - pH:	6.62 pH
		Field - Flow:	0.82 GPM
		Field - Conductivity:	106 umhos/cm
		Field - Temperature:	6.2 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1426156-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.68	mg/L	EPA 200.7	0.09	2014-09-23	21:28:00	HF

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Lab Supervisor

Domenic Ibanez
Lab Supervisor

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Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW33-268	Sample ID By:	Skyline Mine
Date Sampled:	Nov 14, 2014	Sample Taken At:	SW33-268
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1030
		Time Received:	1330
		Mine:	21
		Field - pH:	7.25pH
		Field - Flow:	0.8 GPM
		Field - Conductivity:	110 umhos/cm
		Field - Temperature:	2.5 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1427014-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	42	mg/L	SM2340-B	1	2014-12-05	13:30:00	DI
Anions	0.80	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Balance	7.62	%	SM1030E	-10	2014-12-05	13:30:00	DI
Cations	0.93	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	33	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Bicarbonate Alkalinity as CaCO3	33	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Total Dissolved Solids	64	mg/L	SM2540-C	30	2014-11-18	13:00:00	AL
Total Suspended Solids	<5	mg/L	SM2540-D	5	2014-11-18	13:00:00	AL
Nitrate + Nitrite as Nitrogen	<0.05	mg/L	EPA 300.0	0.05	2014-11-20	02:06:00	AL
Chloride, Cl	1	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Sulfate, SO4	5	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Phosphorus, Total	0.10	mg/L	SM4500-P E	0.05	2014-12-01	06:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	13.58	mg/L	EPA 200.7	0.03	2014-11-19	16:15:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2014-11-20	15:15:00	HF
Magnesium, Mg - Dissolved	2.00	mg/L	EPA 200.7	0.01	2014-11-19	16:15:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2014-11-20	15:15:00	HF
Potassium, K - Dissolved	0.62	mg/L	EPA 200.7	0.14	2014-11-19	16:15:00	HF

Lab Supervisor

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Div. of Oil, Gas & Mining

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Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW33-268	Sample ID By:	Skyline Mine
Date Sampled:	Nov 14, 2014	Sample Taken At:	SW33-268
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1030
		Time Received:	1330
		Mine:	21
		Field - pH:	7.25pH
		Field - Flow:	0.8 GPM
		Field - Conductivity:	110 umhos/cm
		Field - Temperature:	2.5 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1427014-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.58	mg/L	EPA 200.7	0.09	2014-11-19	16:15:00	HF

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Analysis Report

June 25, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW33-268	Sample ID By:	Skyline Mine
Date Sampled:	Jun 3, 2015	Sample Taken At:	SW33-268
Date Received:	Jun 3, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0930
		Time Received:	1620
		Mine:	21
		Field - pH:	7.63 pH
		Field - Flow:	3.50 GPM
		Field - Conductivity:	72 umhos/cm
		Field - Temperature:	3.6 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1529495-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	28	mg/L	SM2340-B	1	2015-06-25	12:00:00	DI
Anions	0.46	meq/L	SM1030E	0	2015-06-25	12:00:00	DI
Balance	15.00	%	SM1030E	-10	2015-06-25	12:00:00	DI
Cations	0.62	meq/L	SM1030E	0	2015-06-25	12:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	18	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Bicarbonate Alkalinity as CaCO3	18	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Total Dissolved Solids	82	mg/L	SM2540-C	30	2015-06-08	11:30:00	HF
Total Suspended Solids	10	mg/L	SM2540-D	5	2015-06-08	11:30:00	HF
Nitrate + Nitrite as Nitrogen	0.77	mg/L	EPA 300.0	0.05	2015-06-04	22:56:00	DI
Chloride, Cl	1	mg/L	EPA 300.0	1	2015-06-04	22:56:00	DI
Sulfate, SO4	3	mg/L	EPA 300.0	1	2015-06-04	22:56:00	DI
Phosphorus, Total	0.09	mg/L	SM4500-P E	0.05	2015-06-10	08:00:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	8.31	mg/L	EPA 200.7	0.03	2015-06-16	03:38:00	HF
Iron, Fe - Total	0.21	mg/L	EPA 200.7	0.05	2015-06-10	17:53:00	HF
Magnesium, Mg - Dissolved	1.72	mg/L	EPA 200.7	0.01	2015-06-16	03:38:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2015-06-10	17:53:00	HF
Potassium, K - Dissolved	0.51	mg/L	EPA 200.7	0.14	2015-06-16	03:38:00	HF

Lab Supervisor

Domenic Ibanez
Lab Supervisor

SGS North America Inc. | Minerals Services Division
2035 North Airport Road Huntington UT 84528 **t** (435) 653-2311 **f** (435)-653-2436 www.sgs.com/minerals

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Div. of Oil, Gas & Mining

SGS

Analysis Report

June 25, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW33-268	Sample ID By:	Skyline Mine
Date Sampled:	Jun 3, 2015	Sample Taken At:	SW33-268
Date Received:	Jun 3, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0930
		Time Received:	1620
		Mine:	21
		Field - pH:	7.63 pH
		Field - Flow:	3.50 GPM
		Field - Conductivity:	72 umhos/cm
		Field - Temperature:	3.6 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1529495-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.14	mg/L	EPA 200.7	0.09	2015-06-16	03:38:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW33-268	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	SW33-268
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	845
		Time Received:	1600
		Mine:	21
		Field - pH:	7.63 pH
		Field - Flow:	5.0 GPM
		Field - Conductivity:	768 umhos/cm
		Field - Temperature:	5.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-006

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	30	mg/L	SM2340-B	1	2016-06-27	10:00:00	DI
Anions	0.63	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Balance	9.39	%	SM1030E	-10	2016-06-27	10:00:00	DI
Cations	0.59	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	21	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Bicarbonate Alkalinity as CaCO3	21	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Total Dissolved Solids	80	mg/L	SM2540-C	30	2016-06-14	15:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-06-14	15:00:00	HF
Nitrate + Nitrite as Nitrogen	2.00	mg/L	EPA 300.0	0.05	2016-06-16	16:33:00	HF
Chloride, Cl	<1	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Sulfate, SO4	2	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Phosphorus, Total	0.09	mg/L	SM4500-P E	0.05	2016-06-22	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	9.17	mg/L	EPA 200.7	0.03	2016-06-15	19:00:00	HF
Iron, Fe - Total	0.34	mg/L	EPA 200.7	0.05	2016-06-17	12:00:00	HF
Magnesium, Mg - Dissolved	1.65	mg/L	EPA 200.7	0.01	2016-06-15	19:00:00	HF
Manganese, Mn - Total	0.002	mg/L	EPA 200.7	0.002	2016-06-17	12:00:00	HF
Potassium, K - Dissolved	<0.14	mg/L	EPA 200.7	0.14	2016-06-15	19:00:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW33-268	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	SW33-268
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	845
		Time Received:	1600
		Mine:	21
		Field - pH:	7.63 pH
		Field - Flow:	5.0 GPM
		Field - Conductivity:	768 umhos/cm
		Field - Temperature:	5.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-006

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	0.10	mg/L	EPA 200.7	0.09	2016-06-15	19:00:00	HF

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Analysis Report

October 26, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW33-268	Sample ID By:	Skyline Mine
Date Sampled:	Sep 26, 2016	Sample Taken At:	SW33-268
Date Received:	Sep 28, 2016	Sample Taken By:	GG
Product Description:	WATER	Time Sampled:	1225
		Time Received:	1030
		Mine:	21
		Field - pH:	7.40 pH
		Field - Flow:	0.65 GPM
		Field - Conductivity:	108 umhos/cm
		Field - Temperature.	8 0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1640982-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	40	mg/L	SM2340-B	1	2016-10-25	09:30:00	DI
Anions	0.83	meq/L	SM1030E	0	2016-10-25	09:30:00	DI
Balance	3.86	%	SM1030E	-10	2016-10-25	09:30:00	DI
Cations	0.90	meq/L	SM1030E	0	2016-10-25	09:30:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	35	mg/L	SM2320-B	5	2016-09-29	09:00:00	DI
Bicarbonate Alkalinity as CaCO3	35	mg/L	SM2320-B	5	2016-09-29	09:00:00	DI
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-09-29	09:00:00	DI
Total Dissolved Solids	85	mg/L	SM2540-C	30	2016-09-29	16:30:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-09-29	16:30:00	MS
Nitrate + Nitrite as Nitrogen	1.35	mg/L	EPA 300.0	0.05	2016-10-14	01:15:00	LR
Chloride, Cl	2	mg/L	EPA 300.0	1	2016-10-14	01:15:00	LR
Sulfate, SO4	5	mg/L	EPA 300.0	1	2016-10-14	01:15:00	LR
Phosphorus, Total	<0.05	mg/L	SM4500P-E	0.05	2016-10-13	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	12.16	mg/L	EPA 200.7	0.03	2016-10-05	17:34:00	MS
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2016-10-07	11:15:31	MS
Magnesium, Mg - Dissolved	2.29	mg/L	EPA 200.7	0.01	2016-10-05	17:34:00	MS
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2016-10-07	11:15:31	MS
Potassium, K - Dissolved	0.70	mg/L	EPA 200.7	0.14	2016-10-05	17:34:00	MS

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Analysis Report

October 26, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW33-268	Sample ID By:	Skyline Mine
Date Sampled:	Sep 26, 2016	Sample Taken At:	SW33-268
Date Received:	Sep 28, 2016	Sample Taken By:	GG
Product Description:	WATER	Time Sampled:	1225
		Time Received:	1030
		Mine:	21
		Field - pH:	7.40 pH
		Field - Flow:	0.65 GPM
		Field - Conductivity:	108 umhos/cm
		Field - Temperature:	8.0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1640982-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.91	mg/L	EPA 200.7	0.09	2016-10-05	17:34:00	MS

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Div. of Oil, Gas & Mining

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Analysis Report

November 03, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW33-268	Sample ID By:	Skyline Mine
Date Sampled:	Oct 10, 2016	Sample Taken At:	SW33-268
Date Received:	Oct 12, 2016	Sample Taken By:	G.G.
Product Description.	WATER	Time Sampled:	1215
		Time Received:	0930
		Mine:	21
		Field - pH:	6.55 pH
		Field - Flow:	0.49 GPM
		Field - Conductivity:	107 umhos/cm
		Field - Temperature:	5.0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641422-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	41	mg/L	SM2340-B	1	2016-11-01	20:21:32	DI
Anions	0.84	meq/L	SM1030E	0	2016-11-01	20:21:32	DI
Balance	4.25	%	SM1030E	-10	2016-11-01	20:21:32	DI
Cations	0.91	meq/L	SM1030E	0	2016-11-01	20:21:32	DI
Alkalinity, mg CaCO3/L (pH 4.5)	36	mg/L	SM2320-B	5	2016-10-20	12:41:00	DI
Bicarbonate Alkalinity as CaCO3	36	mg/L	SM2320-B	5	2016-10-20	12:41:00	DI
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-10-20	12:41:00	DI
Total Dissolved Solids	80	mg/L	SM2540-C	30	2016-10-14	16:51:47	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-10-14	16:31:12	MS
Nitrate + Nitrite as Nitrogen	1.02	mg/L	EPA 300.0	0.05	2016-10-12	10:28:00	LR
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-10-12	10:28:00	LR
Sulfate, SO4	5	mg/L	EPA 300.0	1	2016-10-12	10:28:00	LR
Phosphorus, Total	<0.05	mg/L	SM4500P-E	0.05	2016-10-13	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	12.80	mg/L	EPA 200.7	0.03	2016-10-17	16:51:00	DI
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2016-11-01	09:38:04	DI
Magnesium, Mg - Dissolved	2.27	mg/L	EPA 200.7	0.01	2016-10-17	16:51:00	DI
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2016-11-01	09:38:04	DI
Potassium, K - Dissolved	0.67	mg/L	EPA 200.7	0.14	2016-10-17	16:51:00	DI

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Analysis Report

November 03, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW33-268	Sample ID By:	Skyline Mine
Date Sampled:	Oct 10, 2016	Sample Taken At:	SW33-268
Date Received:	Oct 12, 2016	Sample Taken By:	G.G.
Product Description:	WATER	Time Sampled:	1215
		Time Received:	0930
		Mine:	21
		Field - pH:	6.55 pH
		Field - Flow:	0.49 GPM
		Field - Conductivity:	107 umhos/cm
		Field - Temperature:	5.0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641422-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.63	mg/L	EPA 200.7	0.09	2016-10-17	16:51:00	DI

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Lease UTU – 77114
Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
-Lab Data-
Site: SW32-277

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Analysis Report

October 13, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	S32-277	Sample ID By:	Skyline Mine
Date Sampled:	Sep 16, 2014	Sample Taken At:	S32-277
Date Received:	Sep 18, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1320
		Time Received:	1555
		Mine:	21
		Field - pH:	7.14 pH
		Field - Flow:	0.33 GPM
		Field - Conductivity:	239 umhos/cm
		Field - Temperature:	7.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426156-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	154	mg/L	SM2340-B	1	2014-10-07	12:22:35	DI
Anions	2.90	meq/L	SM1030E	0	2014-10-07	12:22:35	DI
Balance	4.56	%	SM1030E	-10	2014-10-07	12:22:35	DI
Cations	3.17	meq/L	SM1030E	0	2014-10-07	12:22:35	DI
Alkalinity, mg CaCO3/L (pH 4.5)	133	mg/L	SM2320-B	5	2014-09-22	17:04:00	HF
Bicarbonate Alkalinity as CaCO3	133	mg/L	SM2320-B	5	2014-09-22	17:04:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-09-22	17:04:00	HF
Total Dissolved Solids	168	mg/L	SM2540-C	30	2014-09-22	15:50:00	AL
Total Suspended Solids	58	mg/L	SM2540-D	5	2014-09-22	15:50:00	AL
Nitrate + Nitrite as Nitrogen	1.59	mg/L	EPA 300.0	0.05	2014-09-28	10:10:00	DI
Chloride, Cl	1	mg/L	EPA 300.0	1	2014-09-23	21:44:00	DI
Sulfate, SO4	10	mg/L	EPA 300.0	1	2014-09-23	21:44:00	DI
Phosphorus, Total	0.06	mg/L	SM4500-P E	0.05	2014-09-19	06:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	47.81	mg/L	EPA 200.7	0.03	2014-09-23	21:28:00	HF
Iron, Fe - Total	0.33	mg/L	EPA 200.7	0.05	2014-09-25	07:31:00	HF
Magnesium, Mg - Dissolved	8.41	mg/L	EPA 200.7	0.01	2014-09-23	21:28:00	HF
Manganese, Mn - Total	0.014	mg/L	EPA 200.7	0.002	2014-09-25	07:31:00	HF
Potassium, K - Dissolved	0.61	mg/L	EPA 200.7	0.14	2014-09-23	21:28:00	HF

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October 13, 2014

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HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	S32-277	Sample ID By:	Skyline Mine
Date Sampled:	Sep 16, 2014	Sample Taken At:	S32-277
Date Received:	Sep 18, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1320
		Time Received:	1555
		Mine:	21
		Field - pH:	7.14 pH
		Field - Flow:	0.33 GPM
		Field - Conductivity:	239 umhos/cm
		Field - Temperature:	7.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426156-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.84	mg/L	EPA 200.7	0.09	2014-09-23	21:28:00	HF

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SGS

Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-~~279~~ 277	Sample ID By:	Skyline Mine
Date Sampled:	Nov 12, 2014	Sample Taken At:	SW32-279
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0940
		Time Received:	1330
		Mine:	21
		Field - pH:	7.94pH
		Field - Flow:	2.17 GPM
		Field - Conductivity:	246 umhos/cm
		Field - Temperature:	0.5 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	157	mg/L	SM2340-B	1	2014-12-05	13:30:00	DI
Anions	2.93	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Balance	5.23	%	SM1030E	-10	2014-12-05	13:30:00	DI
Cations	3.25	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	133	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Bicarbonate Alkalinity as CaCO3	133	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Total Dissolved Solids	186	mg/L	SM2540-C	30	2014-11-18	13:00:00	AL
Total Suspended Solids	161	mg/L	SM2540-D	5	2014-11-18	13:00:00	AL
Nitrate + Nitrite as Nitrogen	1.44	mg/L	EPA 300.0	0.05	2014-11-20	02:06:00	AL
Chloride, Cl	2	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Sulfate, SO4	10	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Phosphorus, Total	0.19	mg/L	SM4500-P E	0.05	2014-12-01	06:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	47.96	mg/L	EPA 200.7	0.03	2014-11-19	16:15:00	HF
Iron, Fe - Total	1.47	mg/L	EPA 200.7	0.05	2014-11-20	15:15:00	HF
Magnesium, Mg - Dissolved	9.12	mg/L	EPA 200.7	0.01	2014-11-19	16:15:00	HF
Manganese, Mn - Total	0.060	mg/L	EPA 200.7	0.002	2014-11-20	15:15:00	HF
Potassium, K - Dissolved	0.87	mg/L	EPA 200.7	0.14	2014-11-19	16:15:00	HF

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Div. of Oil, Gas & Mining

Lab Supervisor

Domenic Ibanez
Lab Supervisor

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Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-279	Sample ID By:	Skyline Mine
Date Sampled:	Nov 12, 2014	Sample Taken At:	SW32-279
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0940
		Time Received:	1330
		Mine:	21
		Field - pH:	7.94pH
		Field - Flow:	2.17 GPM
		Field - Conductivity:	246 umhos/cm
		Field - Temperature:	0.5 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.99	mg/L	EPA 200.7	0.09	2014-11-19	16:15:00	HF

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Div. of Oil, Gas & Mining

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Analysis Report

June 25, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

277

Client Sample ID:	SW32-~~279~~	Sample ID By:	Skyline Mine
Date Sampled:	Jun 3, 2015	Sample Taken At:	SW32-279
Date Received:	Jun 3, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0835
		Time Received:	1620
		Mine:	21
		Field - pH:	7.37 pH
		Field - Flow:	5.30 GPM
		Field - Conductivity:	223 umhos/cm
		Field - Temperature:	5.0 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1529495-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	102	mg/L	SM2340-B	1	2015-06-25	12:00:00	DI
Anions	1.83	meq/L	SM1030E	0	2015-06-25	12:00:00	DI
Balance	7.42	%	SM1030E	-10	2015-06-25	12:00:00	DI
Cations	2.12	meq/L	SM1030E	0	2015-06-25	12:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	85	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Bicarbonate Alkalinity as CaCO3	85	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Total Dissolved Solids	158	mg/L	SM2540-C	30	2015-06-08	11:30:00	HF
Total Suspended Solids	21	mg/L	SM2540-D	5	2015-06-08	11:30:00	HF
Nitrate + Nitrite as Nitrogen	3.14	mg/L	EPA 300.0	0.05	2015-06-04	22:56:00	DI
Chloride, Cl	1	mg/L	EPA 300.0	1	2015-06-04	22:56:00	DI
Sulfate, SO4	4	mg/L	EPA 300.0	1	2015-06-04	22:56:00	DI
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-06-10	08:00:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	31.67	mg/L	EPA 200.7	0.03	2015-06-16	03:38:00	HF
Iron, Fe - Total	0.13	mg/L	EPA 200.7	0.05	2015-06-10	17:53:00	HF
Magnesium, Mg - Dissolved	5.58	mg/L	EPA 200.7	0.01	2015-06-16	03:38:00	HF
Manganese, Mn - Total	0.004	mg/L	EPA 200.7	0.002	2015-06-10	17:53:00	HF
Potassium, K - Dissolved	0.39	mg/L	EPA 200.7	0.14	2015-06-16	03:38:00	HF

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Analysis Report

June 25, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-279	Sample ID By:	Skyline Mine
Date Sampled:	Jun 3, 2015	Sample Taken At:	SW32-279
Date Received:	Jun 3, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0835
		Time Received:	1620
		Mine:	21
		Field - pH:	7.37 pH
		Field - Flow:	5.30 GPM
		Field - Conductivity:	223 umhos/cm
		Field - Temperature:	5.0 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1529495-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.61	mg/L	EPA 200.7	0.09	2015-06-16	03:38:00	HF

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Analysis Report

September 23, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-~~279~~ 278	Sample ID By:	Skyline Mine
Date Sampled:	Sep 10, 2015	Sample Taken At:	SW32-279
Date Received:	Sep 10, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1025
		Time Received:	1525
		Mine:	21
		Field - pH:	7.46 pH
		Field - Flow:	0.7 GPM
		Field - Conductivity:	318 umhos/cm

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530627-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	152	mg/L	SM2340-B	1	2015-09-21	08:00:00	DI
Acidity	7	mg/L	D1067	5	2015-09-15	15:00:00	HF
Anions	2.88	meq/L	SM1030E	0	2015-09-21	08:00:00	DI
Balance	4.62	%	SM1030E	-10	2015-09-21	08:00:00	DI
Cations	3.15	meq/L	SM1030E	0	2015-09-21	08:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	132	mg/L	SM2320-B	5	2015-09-17	18:37:00	MS
Bicarbonate Alkalinity as CaCO3	132	mg/L	SM2320-B	5	2015-09-17	18:37:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-09-17	18:37:00	MS
Total Dissolved Solids	170	mg/L	SM2540-C	30	2015-09-14	15:00:00	MS
Total Suspended Solids	49	mg/L	SM2540-D	5	2015-09-14	15:00:00	MS
Nitrate + Nitrite as Nitrogen	1.66	mg/L	EPA 300.0	0.05	2015-09-10	19:52:00	DI
Chloride, Cl	1	mg/L	EPA 300.0	1	2015-09-10	19:52:00	DI
Sulfate, SO4	10	mg/L	EPA 300.0	1	2015-09-10	19:52:00	DI
Phosphorus, Total	0.09	mg/L	SM4500-P E	0.05	2015-09-14	09:00:00	HF
METALS BY ICP							
Boron, B - Dissolved	0.02	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Barium, Ba - Dissolved	0.056	mg/L	EPA 200.7	0.002	2015-09-17	11:25:00	HF
Calcium, Ca - Dissolved	46.27	mg/L	EPA 200.7	0.03	2015-09-17	11:25:00	HF
Copper, Cu - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Iron, Fe - Total	0.41	mg/L	EPA 200.7	0.05	2015-09-17	09:07:25	HF

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Analysis Report

September 23, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-279	Sample ID By:	Skyline Mine
Date Sampled:	Sep 10, 2015	Sample Taken At:	SW32-279
Date Received:	Sep 10, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1025
		Time Received:	1525
		Mine:	21
		Field - pH:	7.46 pH
		Field - Flow:	0.7 GPM
		Field - Conductivity:	318 umhos/cm

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530627-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Iron, Fe - Dissolved	0.05	mg/L	EPA 200.7	0.03	2015-09-17	11:25:00	HF
Lead, Pb - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Magnesium, Mg - Dissolved	8.95	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Manganese, Mn - Total	0.018	mg/L	EPA 200.7	0.002	2015-09-17	09:07:25	HF
Manganese, Mn - Dissolved	0.018	mg/L	EPA 200.7	0.002	2015-09-17	11:25:00	HF
Potassium, K - Dissolved	0.72	mg/L	EPA 200.7	0.14	2015-09-17	11:25:00	HF
Sodium, Na - Dissolved	2.08	mg/L	EPA 200.7	0.09	2015-09-17	11:25:00	HF

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Analysis Report

December 18, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-277	Sample ID By:	Skyline Mine
Date Sampled:	Nov 24, 2015	Sample Taken At:	SW32-277
Date Received:	Nov 25, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	0940
		Time Received:	1445
		Mine:	21
		Field - pH:	7.24 pH
		Field - Flow:	0.63 GPM
		Field - Conductivity:	234 umhos/cm
		Field - Temperature:	7.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531469-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	154	mg/L	SM2340-B	1	2015-12-14	09:00:00	HF
Anions	3.05	meq/L	SM1030E	0	2015-12-14	09:00:00	HF
Balance	2.50	%	SM1030E	-10	2015-12-14	09:00:00	HF
Cations	3.20	meq/L	SM1030E	0	2015-12-14	09:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	140	mg/L	SM2320-B	5	2015-12-08	09:22:34	HF
Bicarbonate Alkalinity as CaCO3	140	mg/L	SM2320-B	5	2015-12-08	09:22:34	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-12-08	09:22:34	HF
Total Dissolved Solids	177	mg/L	SM2540-C	30	2015-11-30	15:00:00	HF
Total Suspended Solids	219	mg/L	SM2540-D	5	2015-11-30	15:00:00	HF
Nitrate + Nitrite as Nitrogen	2.33	mg/L	EPA 300.0	0.05	2015-12-03	18:49:00	HF
Chloride, Cl	1	mg/L	EPA 300.0	1	2015-12-03	18:49:00	HF
Sulfate, SO4	11	mg/L	EPA 300.0	1	2015-12-03	18:49:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-12-02	10:15:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	46.91	mg/L	EPA 200.7	0.03	2015-12-01	10:27:00	HF
Iron, Fe - Total	0.21	mg/L	EPA 200.7	0.05	2015-12-01	16:27:00	HF
Magnesium, Mg - Dissolved	8.88	mg/L	EPA 200.7	0.01	2015-12-01	10:27:00	HF
Manganese, Mn - Total	0.030	mg/L	EPA 200.7	0.002	2015-12-01	16:27:00	HF
Potassium, K - Dissolved	0.72	mg/L	EPA 200.7	0.14	2015-12-01	10:27:00	HF

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Div. of Oil, Gas & Mining

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Analysis Report

December 18, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-277	Sample ID By:	Skyline Mine
Date Sampled:	Nov 24, 2015	Sample Taken At:	SW32-277
Date Received:	Nov 25, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	0940
		Time Received:	1445
		Mine:	21
		Field - pH:	7.24 pH
		Field - Flow:	0.63 GPM
		Field - Conductivity:	234 umhos/cm
		Field - Temperature:	7.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531469-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	2.65	mg/L	EPA 200.7	0.09	2015-12-01	10:27:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-277	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	SW32-277
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	940
		Time Received:	1600
		Mine:	21
		Field - pH:	7.45 pH
		Field - Flow:	4.5 GPM
		Field - Conductivity:	201 umhos/cm
		Field - Temperature:	5.8 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-007

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	100	mg/L	SM2340-B	1	2016-06-27	10:00:00	DI
Anions	1.85	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Balance	3.99	%	SM1030E	-10	2016-06-27	10:00:00	DI
Cations	2.00	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	83	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Bicarbonate Alkalinity as CaCO3	83	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Total Dissolved Solids	136	mg/L	SM2540-C	30	2016-06-14	15:00:00	MS
Total Suspended Solids	12	mg/L	SM2540-D	5	2016-06-14	15:00:00	HF
Nitrate + Nitrite as Nitrogen	1.92	mg/L	EPA 300.0	0.05	2016-06-16	16:33:00	HF
Chloride, Cl	2	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Sulfate, SO4	4	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-06-22	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	32.17	mg/L	EPA 200.7	0.03	2016-06-15	19:00:00	HF
Iron, Fe - Total	0.23	mg/L	EPA 200.7	0.05	2016-06-17	12:00:00	HF
Magnesium, Mg - Dissolved	4.80	mg/L	EPA 200.7	0.01	2016-06-15	19:00:00	HF
Manganese, Mn - Total	0.004	mg/L	EPA 200.7	0.002	2016-06-17	12:00:00	HF
Potassium, K - Dissolved	<0.14	mg/L	EPA 200.7	0.14	2016-06-15	19:00:00	HF

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Lab Supervisor

Domenic Ibanez
Lab Supervisor

SGS North America Inc. | Minerals Services Division
2035 North Airport Road Huntington UT 84528 t (435) 653-2311 f (435)-653-2436 www.sgs.com/minerals

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-277	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	SW32-277
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	940
		Time Received:	1600
		Mine:	21
		Field - pH:	7.45 pH
		Field - Flow:	4.5 GPM
		Field - Conductivity:	201 umhos/cm
		Field - Temperature:	5.8 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-007

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	0.28	mg/L	EPA 200.7	0.09	2016-06-15	19:00:00	HF

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Analysis Report

October 26, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-277	Sample ID By:	Skyline Mine
Date Sampled:	Sep 27, 2016	Sample Taken At:	SW32-277
Date Received:	Sep 28, 2016	Sample Taken By:	GG
Product Description:	WATER	Time Sampled:	0945
		Time Received:	1030
		Mine:	21
		Field - pH:	7.43 pH
		Field - Flow:	0.5 GPM
		Field - Conductivity:	308 umhos/cm
		Field - Temperature:	7.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1640982-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	154	mg/L	SM2340-B	1	2016-10-25	09:30:00	DI
Anions	3.12	meq/L	SM1030E	0	2016-10-25	09:30:00	DI
Balance	0.97	%	SM1030E	-10	2016-10-25	09:30:00	DI
Cations	3.18	meq/L	SM1030E	0	2016-10-25	09:30:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	144	mg/L	SM2320-B	5	2016-09-29	09:00:00	DI
Bicarbonate Alkalinity as CaCO3	144	mg/L	SM2320-B	5	2016-09-29	09:00:00	DI
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-09-29	09:00:00	DI
Total Dissolved Solids	197	mg/L	SM2540-C	30	2016-09-29	16:30:00	MS
Total Suspended Solids	75	mg/L	SM2540-D	5	2016-09-29	16:30:00	MS
Nitrate + Nitrite as Nitrogen	1.93	mg/L	EPA 300.0	0.05	2016-10-14	01:15:00	LR
Chloride, Cl	2	mg/L	EPA 300.0	1	2016-10-14	01:15:00	LR
Sulfate, SO4	10	mg/L	EPA 300.0	1	2016-10-14	01:15:00	LR
Phosphorus, Total	0.08	mg/L	SM4500P-E	0.05	2016-10-13	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	47.27	mg/L	EPA 200.7	0.03	2016-10-05	17:34:00	MS
Iron, Fe - Total	1.09	mg/L	EPA 200.7	0.05	2016-10-07	11:15:31	MS
Magnesium, Mg - Dissolved	8.72	mg/L	EPA 200.7	0.01	2016-10-05	17:34:00	MS
Manganese, Mn - Total	0.047	mg/L	EPA 200.7	0.002	2016-10-07	11:15:31	MS
Potassium, K - Dissolved	0.58	mg/L	EPA 200.7	0.14	2016-10-05	17:34:00	MS

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Analysis Report

October 26, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-277	Sample ID By:	Skyline Mine
Date Sampled:	Sep 27, 2016	Sample Taken At:	SW32-277
Date Received:	Sep 28, 2016	Sample Taken By:	GG
Product Description:	WATER	Time Sampled:	0945
		Time Received:	1030
		Mine:	21
		Field - pH:	7.43 pH
		Field - Flow:	0.5 GPM
		Field - Conductivity:	308 umhos/cm
		Field - Temperature:	7.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1640982-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	2.13	mg/L	EPA 200.7	0.09	2016-10-05	17:34:00	MS

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Analysis Report

November 03, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-277	Sample ID By:	Skyline Mine
Date Sampled:	Oct 10, 2016	Sample Taken At:	SW32-277
Date Received:	Oct 12, 2016	Sample Taken By:	G.G.
Product Description:	WATER	Time Sampled:	1130
		Time Received:	0930
		Mine:	21
		Field - pH:	7.63 pH
		Field - Flow:	0.33 GPM
		Field - Conductivity:	132 umhos/cm
		Field - Temperature:	1.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641422-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	161	mg/L	SM2340-B	1	2016-11-01	20:21:32	DI
Anions	3.24	meq/L	SM1030E	0	2016-11-01	20:21:32	DI
Balance	1.29	%	SM1030E	-10	2016-11-01	20:21:32	DI
Cations	3.32	meq/L	SM1030E	0	2016-11-01	20:21:32	DI
Alkalinity, mg CaCO3/L (pH 4.5)	149	mg/L	SM2320-B	5	2016-10-20	12:41:00	DI
Bicarbonate Alkalinity as CaCO3	149	mg/L	SM2320-B	5	2016-10-20	12:41:00	DI
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-10-20	12:41:00	DI
Total Dissolved Solids	149	mg/L	SM2540-C	30	2016-10-14	16:51:47	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-10-14	16:31:12	MS
Nitrate + Nitrite as Nitrogen	1.77	mg/L	EPA 300.0	0.05	2016-10-12	10:28:00	LR
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-10-12	10:28:00	LR
Sulfate, SO4	11	mg/L	EPA 300.0	1	2016-10-12	10:28:00	LR
Phosphorus, Total	<0.05	mg/L	SM4500P-E	0.05	2016-10-13	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	49.61	mg/L	EPA 200.7	0.03	2016-10-17	16:51:00	DI
Iron, Fe - Total	0.15	mg/L	EPA 200.7	0.05	2016-11-01	09:38:03	DI
Magnesium, Mg - Dissolved	8.94	mg/L	EPA 200.7	0.01	2016-10-17	16:51:00	DI
Manganese, Mn - Total	0.008	mg/L	EPA 200.7	0.002	2016-11-01	09:38:03	DI
Potassium, K - Dissolved	0.67	mg/L	EPA 200.7	0.14	2016-10-17	16:51:00	DI

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Analysis Report

November 03, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW32-277	Sample ID By:	Skyline Mine
Date Sampled:	Oct 10, 2016	Sample Taken At:	SW32-277
Date Received:	Oct 12, 2016	Sample Taken By:	G.G.
Product Description:	WATER	Time Sampled:	1130
		Time Received:	0930
		Mine:	21
		Field - pH:	7.63 pH
		Field - Flow:	0.33 GPM
		Field - Conductivity:	132 umhos/cm
		Field - Temperature:	1.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641422-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	2.14	mg/L	EPA 200.7	0.09	2016-10-17	16:51:00	DI

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Lease UTU – 77114
Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
-Lab Data-
Site: SW4-429

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Analysis Report

October 13, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	S4-429	Sample ID By:	Skyline Mine
Date Sampled:	Sep 16, 2014	Sample Taken At:	S4-429
Date Received:	Sep 18, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1420
		Time Received:	1555
		Mine:	21
		Field - pH:	6.83 pH
		Field - Flow:	1.2 GPM
		Field - Conductivity:	174 umhos/cm
		Field - Temperature:	6.9 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1426156-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	75	mg/L	SM2340-B	1	2014-10-07	12:22:35	DI
Anions	1.41	meq/L	SM1030E	0	2014-10-07	12:22:35	DI
Balance	5.31	%	SM1030E	-10	2014-10-07	12:22:35	DI
Cations	1.57	meq/L	SM1030E	0	2014-10-07	12:22:35	DI
Alkalinity, mg CaCO3/L (pH 4.5)	66	mg/L	SM2320-B	5	2014-09-22	17:04:00	HF
Bicarbonate Alkalinity as CaCO3	66	mg/L	SM2320-B	5	2014-09-22	17:04:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-09-22	17:04:00	HF
Total Dissolved Solids	97	mg/L	SM2540-C	30	2014-09-22	15:50:00	AL
Total Suspended Solids	<5	mg/L	SM2540-D	5	2014-09-22	15:50:00	AL
Nitrate + Nitrite as Nitrogen	2.13	mg/L	EPA 300.0	0.05	2014-09-28	10:10:00	DI
Chloride, Cl	<1	mg/L	EPA 300.0	1	2014-09-23	21:44:00	DI
Sulfate, SO4	3	mg/L	EPA 300.0	1	2014-09-23	21:44:00	DI
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2014-09-19	06:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	23.49	mg/L	EPA 200.7	0.03	2014-09-23	21:28:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2014-09-25	07:31:00	HF
Magnesium, Mg - Dissolved	4.07	mg/L	EPA 200.7	0.01	2014-09-23	21:28:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2014-09-25	07:31:00	HF
Potassium, K - Dissolved	0.56	mg/L	EPA 200.7	0.14	2014-09-23	21:28:00	HF

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Analysis Report

October 13, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	S4-429	Sample ID By:	Skyline Mine
Date Sampled:	Sep 16, 2014	Sample Taken At:	S4-429
Date Received:	Sep 18, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1420
		Time Received:	1555
		Mine:	21
		Field - pH:	6.83 pH
		Field - Flow:	1.2 GPM
		Field - Conductivity:	174 umhos/cm
		Field - Temperature:	6.9 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1426156-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.08	mg/L	EPA 200.7	0.09	2014-09-23	21:28:00	HF

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SGS

Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-429	Sample ID By:	Skyline Mine
Date Sampled:	Nov 12, 2014	Sample Taken At:	SW4-429
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1205
		Time Received:	1330
		Mine:	21
		Field - pH:	7.81pH
		Field - Flow:	1.1 GPM
		Field - Conductivity:	163 umhos/cm
		Field - Temperature:	4.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	73	mg/L	SM2340-B	1	2014-12-05	13:30:00	DI
Anions	1.37	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Balance	5.34	%	SM1030E	-10	2014-12-05	13:30:00	DI
Cations	1.52	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	64	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Bicarbonate Alkalinity as CaCO3	64	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Total Dissolved Solids	88	mg/L	SM2540-C	30	2014-11-18	13:00:00	AL
Total Suspended Solids	<5	mg/L	SM2540-D	5	2014-11-18	13:00:00	AL
Nitrate + Nitrite as Nitrogen	2.03	mg/L	EPA 300.0	0.05	2014-11-20	02:06:00	AL
Chloride, Cl	<1	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Sulfate, SO4	3	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Phosphorus, Total	0.06	mg/L	SM4500-P E	0.05	2014-12-01	06:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	22.78	mg/L	EPA 200.7	0.03	2014-11-19	16:15:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2014-11-20	15:15:00	HF
Magnesium, Mg - Dissolved	3.98	mg/L	EPA 200.7	0.01	2014-11-19	16:15:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2014-11-20	15:15:00	HF
Potassium, K - Dissolved	0.49	mg/L	EPA 200.7	0.14	2014-11-19	16:15:00	HF

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ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-429	Sample ID By:	Skyline Mine
Date Sampled:	Nov 12, 2014	Sample Taken At:	SW4-429
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1205
		Time Received:	1330
		Mine:	21
		Field - pH:	7.81pH
		Field - Flow:	1.1 GPM
		Field - Conductivity:	163 umhos/cm
		Field - Temperature:	4.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.11	mg/L	EPA 200.7	0.09	2014-11-19	16:15:00	HF

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SGS

Analysis Report

June 25, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-429	Sample ID By:	Skyline Mine
Date Sampled:	Jun 3, 2015	Sample Taken At:	SW4-429
Date Received:	Jun 3, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1035
		Time Received:	1620
		Mine:	21
		Field - pH:	7.42 pH
		Field - Flow:	10.9 GPM
		Field - Conductivity:	165 umhos/cm
		Field - Temperature:	4.1 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1529495-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	73	mg/L	SM2340-B	1	2015-06-25	12:00:00	DI
Anions	1.35	meq/L	SM1030E	0	2015-06-25	12:00:00	DI
Balance	5.34	%	SM1030E	-10	2015-06-25	12:00:00	DI
Cations	1.50	meq/L	SM1030E	0	2015-06-25	12:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	62	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Bicarbonate Alkalinity as CaCO3	62	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Total Dissolved Solids	100	mg/L	SM2540-C	30	2015-06-08	11:30:00	HF
Total Suspended Solids	<5	mg/L	SM2540-D	5	2015-06-08	11:30:00	HF
Nitrate + Nitrite as Nitrogen	2.47	mg/L	EPA 300.0	0.05	2015-06-04	22:56:00	AL
Chloride, Cl	<1	mg/L	EPA 300.0	1	2015-06-04	22:56:00	AL
Sulfate, SO4	4	mg/L	EPA 300.0	1	2015-06-24	15:05:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-06-10	08:00:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	21.51	mg/L	EPA 200.7	0.03	2015-06-16	03:38:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2015-06-10	17:53:00	HF
Magnesium, Mg - Dissolved	4.65	mg/L	EPA 200.7	0.01	2015-06-16	03:38:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2015-06-10	17:53:00	HF
Potassium, K - Dissolved	0.43	mg/L	EPA 200.7	0.14	2015-06-16	03:38:00	HF

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Analysis Report

June 25, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-429	Sample ID By:	Skyline Mine
Date Sampled:	Jun 3, 2015	Sample Taken At:	SW4-429
Date Received:	Jun 3, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1035
		Time Received:	1620
		Mine:	21
		Field - pH:	7.42 pH
		Field - Flow:	10.9 GPM
		Field - Conductivity:	165 umhos/cm
		Field - Temperature:	4.1 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1529495-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	0.80	mg/L	EPA 200.7	0.09	2015-06-16	03:38:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-429	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	SW4-429
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1130
		Time Received:	1600
		Mine:	21
		Field - pH:	7.58 pH
		Field - Flow:	10.50 GPM
		Field - Conductivity:	148 umhos/cm
		Field - Temperature:	5.0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-009

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	70	mg/L	SM2340-B	1	2016-06-27	10:00:00	DI
Anions	1.27	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Balance	3.84	%	SM1030E	-10	2016-06-27	10:00:00	DI
Cations	1.37	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	57	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Bicarbonate Alkalinity as CaCO3	57	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Total Dissolved Solids	106	mg/L	SM2540-C	30	2016-06-14	15:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-06-14	15:00:00	HF
Nitrate + Nitrite as Nitrogen	1.93	mg/L	EPA 300.0	0.05	2016-06-16	16:33:00	HF
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Sulfate, SO4	2	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-06-22	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	21.17	mg/L	EPA 200.7	0.03	2016-06-15	19:00:00	HF
Iron, Fe - Total	0.10	mg/L	EPA 200.7	0.05	2016-06-17	12:00:00	HF
Magnesium, Mg - Dissolved	4.14	mg/L	EPA 200.7	0.01	2016-06-15	19:00:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2016-06-17	12:00:00	HF
Potassium, K - Dissolved	<0.14	mg/L	EPA 200.7	0.14	2016-06-15	19:00:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-429	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	SW4-429
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1130
		Time Received:	1600
		Mine:	21
		Field - pH:	7.58 pH
		Field - Flow:	10.50 GPM
		Field - Conductivity:	148 umhos/cm
		Field - Temperature:	5.0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-009

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	<0.09	mg/L	EPA 200.7	0.09	2016-06-15	19:00:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-429	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	SW4-429
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1235
		Time Received:	1440
		Mine:	21
		Field - pH:	7.60 pH
		Field - Flow:	1.9 GPM
		Field - Conductivity:	193 umhos/cm
		Field - Temperature:	6.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-005

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	75	mg/L	SM2340-B	1	2016-07-29	15:00:00	HF
Anions	1.50	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Balance	1.30	%	SM1030E	-10	2016-07-29	15:00:00	HF
Cations	1.54	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	71	mg/L	SM2320-B	5	2016-07-21	15:30:08	MS
Bicarbonate Alkalinity as CaCO3	71	mg/L	SM2320-B	5	2016-07-21	15:30:08	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-07-21	15:30:08	MS
Total Dissolved Solids	131	mg/L	SM2540-C	30	2016-07-20	16:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-07-20	16:00:00	MS
Nitrate + Nitrite as Nitrogen	2.43	mg/L	EPA 300.0	0.05	2016-07-19	23:11:00	HF
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Sulfate, SO4	2	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-07-26	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	22.04	mg/L	EPA 200.7	0.03	2016-07-27	15:09:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2016-07-20	11:33:00	HF
Magnesium, Mg - Dissolved	4.73	mg/L	EPA 200.7	0.01	2016-07-27	15:09:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2016-07-20	11:33:00	HF
Potassium, K - Dissolved	0.54	mg/L	EPA 200.7	0.14	2016-07-27	15:09:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-429	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	SW4-429
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1235
		Time Received:	1440
		Mine:	21
		Field - pH:	7.60 pH
		Field - Flow:	1.9 GPM
		Field - Conductivity:	193 umhos/cm
		Field - Temperature:	6.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-005

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	ANALYZED TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	0.82	mg/L	EPA 200.7	0.09	2016-07-27	15:09:00	HF

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Analysis Report

November 03, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-429	Sample ID By:	Skyline Mine
Date Sampled:	Oct 10, 2016	Sample Taken At:	SW4-429
Date Received:	Oct 12, 2016	Sample Taken By:	G.G.
Product Description:	WATER	Time Sampled:	1330
		Time Received:	0930
		Mine:	21
		Field - pH:	7.51 pH
		Field - Flow:	0.61 GPM
		Field - Conductivity:	185 umhos/cm
		Field - Temperature:	7.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641422-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	80	mg/L	SM2340-B	1	2016-11-01	20:21:32	DI
Anions	1.59	meq/L	SM1030E	0	2016-11-01	20:21:32	DI
Balance	2.57	%	SM1030E	-10	2016-11-01	20:21:32	DI
Cations	1.67	meq/L	SM1030E	0	2016-11-01	20:21:32	DI
Alkalinity, mg CaCO3/L (pH 4.5)	75	mg/L	SM2320-B	5	2016-10-20	12:41:00	DI
Bicarbonate Alkalinity as CaCO3	75	mg/L	SM2320-B	5	2016-10-20	12:41:00	DI
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-10-20	12:41:00	DI
Total Dissolved Solids	113	mg/L	SM2540-C	30	2016-10-14	16:51:47	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-10-14	16:31:12	MS
Nitrate + Nitrite as Nitrogen	2.23	mg/L	EPA 300.0	0.05	2016-10-12	10:28:00	LR
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-10-12	10:28:00	LR
Sulfate, SO4	3	mg/L	EPA 300.0	1	2016-10-12	10:28:00	LR
Phosphorus, Total	0.08	mg/L	SM4500P-E	0.05	2016-10-13	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	24.77	mg/L	EPA 200.7	0.03	2016-10-17	16:51:00	DI
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2016-11-01	09:38:05	DI
Magnesium, Mg - Dissolved	4.46	mg/L	EPA 200.7	0.01	2016-10-17	16:51:00	DI
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2016-11-01	09:38:05	DI
Potassium, K - Dissolved	0.54	mg/L	EPA 200.7	0.14	2016-10-17	16:51:00	DI

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Analysis Report

November 03, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-429	Sample ID By:	Skyline Mine
Date Sampled:	Oct 10, 2016	Sample Taken At:	SW4-429
Date Received:	Oct 12, 2016	Sample Taken By:	G.G.
Product Description:	WATER	Time Sampled:	1330
		Time Received:	0930
		Mine:	21
		Field - pH:	7.51 pH
		Field - Flow:	0.61 GPM
		Field - Conductivity:	185 umhos/cm
		Field - Temperature:	7.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641422-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.21	mg/L	EPA 200.7	0.09	2016-10-17	16:51:00	DI

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Lease UTU – 77114
Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
-Lab Data-
Site: SW4-173

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Analysis Report

September 23, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Sep 10, 2015	Sample Taken At:	SW4-173
Date Received:	Sep 10, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1140
		Time Received:	1525
		Mine:	21
		Field - pH:	7.54 pH
		Field - Flow:	0.4 GPM
		Field - Conductivity:	284 umhos/cm

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530627-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Iron, Fe - Dissolved	<0.03	mg/L	EPA 200.7	0.03	2015-09-17	11:25:00	HF
Lead, Pb - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Magnesium, Mg - Dissolved	7.95	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2015-09-17	09:07:26	HF
Manganese, Mn - Dissolved	<0.002	mg/L	EPA 200.7	0.002	2015-09-17	11:25:00	HF
Potassium, K - Dissolved	0.63	mg/L	EPA 200.7	0.14	2015-09-17	11:25:00	HF
Sodium, Na - Dissolved	1.91	mg/L	EPA 200.7	0.09	2015-09-17	11:25:00	HF

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Analysis Report

September 23, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Sep 10, 2015	Sample Taken At:	SW4-173
Date Received:	Sep 10, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1140
		Time Received:	1525
		Mine:	21
		Field - pH:	7.54 pH
		Field - Flow:	0.4 GPM
		Field - Conductivity:	284 umhos/cm

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530627-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	136	mg/L	SM2340-B	1	2015-09-21	08:00:00	DI
Acidity	5	mg/L	D1067	5	2015-09-15	15:00:00	HF
Anions	2.64	meq/L	SM1030E	0	2015-09-21	08:00:00	DI
Balance	3.28	%	SM1030E	-10	2015-09-21	08:00:00	DI
Cations	2.82	meq/L	SM1030E	0	2015-09-21	08:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	124	mg/L	SM2320-B	5	2015-09-17	18:37:00	MS
Bicarbonate Alkalinity as CaCO3	124	mg/L	SM2320-B	5	2015-09-17	18:37:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-09-17	18:37:00	MS
Total Dissolved Solids	189	mg/L	SM2540-C	30	2015-09-14	15:00:00	MS
Total Suspended Solids	11	mg/L	SM2540-D	5	2015-09-14	15:00:00	MS
Nitrate + Nitrite as Nitrogen	0.57	mg/L	EPA 300.0	0.05	2015-09-10	19:52:00	DI
Chloride, Cl	1	mg/L	EPA 300.0	1	2015-09-10	19:52:00	DI
Sulfate, SO4	6	mg/L	EPA 300.0	1	2015-09-10	19:52:00	DI
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-09-14	09:00:00	HF
METALS BY ICP							
Boron, B - Dissolved	0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Barium, Ba - Dissolved	0.022	mg/L	EPA 200.7	0.002	2015-09-17	11:25:00	HF
Calcium, Ca - Dissolved	41.37	mg/L	EPA 200.7	0.03	2015-09-17	11:25:00	HF
Copper, Cu - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2015-09-17	09:07:26	HF

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Analysis Report

June 25, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Jun 3, 2015	Sample Taken At:	SW4-173
Date Received:	Jun 3, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1110
		Time Received:	1620
		Mine:	21
		Field - pH:	7.06 pH
		Field - Flow:	1.8 GPM
		Field - Conductivity:	931 umhos/cm
		Field - Temperature:	4.0 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1529495-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.62	mg/L	EPA 200.7	0.09	2015-06-16	03:38:00	HF

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Analysis Report

June 25, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Jun 3, 2015	Sample Taken At:	SW4-173
Date Received:	Jun 3, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1110
		Time Received:	1620
		Mine:	21
		Field - pH:	7.06 pH
		Field - Flow:	1.8 GPM
		Field - Conductivity:	931 umhos/cm
		Field - Temperature:	4.0 Deg. C

Comments: Dissolved Metals Field Filtered; Rerun For Balance is a Match

SGS Minerals Sample ID: 782-1529495-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	37	mg/L	SM2340-B	1	2015-06-25	12:00:00	DI
Anions	0.73	meq/L	SM1030E	0	2015-06-25	12:00:00	DI
Balance	5.60	%	SM1030E	-10	2015-06-25	12:00:00	DI
Cations	0.82	meq/L	SM1030E	0	2015-06-25	12:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	31	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Bicarbonate Alkalinity as CaCO3	31	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-06-09	13:00:00	HF
Total Dissolved Solids	71	mg/L	SM2540-C	30	2015-06-08	11:30:00	HF
Total Suspended Solids	9	mg/L	SM2540-D	5	2015-06-08	11:30:00	HF
Nitrate + Nitrite as Nitrogen	0.09	mg/L	EPA 300.0	0.05	2015-06-04	22:56:00	DI
Chloride, Cl	1	mg/L	EPA 300.0	1	2015-06-04	22:56:00	DI
Sulfate, SO4	3	mg/L	EPA 300.0	1	2015-06-04	22:56:00	DI
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-06-10	08:00:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	10.76	mg/L	EPA 200.7	0.03	2015-06-16	03:38:00	HF
Iron, Fe - Total	0.23	mg/L	EPA 200.7	0.05	2015-06-10	17:53:00	HF
Magnesium, Mg - Dissolved	2.46	mg/L	EPA 200.7	0.01	2015-06-16	03:38:00	HF
Manganese, Mn - Total	0.006	mg/L	EPA 200.7	0.002	2015-06-10	17:53:00	HF
Potassium, K - Dissolved	0.36	mg/L	EPA 200.7	0.14	2015-06-16	03:38:00	HF

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Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Nov 12, 2014	Sample Taken At:	SW4-173
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1115
		Time Received:	1330
		Mine:	21
		Field - pH:	7.75pH
		Field - Flow:	0.4 GPM
		Field - Conductivity:	274 umhos/cm
		Field - Temperature:	3.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.76	mg/L	EPA 200.7	0.09	2014-11-19	16:15:00	HF

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Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Nov 12, 2014	Sample Taken At:	SW4-173
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1115
		Time Received:	1330
		Mine:	21
		Field - pH:	7.75pH
		Field - Flow:	0.4 GPM
		Field - Conductivity:	274 umhos/cm
		Field - Temperature:	3.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	135	mg/L	SM2340-B	1	2014-12-05	13:30:00	DI
Anions	2.65	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Balance	2.73	%	SM1030E	-10	2014-12-05	13:30:00	DI
Cations	2.79	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	123	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Bicarbonate Alkalinity as CaCO3	123	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Total Dissolved Solids	169	mg/L	SM2540-C	30	2014-11-18	13:00:00	AL
Total Suspended Solids	8	mg/L	SM2540-D	5	2014-11-18	13:00:00	AL
Nitrate + Nitrite as Nitrogen	0.57	mg/L	EPA 300.0	0.05	2014-11-20	02:06:00	AL
Chloride, Cl	2	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Sulfate, SO4	6	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2014-12-01	06:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	42.00	mg/L	EPA 200.7	0.03	2014-11-19	16:15:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2014-11-20	15:15:00	HF
Magnesium, Mg - Dissolved	7.39	mg/L	EPA 200.7	0.01	2014-11-19	16:15:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2014-11-20	15:15:00	HF
Potassium, K - Dissolved	0.52	mg/L	EPA 200.7	0.14	2014-11-19	16:15:00	HF

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Analysis Report

October 14, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	S4-173	Sample ID By:	Skyline Mine
Date Sampled:	Sep 25, 2014	Sample Taken At:	S4-173
Date Received:	Sep 25, 2014	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1010
		Time Received:	1555
		Mine:	21
		Field - pH:	7.42 pH
		Field - Flow:	0.52 GPM
		Field - Conductivity:	287 umhos/cm
		Field - Temperature:	5.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426286-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	132	mg/L	SM2340-B	1	2014-10-07	12:20:47	AL
Anions	2.68	meq/L	SM1030E	0	2014-10-07	12:20:47	AL
Balance	1.36	%	SM1030E	-10	2014-10-07	12:20:47	AL
Cations	2.76	meq/L	SM1030E	0	2014-10-07	12:20:47	AL
Alkalinity, mg CaCO3/L (pH 4.5)	126	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Bicarbonate Alkalinity as CaCO3	126	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Total Dissolved Solids	163	mg/L	SM2540-C	30	2014-09-29	14:55:00	AL
Total Suspended Solids	7	mg/L	SM2540-D	5	2014-09-29	14:55:00	AL
Nitrate + Nitrite as Nitrogen	<0.05	mg/L	EPA 300.0	0.05	2014-09-27	01:25:00	AL
Chloride, Cl	1	mg/L	EPA 300.0	1	2014-09-27	01:25:00	AL
Sulfate, SO4	6	mg/L	EPA 300.0	1	2014-09-27	01:25:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2014-10-01	05:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	40.60	mg/L	EPA 200.7	0.03	2014-09-30	18:28:00	AL
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2014-10-02	17:25:00	AL
Magnesium, Mg - Dissolved	7.51	mg/L	EPA 200.7	0.01	2014-09-30	18:28:00	AL
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2014-10-02	17:25:00	AL
Potassium, K - Dissolved	0.61	mg/L	EPA 200.7	0.14	2014-09-30	18:28:00	AL

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Analysis Report

October 14, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	S4-173	Sample ID By:	Skyline Mine
Date Sampled:	Sep 25, 2014	Sample Taken At:	S4-173
Date Received:	Sep 25, 2014	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1010
		Time Received:	1555
		Mine:	21
		Field - pH:	7.42 pH
		Field - Flow:	0.52 GPM
		Field - Conductivity:	287 umhos/cm
		Field - Temperature:	5.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426286-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	2.24	mg/L	EPA 200.7	0.09	2014-09-30	18:28:00	AL

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Analysis Report

December 18, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Nov 24, 2015	Sample Taken At:	SW4-173
Date Received:	Nov 25, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1315
		Time Received:	1445
		Mine:	21
		Field - pH:	7.24 pH
		Field - Flow:	0.29 GPM
		Field - Conductivity:	277 umhos/cm
		Field - Temperature:	3.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531469-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	128	mg/L	SM2340-B	1	2015-12-14	09:00:00	HF
Anions	2.68	meq/L	SM1030E	0	2015-12-14	09:00:00	HF
Balance	-0.31	%	SM1030E	-10	2015-12-14	09:00:00	HF
Cations	2.66	meq/L	SM1030E	0	2015-12-14	09:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	126	mg/L	SM2320-B	5	2015-12-08	09:22:44	HF
Bicarbonate Alkalinity as CaCO3	126	mg/L	SM2320-B	5	2015-12-08	09:22:44	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-12-08	09:22:44	HF
Total Dissolved Solids	156	mg/L	SM2540-C	30	2015-11-30	15:00:00	HF
Total Suspended Solids	14	mg/L	SM2540-D	5	2015-11-30	15:00:00	HF
Nitrate + Nitrite as Nitrogen	3.77	mg/L	EPA 300.0	0.05	2015-12-03	18:49:00	HF
Chloride, Cl	1	mg/L	EPA 300.0	1	2015-12-03	18:49:00	HF
Sulfate, SO4	6	mg/L	EPA 300.0	1	2015-12-03	18:49:00	HF
Phosphorus, Total	0.07	mg/L	SM4500-P E	0.05	2015-12-02	10:15:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	39.08	mg/L	EPA 200.7	0.03	2015-12-01	10:27:00	HF
Iron, Fe - Total	0.59	mg/L	EPA 200.7	0.05	2015-12-01	16:27:00	HF
Magnesium, Mg - Dissolved	7.28	mg/L	EPA 200.7	0.01	2015-12-01	10:27:00	HF
Manganese, Mn - Total	0.057	mg/L	EPA 200.7	0.002	2015-12-01	16:27:00	HF
Potassium, K - Dissolved	0.75	mg/L	EPA 200.7	0.14	2015-12-01	10:27:00	HF

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December 18, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Nov 24, 2015	Sample Taken At:	SW4-173
Date Received:	Nov 25, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1315
		Time Received:	1445
		Mine:	21
		Field - pH:	7.24 pH
		Field - Flow:	0.29 GPM
		Field - Conductivity:	277 umhos/cm
		Field - Temperature:	3.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531469-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	2.09	mg/L	EPA 200.7	0.09	2015-12-01	10:27:00	HF

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SGS

Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	SW4-173
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1030
		Time Received:	1600
		Mine:	21
		Field - pH:	7.66 pH
		Field - Flow:	1.3 GPM
		Field - Conductivity:	86 umhos/cm
		Field - Temperature:	4.8 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-008

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	58	mg/L	SM2340-B	1	2016-06-27	10:00:00	DI
Anions	1.12	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Balance	1.79	%	SM1030E	-10	2016-06-27	10:00:00	DI
Cations	1.16	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	50	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Bicarbonate Alkalinity as CaCO3	50	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Total Dissolved Solids	96	mg/L	SM2540-C	30	2016-06-14	15:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-06-14	15:00:00	HF
Nitrate + Nitrite as Nitrogen	1.34	mg/L	EPA 300.0	0.05	2016-06-16	16:33:00	HF
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Sulfate, SO4	3	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-06-22	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	17.78	mg/L	EPA 200.7	0.03	2016-06-15	19:00:00	HF
Iron, Fe - Total	0.28	mg/L	EPA 200.7	0.05	2016-06-17	12:00:00	HF
Magnesium, Mg - Dissolved	3.24	mg/L	EPA 200.7	0.01	2016-06-15	19:00:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2016-06-17	12:00:00	HF
Potassium, K - Dissolved	<0.14	mg/L	EPA 200.7	0.14	2016-06-15	19:00:00	HF

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Lab Supervisor

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	SW4-173
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1030
		Time Received:	1600
		Mine:	21
		Field - pH:	7.66 pH
		Field - Flow:	1.3 GPM
		Field - Conductivity:	86 umhos/cm
		Field - Temperature:	4.8 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-008

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	0.41	mg/L	EPA 200.7	0.09	2016-06-15	19:00:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	SW4-173
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1315
		Time Received:	1440
		Mine:	21
		Field - pH:	7.83 pH
		Field - Flow:	0.5 GPM
		Field - Conductivity:	237 umhos/cm
		Field - Temperature:	5.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-006

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	119	mg/L	SM2340-B	1	2016-07-29	15:00:00	HF
Anions	2.43	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Balance	0.31	%	SM1030E	-10	2016-07-29	15:00:00	HF
Cations	2.45	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	114	mg/L	SM2320-B	5	2016-07-21	15:30:09	MS
Bicarbonate Alkalinity as CaCO3	114	mg/L	SM2320-B	5	2016-07-21	15:30:09	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-07-21	15:30:09	MS
Total Dissolved Solids	144	mg/L	SM2540-C	30	2016-07-20	16:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-07-20	16:00:00	MS
Nitrate + Nitrite as Nitrogen	0.49	mg/L	EPA 300.0	0.05	2016-07-19	23:11:00	HF
Chloride, Cl	2	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Sulfate, SO4	5	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-07-26	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	36.30	mg/L	EPA 200.7	0.03	2016-07-27	15:09:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2016-07-20	11:33:00	HF
Magnesium, Mg - Dissolved	6.79	mg/L	EPA 200.7	0.01	2016-07-27	15:09:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2016-07-20	11:33:00	HF
Potassium, K - Dissolved	0.52	mg/L	EPA 200.7	0.14	2016-07-27	15:09:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	SW4-173
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1315
		Time Received:	1440
		Mine:	21
		Field - pH:	7.83 pH
		Field - Flow:	0.5 GPM
		Field - Conductivity:	237 umhos/cm
		Field - Temperature:	5.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-006

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.44	mg/L	EPA 200.7	0.09	2016-07-27	15:09:00	HF

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Analysis Report

November 03, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Oct 10, 2016	Sample Taken At:	SW4-173
Date Received:	Oct 12, 2016	Sample Taken By:	G.G.
Product Description:	WATER	Time Sampled:	1400
		Time Received:	0930
		Mine:	21
		Field - pH:	7.48 pH
		Field - Flow:	0.35 GPM
		Field - Conductivity:	281 umhos/cm
		Field - Temperature:	5.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641422-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	140	mg/L	SM2340-B	1	2016-11-01	20:21:32	DI
Anions	2.84	meq/L	SM1030E	0	2016-11-01	20:21:32	DI
Balance	0.94	%	SM1030E	-10	2016-11-01	20:21:32	DI
Cations	2.90	meq/L	SM1030E	0	2016-11-01	20:21:32	DI
Alkalinity, mg CaCO3/L (pH 4.5)	133	mg/L	SM2320-B	5	2016-10-21	10:40:27	SM
Bicarbonate Alkalinity as CaCO3	133	mg/L	SM2320-B	5	2016-10-21	10:40:27	SM
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-10-21	10:40:27	SM
Total Dissolved Solids	167	mg/L	SM2540-C	30	2016-10-14	16:51:47	MS
Total Suspended Solids	23	mg/L	SM2540-D	5	2016-10-14	16:31:12	MS
Nitrate + Nitrite as Nitrogen	0.58	mg/L	EPA 300.0	0.05	2016-10-12	10:28:00	LR
Chloride, Cl	2	mg/L	EPA 300.0	1	2016-10-12	10:28:00	LR
Sulfate, SO4	6	mg/L	EPA 300.0	1	2016-10-12	10:28:00	LR
Phosphorus, Total	0.12	mg/L	SM4500P-E	0.05	2016-10-13	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	43.25	mg/L	EPA 200.7	0.03	2016-10-17	16:51:00	DI
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2016-11-01	09:38:06	DI
Magnesium, Mg - Dissolved	7.76	mg/L	EPA 200.7	0.01	2016-10-17	16:51:00	DI
Manganese, Mn - Total	0.003	mg/L	EPA 200.7	0.002	2016-11-01	09:38:06	DI
Potassium, K - Dissolved	0.75	mg/L	EPA 200.7	0.14	2016-10-17	16:51:00	DI

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Analysis Report

November 03, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW4-173	Sample ID By:	Skyline Mine
Date Sampled:	Oct 10, 2016	Sample Taken At:	SW4-173
Date Received:	Oct 12, 2016	Sample Taken By:	G.G.
Product Description:	WATER	Time Sampled:	1400
		Time Received:	0930
		Mine:	21
		Field - pH:	7.48 pH
		Field - Flow:	0.35 GPM
		Field - Conductivity:	281 umhos/cm
		Field - Temperature:	5.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641422-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.85	mg/L	EPA 200.7	0.09	2016-10-17	16:51:00	DI

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Lease UTU – 77114
Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
-Lab Data-
Site: CS - 30

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Analysis Report

October 14, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Sep 25, 2014	Sample Taken At:	CS-30
Date Received:	Sep 25, 2014	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1040
		Time Received:	1555
		Mine:	21
		Field - pH:	8.44 pH
		Field - Flow:	445.7 GPM
		Field - Conductivity:	304 umhos/cm
		Field - Temperature:	5.8 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426286-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	157	mg/L	SM2340-B	1	2014-10-07	12:20:47	AL
Anions	3.09	meq/L	SM1030E	0	2014-10-07	12:20:47	AL
Balance	2.14	%	SM1030E	-10	2014-10-07	12:20:47	AL
Cations	3.23	meq/L	SM1030E	0	2014-10-07	12:20:47	AL
Alkalinity, mg CaCO3/L (pH 4.5)	147	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Bicarbonate Alkalinity as CaCO3	147	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Total Dissolved Solids	190	mg/L	SM2540-C	30	2014-09-29	14:55:00	AL
Total Suspended Solids	26	mg/L	SM2540-D	5	2014-09-29	14:55:00	AL
Nitrate + Nitrite as Nitrogen	<0.05	mg/L	EPA 300.0	0.05	2014-09-27	01:25:00	AL
Chloride, Cl	3	mg/L	EPA 300.0	1	2014-09-27	01:25:00	AL
Sulfate, SO4	4	mg/L	EPA 300.0	1	2014-09-27	01:25:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2014-10-01	05:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	50.82	mg/L	EPA 200.7	0.03	2014-09-30	18:28:00	AL
Iron, Fe - Total	0.09	mg/L	EPA 200.7	0.05	2014-10-02	17:25:00	AL
Magnesium, Mg - Dissolved	7.32	mg/L	EPA 200.7	0.01	2014-09-30	18:28:00	AL
Manganese, Mn - Total	0.010	mg/L	EPA 200.7	0.002	2014-10-02	17:25:00	AL
Potassium, K - Dissolved	0.59	mg/L	EPA 200.7	0.14	2014-09-30	18:28:00	AL

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Analysis Report

October 14, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Sep 25, 2014	Sample Taken At:	CS-30
Date Received:	Sep 25, 2014	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1040
		Time Received:	1555
		Mine:	21
		Field - pH:	8.44 pH
		Field - Flow:	445.7 GPM
		Field - Conductivity:	304 umhos/cm
		Field - Temperature:	5.8 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426286-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.75	mg/L	EPA 200.7	0.09	2014-09-30	18:28:00	AL

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Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Nov 12, 2014	Sample Taken At:	CS-30
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1245
		Time Received:	1330
		Mine:	21
		Field - pH:	8.67pH
		Field - Flow:	0.6 GPM
		Field - Conductivity:	309 umhos/cm
		Field - Temperature:	501.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-005

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	149	mg/L	SM2340-B	1	2014-12-05	13:30:00	DI
Anions	2.85	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Balance	3.53	%	SM1030E	-10	2014-12-05	13:30:00	DI
Cations	3.06	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	134	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Bicarbonate Alkalinity as CaCO3	134	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Total Dissolved Solids	180	mg/L	SM2540-C	30	2014-11-18	13:00:00	AL
Total Suspended Solids	<5	mg/L	SM2540-D	5	2014-11-18	13:00:00	AL
Nitrate + Nitrite as Nitrogen	0.81	mg/L	EPA 300.0	0.05	2014-11-20	02:06:00	AL
Chloride, Cl	3	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Sulfate, SO4	4	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2014-12-01	06:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	49.32	mg/L	EPA 200.7	0.03	2014-11-19	16:15:00	HF
Iron, Fe - Total	0.06	mg/L	EPA 200.7	0.05	2014-11-20	15:15:00	HF
Magnesium, Mg - Dissolved	6.27	mg/L	EPA 200.7	0.01	2014-11-19	16:15:00	HF
Manganese, Mn - Total	0.008	mg/L	EPA 200.7	0.002	2014-11-20	15:15:00	HF
Potassium, K - Dissolved	0.53	mg/L	EPA 200.7	0.14	2014-11-19	16:15:00	HF

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Lab Supervisor
Domenic Ibanez
Lab Supervisor

Div. of Oil, Gas & Mining

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Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Nov 12, 2014	Sample Taken At:	CS-30
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1245
		Time Received:	1330
		Mine:	21
		Field - pH:	8.67pH
		Field - Flow:	0.6 GPM
		Field - Conductivity:	309 umhos/cm
		Field - Temperature:	501.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-005

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.53	mg/L	EPA 200.7	0.09	2014-11-19	16:15:00	HF

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Analysis Report

June 24, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Jun 6, 2015	Sample Taken At:	CS-30
Date Received:	Jun 8, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0910
		Time Received:	1555
		Mine:	21
		Field - pH:	8.69 pH
		Field - Flow:	3653.0 GPM
		Field - Conductivity:	342 umhos/cm
		Field - Temperature:	5.0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1529535-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	177	mg/L	SM2340-B	1	2015-06-23	14:00:00	DI
Anions	3.44	meq/L	SM1030E	0	2015-06-23	14:00:00	DI
Balance	2.80	%	SM1030E	-10	2015-06-23	14:00:00	DI
Cations	3.63	meq/L	SM1030E	0	2015-06-23	14:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	161	mg/L	SM2320-B	5	2015-06-10	13:59:00	HF
Bicarbonate Alkalinity as CaCO3	161	mg/L	SM2320-B	5	2015-06-10	13:59:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-06-10	13:59:00	HF
Total Dissolved Solids	228	mg/L	SM2540-C	30	2015-06-10	11:20:00	HF
Total Suspended Solids	6	mg/L	SM2540-D	5	2015-06-10	11:20:00	HF
Nitrate + Nitrite as Nitrogen	2.27	mg/L	EPA 300.0	0.05	2015-06-18	23:54:00	AL
Chloride, Cl	4	mg/L	EPA 300.0	1	2015-06-17	01:18:00	AL
Sulfate, SO4	4	mg/L	EPA 300.0	1	2015-06-17	01:18:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-06-10	08:00:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	57.52	mg/L	EPA 200.7	0.03	2015-06-16	03:38:00	HF
Iron, Fe - Total	0.09	mg/L	EPA 200.7	0.05	2015-06-10	17:53:00	HF
Magnesium, Mg - Dissolved	8.09	mg/L	EPA 200.7	0.01	2015-06-16	03:38:00	HF
Manganese, Mn - Total	0.015	mg/L	EPA 200.7	0.002	2015-06-10	17:53:00	HF
Potassium, K - Dissolved	0.32	mg/L	EPA 200.7	0.14	2015-06-16	03:38:00	HF

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Analysis Report

June 24, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Jun 6, 2015	Sample Taken At:	CS-30
Date Received:	Jun 8, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0910
		Time Received:	1555
		Mine:	21
		Field - pH:	8.69 pH
		Field - Flow:	3653.0 GPM
		Field - Conductivity:	342 umhos/cm
		Field - Temperature:	5.0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1529535-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	2.08	mg/L	EPA 200.7	0.09	2015-06-16	03:38:00	HF

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Analysis Report

October 02, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Sep 15, 2015	Sample Taken At:	CS-30
Date Received:	Sep 15, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0830
		Time Received:	1540
		Mine:	21
		Field - pH:	8.68 pH
		Field - Flow:	531.4 GPM
		Field - Conductivity:	308 umhos/cm
		Field - Temperature:	6.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530675-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	150	mg/L	SM2340-B	1	2015-10-01	16:57:13	DI
Acidity	<5	mg/L	D1067	5	2015-09-15	16:00:00	HF
Anions	3.01	meq/L	SM1030E	0	2015-10-01	16:57:13	DI
Balance	1.41	%	SM1030E	-10	2015-10-01	16:57:13	DI
Cations	3.10	meq/L	SM1030E	0	2015-10-01	16:57:13	DI
Alkalinity, mg CaCO3/L (pH 4.5)	142	mg/L	SM2320-B	5	2015-09-21	17:56:00	MS
Bicarbonate Alkalinity as CaCO3	142	mg/L	SM2320-B	5	2015-09-21	17:56:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-09-21	17:56:00	MS
Total Dissolved Solids	164	mg/L	SM2540-C	30	2015-09-17	16:00:00	HF
Total Suspended Solids	<5	mg/L	SM2540-D	5	2015-09-17	16:00:00	HF
Nitrate + Nitrite as Nitrogen	0.62	mg/L	EPA 300.0	0.05	2015-09-16	15:47:00	DI
Chloride, Cl	3	mg/L	EPA 300.0	1	2015-09-16	15:47:00	DI
Sulfate, SO4	4	mg/L	EPA 300.0	1	2015-09-16	15:47:00	DI
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-09-21	07:00:00	HF
METALS BY ICP							
Boron, B - Dissolved	0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Barium, Ba - Dissolved	0.062	mg/L	EPA 200.7	0.002	2015-09-17	11:25:00	HF
Calcium, Ca - Dissolved	48.80	mg/L	EPA 200.7	0.03	2015-09-17	11:25:00	HF
Copper, Cu - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF

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Analysis Report

October 02, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Sep 15, 2015	Sample Taken At:	CS-30
Date Received:	Sep 15, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0830
		Time Received:	1540
		Mine:	21
		Field - pH:	8.68 pH
		Field - Flow:	531.4 GPM
		Field - Conductivity:	308 umhos/cm
		Field - Temperature:	6.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530675-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2015-09-18	11:10:00	HF
Iron, Fe - Dissolved	0.08	mg/L	EPA 200.7	0.03	2015-09-17	11:25:00	HF
Lead, Pb - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Magnesium, Mg - Dissolved	6.84	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Manganese, Mn - Total	0.007	mg/L	EPA 200.7	0.002	2015-09-18	11:10:00	HF
Manganese, Mn - Dissolved	0.009	mg/L	EPA 200.7	0.002	2015-09-17	11:25:00	HF
Potassium, K - Dissolved	1.31	mg/L	EPA 200.7	0.14	2015-09-17	11:25:00	HF
Sodium, Na - Dissolved	1.48	mg/L	EPA 200.7	0.09	2015-09-22	11:10:00	HF

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Analysis Report

December 28, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Dec 7, 2015	Sample Taken At:	CS-30
Date Received:	Dec 8, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1320
		Time Received:	1620
		Mine:	21
		Field - pH:	2.40 pH
		Field - Flow:	395.9 GPM
		Field - Conductivity:	341 umhos/cm
		Field - Temperature:	2.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531653-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	152	mg/L	SM2340-B	1	2015-12-17	13:00:00	HF
Anions	2.97	meq/L	SM1030E	0	2015-12-17	12:00:00	HF
Balance	2.63	%	SM1030E	-10	2015-12-17	12:00:00	HF
Cations	3.13	meq/L	SM1030E	0	2015-12-17	12:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	141	mg/L	SM2320-B	5	2015-12-10	15:00:00	MS
Bicarbonate Alkalinity as CaCO3	141	mg/L	SM2320-B	5	2015-12-10	15:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-12-10	15:00:00	MS
Total Dissolved Solids	167	mg/L	SM2540-C	30	2015-12-10	12:22:00	HF
Total Suspended Solids	<5	mg/L	SM2540-D	5	2015-12-10	12:22:00	HF
Nitrate + Nitrite as Nitrogen	1.02	mg/L	EPA 300.0	0.05	2015-12-08	23:11:00	HF
Chloride, Cl	2	mg/L	EPA 300.0	1	2015-12-08	23:11:00	HF
Sulfate, SO4	4	mg/L	EPA 300.0	1	2015-12-08	23:11:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-12-16	07:30:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	49.65	mg/L	EPA 200.7	0.03	2015-12-09	12:00:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2015-12-10	12:00:00	HF
Magnesium, Mg - Dissolved	6.85	mg/L	EPA 200.7	0.01	2015-12-09	12:00:00	HF
Manganese, Mn - Total	0.005	mg/L	EPA 200.7	0.002	2015-12-10	12:00:00	HF
Potassium, K - Dissolved	0.63	mg/L	EPA 200.7	0.14	2015-12-09	12:00:00	HF

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Div. of Oil, Gas & Mining

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Analysis Report

December 28, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Dec 7, 2015	Sample Taken At:	CS-30
Date Received:	Dec 8, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1320
		Time Received:	1620
		Mine:	21
		Field - pH:	2.40 pH
		Field - Flow:	395.9 GPM
		Field - Conductivity:	341 umhos/cm
		Field - Temperature:	2.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531653-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.75	mg/L	EPA 200.7	0.09	2015-12-09	12:00:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Jun 8, 2016	Sample Taken At:	CS-30
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	840
		Time Received:	1600
		Mine:	21
		Field - pH:	8.29 pH
		Field - Flow:	7139.4 GPM
		Field - Conductivity:	279 umhos/cm
		Field - Temperature:	6.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	146	mg/L	SM2340-B	1	2016-06-27	10:00:00	DI
Anions	2.92	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Balance	0.12	%	SM1030E	-10	2016-06-27	10:00:00	DI
Cations	2.93	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	138	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Bicarbonate Alkalinity as CaCO3	138	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Total Dissolved Solids	180	mg/L	SM2540-C	30	2016-06-14	15:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-06-14	15:00:00	HF
Nitrate + Nitrite as Nitrogen	0.28	mg/L	EPA 300.0	0.05	2016-06-16	16:33:00	HF
Chloride, Cl	3	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Sulfate, SO4	3	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-06-22	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	48.68	mg/L	EPA 200.7	0.03	2016-06-15	19:00:00	HF
Iron, Fe - Total	0.15	mg/L	EPA 200.7	0.05	2016-06-17	12:00:00	HF
Magnesium, Mg - Dissolved	5.82	mg/L	EPA 200.7	0.01	2016-06-15	19:00:00	HF
Manganese, Mn - Total	0.016	mg/L	EPA 200.7	0.002	2016-06-17	12:00:00	HF
Potassium, K - Dissolved	<0.14	mg/L	EPA 200.7	0.14	2016-06-15	19:00:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Jun 8, 2016	Sample Taken At:	CS-30
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	840
		Time Received:	1600
		Mine:	21
		Field - pH:	8.29 pH
		Field - Flow:	7139.4 GPM
		Field - Conductivity:	279 umhos/cm
		Field - Temperature:	6.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	0.74	mg/L	EPA 200.7	0.09	2016-06-15	19:00:00	HF

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2035 North Airport Road Huntington UT 84528 t (435) 653-2311 f (435)-653-2436 www.sgs.com/minerals

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SGS

Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	CS-30
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1345
		Time Received:	1440
		Mine:	21
		Field - pH:	8.74 pH
		Field - Flow:	1408.1 GPM
		Field - Conductivity:	301 umhos/cm
		Field - Temperature:	13.5 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-007

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	148	mg/L	SM2340-B	1	2016-07-29	15:00:00	HF
Anions	3.06	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Balance	-0.35	%	SM1030E	-10	2016-07-29	15:00:00	HF
Cations	3.03	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	143	mg/L	SM2320-B	5	2016-07-21	15:30:09	MS
Bicarbonate Alkalinity as CaCO3	143	mg/L	SM2320-B	5	2016-07-21	15:30:09	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-07-21	15:30:09	MS
Total Dissolved Solids	185	mg/L	SM2540-C	30	2016-07-20	16:00:00	MS
Total Suspended Solids	6	mg/L	SM2540-D	5	2016-07-20	16:00:00	MS
Nitrate + Nitrite as Nitrogen	0.42	mg/L	EPA 300.0	0.05	2016-07-19	23:11:00	HF
Chloride, Cl	3	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Sulfate, SO4	5	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-07-26	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	47.32	mg/L	EPA 200.7	0.03	2016-07-27	15:09:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2016-07-20	11:33:00	HF
Magnesium, Mg - Dissolved	7.29	mg/L	EPA 200.7	0.01	2016-07-27	15:09:00	HF
Manganese, Mn - Total	0.006	mg/L	EPA 200.7	0.002	2016-07-20	11:33:00	HF
Potassium, K - Dissolved	0.35	mg/L	EPA 200.7	0.14	2016-07-27	15:09:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	CS-30
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1345
		Time Received:	1440
		Mine:	21
		Field - pH:	8.74 pH
		Field - Flow:	1408.1 GPM
		Field - Conductivity:	301 umhos/cm
		Field - Temperature:	13.5 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-007

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.49	mg/L	EPA 200.7	0.09	2016-07-27	15:09:00	HF

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Analysis Report

November 15, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Oct 18, 2016	Sample Taken At:	CS-30
Date Received:	Oct 20, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1210
		Time Received:	0830
		Mine:	21
		Field - pH:	8.82 pH
		Field - Flow:	412.9 GPM
		Field - Conductivity:	301 umhos/cm
		Field - Temperature:	4.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641666-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	147	mg/L	SM2340-B	1	2016-11-11	08:00:00	DI
Anions	3.18	meq/L	SM1030E	0	2016-11-11	08:00:00	DI
Balance	-2.30	%	SM1030E	-10	2016-11-11	08:00:00	DI
Cations	3.03	meq/L	SM1030E	0	2016-11-11	08:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	151	mg/L	SM2320-B	5	2016-10-26	10:01:00	SM
Bicarbonate Alkalinity as CaCO3	151	mg/L	SM2320-B	5	2016-10-26	10:01:00	SM
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-10-26	10:01:00	SM
Total Dissolved Solids	180	mg/L	SM2540-C	30	2016-10-24	13:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-10-24	13:00:00	MS
Nitrate + Nitrite as Nitrogen	2.40	mg/L	EPA 300.0	0.05	2016-10-26	07:51:00	LR
Chloride, Cl	3	mg/L	EPA 300.0	1	2016-10-26	07:51:00	LR
Sulfate, SO4	4	mg/L	EPA 300.0	1	2016-10-26	07:51:00	LR
Phosphorus, Total	<0.05	mg/L	SM4500P-E	0.05	2016-11-04	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	47.95	mg/L	EPA 200.7	0.03	2016-10-25	17:16:00	MS
Iron, Fe - Total	0.05	mg/L	EPA 200.7	0.05	2016-10-26	16:52:00	MS
Magnesium, Mg - Dissolved	6.71	mg/L	EPA 200.7	0.01	2016-10-25	17:16:00	MS
Manganese, Mn - Total	0.006	mg/L	EPA 200.7	0.002	2016-10-26	16:52:00	MS
Potassium, K - Dissolved	0.67	mg/L	EPA 200.7	0.14	2016-10-25	17:16:00	MS

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Analysis Report

November 15, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-30	Sample ID By:	Skyline Mine
Date Sampled:	Oct 18, 2016	Sample Taken At:	CS-30
Date Received:	Oct 20, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1210
		Time Received:	0830
		Mine:	21
		Field - pH:	8.82 pH
		Field - Flow:	412.9 GPM
		Field - Conductivity:	301 umhos/cm
		Field - Temperature:	4.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641666-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.66	mg/L	EPA 200.7	0.09	2016-10-25	17:16:00	MS

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Lease UTU – 77114

Baseline Water Quality Data of Proposed Additional Water Monitoring Sites

-Lab Data-

Site: CS - 29

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Analysis Report

October 14, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Sep 25, 2014	Sample Taken At:	CS-29
Date Received:	Sep 25, 2014	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1110
		Time Received:	1555
		Mine:	21
		Field - pH:	7.72 pH
		Field - Flow:	136.3 GPM
		Field - Conductivity:	280 umhos/cm
		Field - Temperature:	8.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426286-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	136	mg/L	SM2340-B	1	2014-10-07	12:20:47	AL
Anions	2.75	meq/L	SM1030E	0	2014-10-07	12:20:47	AL
Balance	2.18	%	SM1030E	-10	2014-10-07	12:20:47	AL
Cations	2.87	meq/L	SM1030E	0	2014-10-07	12:20:47	AL
Alkalinity, mg CaCO3/L (pH 4.5)	123	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Bicarbonate Alkalinity as CaCO3	123	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Total Dissolved Solids	155	mg/L	SM2540-C	30	2014-09-29	14:55:00	AL
Total Suspended Solids	<5	mg/L	SM2540-D	5	2014-09-29	14:55:00	AL
Nitrate + Nitrite as Nitrogen	<0.05	mg/L	EPA 300.0	0.05	2014-09-27	01:25:00	AL
Chloride, Cl	6	mg/L	EPA 300.0	1	2014-09-27	01:25:00	AL
Sulfate, SO4	6	mg/L	EPA 300.0	1	2014-09-27	01:25:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2014-10-01	05:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	44.12	mg/L	EPA 200.7	0.03	2014-09-30	18:28:00	AL
Iron, Fe - Total	0.39	mg/L	EPA 200.7	0.05	2014-10-02	17:25:00	AL
Magnesium, Mg - Dissolved	6.21	mg/L	EPA 200.7	0.01	2014-09-30	18:28:00	AL
Manganese, Mn - Total	0.029	mg/L	EPA 200.7	0.002	2014-10-02	17:25:00	AL
Potassium, K - Dissolved	0.68	mg/L	EPA 200.7	0.14	2014-09-30	18:28:00	AL

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Analysis Report

October 14, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Sep 25, 2014	Sample Taken At:	CS-29
Date Received:	Sep 25, 2014	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1110
		Time Received:	1555
		Mine:	21
		Field - pH:	7.72 pH
		Field - Flow:	136.3 GPM
		Field - Conductivity:	280 umhos/cm
		Field - Temperature:	8.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426286-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	3.26	mg/L	EPA 200.7	0.09	2014-09-30	18:28:00	AL

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Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Nov 12, 2014	Sample Taken At:	CS-29
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1325
		Time Received:	1330
		Mine:	21
		Field - pH:	8.16pH
		Field - Flow:	103.5 GPM
		Field - Conductivity:	309 umhos/cm
		Field - Temperature:	0.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-006

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	140	mg/L	SM2340-B	1	2014-12-05	13:30:00	DI
Anions	2.88	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Balance	1.50	%	SM1030E	-10	2014-12-05	13:30:00	DI
Cations	2.96	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	126	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Bicarbonate Alkalinity as CaCO3	126	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Total Dissolved Solids	162	mg/L	SM2540-C	30	2014-11-18	13:00:00	AL
Total Suspended Solids	<5	mg/L	SM2540-D	5	2014-11-18	13:00:00	AL
Nitrate + Nitrite as Nitrogen	0.61	mg/L	EPA 300.0	0.05	2014-11-21	20:51:00	AL
Chloride, Cl	6	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Sulfate, SO4	9	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2014-12-01	06:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	45.94	mg/L	EPA 200.7	0.03	2014-11-19	16:15:00	HF
Iron, Fe - Total	0.12	mg/L	EPA 200.7	0.05	2014-11-20	15:15:00	HF
Magnesium, Mg - Dissolved	6.16	mg/L	EPA 200.7	0.01	2014-11-19	16:15:00	HF
Manganese, Mn - Total	0.017	mg/L	EPA 200.7	0.002	2014-11-20	15:15:00	HF
Potassium, K - Dissolved	0.51	mg/L	EPA 200.7	0.14	2014-11-19	16:15:00	HF

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Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Nov 12, 2014	Sample Taken At:	CS-29
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1325
		Time Received:	1330
		Mine:	21
		Field - pH:	8.16pH
		Field - Flow:	103.5 GPM
		Field - Conductivity:	309 umhos/cm
		Field - Temperature:	0.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-006

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	3.47	mg/L	EPA 200.7	0.09	2014-11-19	16:15:00	HF

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Analysis Report

June 24, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Jun 6, 2015	Sample Taken At:	CS-29
Date Received:	Jun 8, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0830
		Time Received:	1555
		Mine:	21
		Field - pH:	8.74 pH
		Field - Flow:	1032.60 GPM
		Field - Conductivity:	191 umhos/cm
		Field - Temperature:	5.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1529535-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	87	mg/L	SM2340-B	1	2015-06-23	14:00:00	DI
Anions	1.72	meq/L	SM1030E	0	2015-06-23	14:00:00	DI
Balance	4.03	%	SM1030E	-10	2015-06-23	14:00:00	DI
Cations	1.86	meq/L	SM1030E	0	2015-06-23	14:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	78	mg/L	SM2320-B	5	2015-06-10	13:59:00	HF
Bicarbonate Alkalinity as CaCO3	78	mg/L	SM2320-B	5	2015-06-10	13:59:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-06-10	13:59:00	HF
Total Dissolved Solids	144	mg/L	SM2540-C	30	2015-06-10	11:20:00	HF
Total Suspended Solids	<5	mg/L	SM2540-D	5	2015-06-10	11:20:00	HF
Nitrate + Nitrite as Nitrogen	2.25	mg/L	EPA 300.0	0.05	2015-06-18	23:54:00	AL
Chloride, Cl	4	mg/L	EPA 300.0	1	2015-06-17	01:18:00	AL
Sulfate, SO4	3	mg/L	EPA 300.0	1	2015-06-17	01:18:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-06-10	08:00:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	26.58	mg/L	EPA 200.7	0.03	2015-06-16	03:38:00	HF
Iron, Fe - Total	0.37	mg/L	EPA 200.7	0.05	2015-06-10	17:53:00	HF
Magnesium, Mg - Dissolved	5.02	mg/L	EPA 200.7	0.01	2015-06-16	03:38:00	HF
Manganese, Mn - Total	0.041	mg/L	EPA 200.7	0.002	2015-06-10	17:53:00	HF
Potassium, K - Dissolved	0.48	mg/L	EPA 200.7	0.14	2015-06-16	03:38:00	HF

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FEB 13 2017

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Div. of Oil, Gas & Mining

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Analysis Report

June 24, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Jun 6, 2015	Sample Taken At:	CS-29
Date Received:	Jun 8, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0830
		Time Received:	1555
		Mine:	21
		Field - pH:	8.74 pH
		Field - Flow:	1032.60 GPM
		Field - Conductivity:	191 umhos/cm
		Field - Temperature:	5.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1529535-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	2.55	mg/L	EPA 200.7	0.09	2015-06-16	03:38:00	HF

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Analysis Report

October 02, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Sep 15, 2015	Sample Taken At:	CS-29
Date Received:	Sep 15, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0915
		Time Received:	1540
		Mine:	21
		Field - pH:	8.23 pH
		Field - Flow:	91.0 GPM
		Field - Conductivity:	267 umhos/cm
		Field - Temperature:	7.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530675-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	127	mg/L	SM2340-B	1	2015-10-01	16:57:13	DI
Acidity	<5	mg/L	D1067	5	2015-09-15	16:00:00	HF
Anions	2.60	meq/L	SM1030E	0	2015-10-01	16:57:13	DI
Balance	1.13	%	SM1030E	-10	2015-10-01	16:57:13	DI
Cations	2.66	meq/L	SM1030E	0	2015-10-01	16:57:13	DI
Alkalinity, mg CaCO3/L (pH 4.5)	119	mg/L	SM2320-B	5	2015-09-21	17:56:00	MS
Bicarbonate Alkalinity as CaCO3	119	mg/L	SM2320-B	5	2015-09-21	17:56:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-09-21	17:56:00	MS
Total Dissolved Solids	141	mg/L	SM2540-C	30	2015-09-17	16:00:00	HF
Total Suspended Solids	<5	mg/L	SM2540-D	5	2015-09-17	16:00:00	HF
Nitrate + Nitrite as Nitrogen	0.20	mg/L	EPA 300.0	0.05	2015-09-16	15:47:00	DI
Chloride, Cl	4	mg/L	EPA 300.0	1	2015-09-16	15:47:00	DI
Sulfate, SO4	5	mg/L	EPA 300.0	1	2015-09-16	15:47:00	DI
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-09-21	07:00:00	HF
METALS BY ICP							
Boron, B - Dissolved	0.02	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Barium, Ba - Dissolved	0.061	mg/L	EPA 200.7	0.002	2015-09-17	11:25:00	HF
Calcium, Ca - Dissolved	40.96	mg/L	EPA 200.7	0.03	2015-09-17	11:25:00	HF
Copper, Cu - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF

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Analysis Report

October 02, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Sep 15, 2015	Sample Taken At:	CS-29
Date Received:	Sep 15, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	0915
		Time Received:	1540
		Mine:	21
		Field - pH:	8.23 pH
		Field - Flow:	91.0 GPM
		Field - Conductivity:	267 umhos/cm
		Field - Temperature:	7.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530675-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Iron, Fe - Total	0.16	mg/L	EPA 200.7	0.05	2015-09-18	11:10:00	HF
Iron, Fe - Dissolved	0.07	mg/L	EPA 200.7	0.03	2015-09-17	11:25:00	HF
Lead, Pb - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Magnesium, Mg - Dissolved	6.04	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Manganese, Mn - Total	0.020	mg/L	EPA 200.7	0.002	2015-09-18	11:10:00	HF
Manganese, Mn - Dissolved	0.018	mg/L	EPA 200.7	0.002	2015-09-17	11:25:00	HF
Potassium, K - Dissolved	1.10	mg/L	EPA 200.7	0.14	2015-09-17	11:25:00	HF
Sodium, Na - Dissolved	2.04	mg/L	EPA 200.7	0.09	2015-09-22	11:10:00	HF

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Analysis Report

December 28, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Dec 7, 2015	Sample Taken At:	CS-29
Date Received:	Dec 8, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1335
		Time Received:	1620
		Mine:	21
		Field - pH:	8.05 pH
		Field - Flow:	54.7 GPM
		Field - Conductivity:	301 umhos/cm
		Field - Temperature:	0.8 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531653-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	133	mg/L	SM2340-B	1	2015-12-17	13:00:00	HF
Anions	2.75	meq/L	SM1030E	0	2015-12-17	12:00:00	HF
Balance	1.12	%	SM1030E	-10	2015-12-17	12:00:00	HF
Cations	2.81	meq/L	SM1030E	0	2015-12-17	12:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	121	mg/L	SM2320-B	5	2015-12-10	15:00:00	MS
Bicarbonate Alkalinity as CaCO3	121	mg/L	SM2320-B	5	2015-12-10	15:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-12-10	15:00:00	MS
Total Dissolved Solids	151	mg/L	SM2540-C	30	2015-12-10	12:22:00	HF
Total Suspended Solids	<5	mg/L	SM2540-D	5	2015-12-10	12:22:00	HF
Nitrate + Nitrite as Nitrogen	0.81	mg/L	EPA 300.0	0.05	2015-12-08	23:11:00	HF
Chloride, Cl	5	mg/L	EPA 300.0	1	2015-12-08	23:11:00	HF
Sulfate, SO4	9	mg/L	EPA 300.0	1	2015-12-08	23:11:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-12-16	07:30:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	43.00	mg/L	EPA 200.7	0.03	2015-12-09	12:00:00	HF
Iron, Fe - Total	0.14	mg/L	EPA 200.7	0.05	2015-12-10	12:00:00	HF
Magnesium, Mg - Dissolved	6.15	mg/L	EPA 200.7	0.01	2015-12-09	12:00:00	HF
Manganese, Mn - Total	0.043	mg/L	EPA 200.7	0.002	2015-12-10	12:00:00	HF
Potassium, K - Dissolved	0.65	mg/L	EPA 200.7	0.14	2015-12-09	12:00:00	HF

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Analysis Report

December 28, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Dec 7, 2015	Sample Taken At:	CS-29
Date Received:	Dec 8, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1335
		Time Received:	1620
		Mine:	21
		Field - pH:	8.05 pH
		Field - Flow:	54.7 GPM
		Field - Conductivity:	301 umhos/cm
		Field - Temperature:	0.8 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531653-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	3.24	mg/L	EPA 200.7	0.09	2015-12-09	12:00:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Jun 8, 2016	Sample Taken At:	CS-29
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	805
		Time Received:	1600
		Mine:	21
		Field - pH:	8.00 pH
		Field - Flow:	888.4 GPM
		Field - Conductivity:	158 umhos/cm
		Field - Temperature:	5.9 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	74	mg/L	SM2340-B	1	2016-06-27	10:00:00	DI
Anions	1.39	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Balance	3.85	%	SM1030E	-10	2016-06-27	10:00:00	DI
Cations	1.51	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	65	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Bicarbonate Alkalinity as CaCO3	65	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Total Dissolved Solids	120	mg/L	SM2540-C	30	2016-06-14	15:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-06-14	15:00:00	HF
Nitrate + Nitrite as Nitrogen	0.23	mg/L	EPA 300.0	0.05	2016-06-16	16:33:00	HF
Chloride, Cl	2	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Sulfate, SO4	2	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-06-22	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	23.43	mg/L	EPA 200.7	0.03	2016-06-15	19:00:00	HF
Iron, Fe - Total	0.41	mg/L	EPA 200.7	0.05	2016-06-17	12:00:00	HF
Magnesium, Mg - Dissolved	3.81	mg/L	EPA 200.7	0.01	2016-06-15	19:00:00	HF
Manganese, Mn - Total	0.035	mg/L	EPA 200.7	0.002	2016-06-17	12:00:00	HF
Potassium, K - Dissolved	<0.14	mg/L	EPA 200.7	0.14	2016-06-15	19:00:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Jun 8, 2016	Sample Taken At:	CS-29
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	805
		Time Received:	1600
		Mine:	21
		Field - pH:	8.00 pH
		Field - Flow:	888.4 GPM
		Field - Conductivity:	158 umhos/cm
		Field - Temperature:	5.9 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	0.83	mg/L	EPA 200.7	0.09	2016-06-15	19:00:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	CS-29
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1415
		Time Received:	1440
		Mine:	21
		Field - pH:	8.93 pH
		Field - Flow:	176.1 GPM
		Field - Conductivity:	227 umhos/cm
		Field - Temperature:	17.0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-008

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	106	mg/L	SM2340-B	1	2016-07-29	15:00:00	HF
Anions	2.07	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Balance	2.55	%	SM1030E	-10	2016-07-29	15:00:00	HF
Cations	2.18	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	97	mg/L	SM2320-B	5	2016-07-21	15:00:00	MS
Bicarbonate Alkalinity as CaCO3	97	mg/L	SM2320-B	5	2016-07-21	15:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-07-21	15:00:00	MS
Total Dissolved Solids	124	mg/L	SM2540-C	30	2016-07-20	16:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-07-20	16:00:00	MS
Nitrate + Nitrite as Nitrogen	0.38	mg/L	EPA 300.0	0.05	2016-07-19	23:11:00	HF
Chloride, Cl	2	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Sulfate, SO4	4	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-07-26	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	34.52	mg/L	EPA 200.7	0.03	2016-07-27	15:09:00	HF
Iron, Fe - Total	0.20	mg/L	EPA 200.7	0.05	2016-07-20	11:33:00	HF
Magnesium, Mg - Dissolved	4.88	mg/L	EPA 200.7	0.01	2016-07-27	15:09:00	HF
Manganese, Mn - Total	0.025	mg/L	EPA 200.7	0.002	2016-07-20	11:33:00	HF
Potassium, K - Dissolved	0.33	mg/L	EPA 200.7	0.14	2016-07-27	15:09:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	CS-29
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1415
		Time Received:	1440
		Mine:	21
		Field - pH:	8.93 pH
		Field - Flow:	176.1 GPM
		Field - Conductivity:	227 umhos/cm
		Field - Temperature:	17.0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-008

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.17	mg/L	EPA 200.7	0.09	2016-07-27	15:09:00	HF

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Lab Supervisor

Domenic Ibanez
Lab Supervisor

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Analysis Report

November 15, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Oct 18, 2016	Sample Taken At:	CS-29
Date Received:	Oct 20, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1140
		Time Received:	0830
		Mine:	21
		Field - pH:	8.43 pH
		Field - Flow:	154.8 GPM
		Field - Conductivity:	285 umhos/cm
		Field - Temperature:	3.9 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641666-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	133	mg/L	SM2340-B	1	2016-11-11	08:00:00	DI
Anions	2.85	meq/L	SM1030E	0	2016-11-11	08:00:00	DI
Balance	0.92	%	SM1030E	-10	2016-11-11	08:00:00	DI
Cations	2.90	meq/L	SM1030E	0	2016-11-11	08:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	124	mg/L	SM2320-B	5	2016-10-26	09:58:00	SM
Bicarbonate Alkalinity as CaCO3	124	mg/L	SM2320-B	5	2016-10-26	09:58:00	SM
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-10-26	09:58:00	SM
Total Dissolved Solids	177	mg/L	SM2540-C	30	2016-10-24	13:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-10-24	13:00:00	MS
Nitrate + Nitrite as Nitrogen	0.50	mg/L	EPA 300.0	0.05	2016-10-26	07:51:00	LR
Chloride, Cl	5	mg/L	EPA 300.0	1	2016-10-26	07:51:00	LR
Sulfate, SO4	10	mg/L	EPA 300.0	1	2016-10-26	07:51:00	LR
Phosphorus, Total	0.10	mg/L	SM4500P-E	0.05	2016-11-04	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	42.68	mg/L	EPA 200.7	0.03	2016-11-10	15:00:00	DI
Iron, Fe - Total	0.15	mg/L	EPA 200.7	0.05	2016-10-26	16:52:00	DI
Magnesium, Mg - Dissolved	6.51	mg/L	EPA 200.7	0.01	2016-11-10	15:00:00	DI
Manganese, Mn - Total	0.018	mg/L	EPA 200.7	0.002	2016-10-26	16:52:00	DI
Potassium, K - Dissolved	1.14	mg/L	EPA 200.7	0.14	2016-11-10	15:00:00	DI

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Analysis Report

November 15, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-29	Sample ID By:	Skyline Mine
Date Sampled:	Oct 18, 2016	Sample Taken At:	CS-29
Date Received:	Oct 20, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1140
		Time Received:	0830
		Mine:	21
		Field - pH:	8.43 pH
		Field - Flow:	154.8 GPM
		Field - Conductivity:	285 umhos/cm
		Field - Temperature:	3.9 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641666-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	4.69	mg/L	EPA 200.7	0.09	2016-11-10	15:00:00	DI

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Lease UTU – 77114
Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
-Lab Data-
Site: CS - 28

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Analysis Report

October 14, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Sep 25, 2014	Sample Taken At:	CS-28
Date Received:	Sep 25, 2014	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1230
		Time Received:	1555
		Mine:	21
		Field - pH:	8.56 pH
		Field - Flow:	133.3 GPM
		Field - Conductivity:	329 umhos/cm
		Field - Temperature:	6.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426286-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	185	mg/L	SM2340-B	1	2014-10-07	12:20:47	AL
Anions	3.65	meq/L	SM1030E	0	2014-10-07	12:20:47	AL
Balance	1.95	%	SM1030E	-10	2014-10-07	12:20:47	AL
Cations	3.79	meq/L	SM1030E	0	2014-10-07	12:20:47	AL
Alkalinity, mg CaCO3/L (pH 4.5)	174	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Bicarbonate Alkalinity as CaCO3	174	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Total Dissolved Solids	207	mg/L	SM2540-C	30	2014-09-29	14:55:00	AL
Total Suspended Solids	<5	mg/L	SM2540-D	5	2014-09-29	14:55:00	AL
Nitrate + Nitrite as Nitrogen	<0.05	mg/L	EPA 300.0	0.05	2014-09-27	01:25:00	AL
Chloride, Cl	1	mg/L	EPA 300.0	1	2014-09-27	01:25:00	AL
Sulfate, SO4	7	mg/L	EPA 300.0	1	2014-09-27	01:25:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2014-10-01	05:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	60.71	mg/L	EPA 200.7	0.03	2014-09-30	18:28:00	AL
Iron, Fe - Total	0.14	mg/L	EPA 200.7	0.05	2014-10-02	17:25:00	AL
Magnesium, Mg - Dissolved	8.12	mg/L	EPA 200.7	0.01	2014-09-30	18:28:00	AL
Manganese, Mn - Total	0.010	mg/L	EPA 200.7	0.002	2014-10-02	17:25:00	AL
Potassium, K - Dissolved	0.77	mg/L	EPA 200.7	0.14	2014-09-30	18:28:00	AL

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Analysis Report

October 14, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Sep 25, 2014	Sample Taken At:	CS-28
Date Received:	Sep 25, 2014	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1230
		Time Received:	1555
		Mine:	21
		Field - pH:	8.56 pH
		Field - Flow:	133.3 GPM
		Field - Conductivity:	329 umhos/cm
		Field - Temperature:	6.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426286-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.77	mg/L	EPA 200.7	0.09	2014-09-30	18:28:00	AL

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Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28
Date Sampled:	Nov 12, 2014
Date Received:	Nov 17, 2014
Product Description:	WATER

Sample ID By:	Skyline Mine
Sample Taken At:	CS-28
Sample Taken By:	J.A.
Time Sampled:	1540
Time Received:	1330
Mine:	21
Field - pH:	8.53pH
Field - Flow:	100.30 GPM
Field - Conductivity:	360 umhos/cm
Field - Temperature:	-0.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-009

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	177	mg/L	SM2340-B	1	2014-12-05	13:30:00	DI
Anions	3.47	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Balance	2.12	%	SM1030E	-10	2014-12-05	13:30:00	DI
Cations	3.62	meq/L	SM1030E	0	2014-12-05	13:30:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	163	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Bicarbonate Alkalinity as CaCO3	163	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-11-18	11:30:00	HF
Total Dissolved Solids	196	mg/L	SM2540-C	30	2014-11-18	13:00:00	AL
Total Suspended Solids	6	mg/L	SM2540-D	5	2014-11-18	13:00:00	AL
Nitrate + Nitrite as Nitrogen	<0.05	mg/L	EPA 300.0	0.05	2014-11-21	20:51:00	AL
Chloride, Cl	1	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Sulfate, SO4	8	mg/L	EPA 300.0	1	2014-11-20	02:06:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2014-12-01	06:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	58.73	mg/L	EPA 200.7	0.03	2014-11-19	16:15:00	HF
Iron, Fe - Total	0.14	mg/L	EPA 200.7	0.05	2014-12-05	08:41:27	HF
Magnesium, Mg - Dissolved	7.26	mg/L	EPA 200.7	0.01	2014-11-19	16:15:00	HF
Manganese, Mn - Total	0.016	mg/L	EPA 200.7	0.002	2014-12-05	08:41:27	HF
Potassium, K - Dissolved	4.68	mg/L	EPA 200.7	0.14	2014-11-19	16:15:00	HF

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Analysis Report

December 08, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Nov 12, 2014	Sample Taken At:	CS-28
Date Received:	Nov 17, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1540
		Time Received:	1330
		Mine:	21
		Field - pH:	8.53pH
		Field - Flow:	100.30 GPM
		Field - Conductivity:	360 umhos/cm
		Field - Temperature:	-0.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427014-009

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.70	mg/L	EPA 200.7	0.09	2014-11-19	16:15:00	HF

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Analysis Report

June 24, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Jun 6, 2015	Sample Taken At:	CS-28
Date Received:	Jun 8, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1030
		Time Received:	1555
		Mine:	21
		Field - pH:	8.71 pH
		Field - Flow:	1349.8 GPM
		Field - Conductivity:	312 umhos/cm
		Field - Temperature:	7.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1529535-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	156	mg/L	SM2340-B	1	2015-06-23	14:00:00	DI
Anions	3.03	meq/L	SM1030E	0	2015-06-23	14:00:00	DI
Balance	2.59	%	SM1030E	-10	2015-06-23	14:00:00	DI
Cations	3.19	meq/L	SM1030E	0	2015-06-23	14:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	147	mg/L	SM2320-B	5	2015-06-10	13:59:00	HF
Bicarbonate Alkalinity as CaCO3	147	mg/L	SM2320-B	5	2015-06-10	13:59:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-06-10	13:59:00	HF
Total Dissolved Solids	194	mg/L	SM2540-C	30	2015-06-10	11:20:00	HF
Total Suspended Solids	11	mg/L	SM2540-D	5	2015-06-10	11:20:00	HF
Nitrate + Nitrite as Nitrogen	2.08	mg/L	EPA 300.0	0.05	2015-06-18	23:54:00	AL
Chloride, Cl	1	mg/L	EPA 300.0	1	2015-06-17	01:18:00	AL
Sulfate, SO4	3	mg/L	EPA 300.0	1	2015-06-17	01:18:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-06-10	08:00:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	52.85	mg/L	EPA 200.7	0.03	2015-06-16	03:38:00	HF
Iron, Fe - Total	0.14	mg/L	EPA 200.7	0.05	2015-06-10	17:53:00	HF
Magnesium, Mg - Dissolved	5.78	mg/L	EPA 200.7	0.01	2015-06-16	03:38:00	HF
Manganese, Mn - Total	0.014	mg/L	EPA 200.7	0.002	2015-06-10	17:53:00	HF
Potassium, K - Dissolved	0.63	mg/L	EPA 200.7	0.14	2015-06-16	03:38:00	HF

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Analysis Report

June 24, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Jun 6, 2015	Sample Taken At:	CS-28
Date Received:	Jun 8, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1030
		Time Received:	1555
		Mine:	21
		Field - pH:	8.71 pH
		Field - Flow:	1349.8 GPM
		Field - Conductivity:	312 umhos/cm
		Field - Temperature:	7.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1529535-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.50	mg/L	EPA 200.7	0.09	2015-06-16	03:38:00	HF

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Analysis Report

September 22, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Sep 9, 2015	Sample Taken At:	CS-28
Date Received:	Sep 9, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1240
		Time Received:	1550
		Mine:	21
		Field - pH:	8.47 pH
		Field - Flow:	107.0 GPM
		Field - Conductivity:	322 umhos/cm
		Field - Temperature:	7.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530615-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Iron, Fe - Total	0.15	mg/L	EPA 200.7	0.05	2015-09-15	12:30:00	HF
Iron, Fe - Dissolved	<0.03	mg/L	EPA 200.7	0.03	2015-09-10	20:33:00	HF
Lead, Pb - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-10	20:33:00	HF
Magnesium, Mg - Dissolved	7.69	mg/L	EPA 200.7	0.01	2015-09-10	20:33:00	HF
Manganese, Mn - Total	0.012	mg/L	EPA 200.7	0.002	2015-09-15	12:30:00	HF
Manganese, Mn - Dissolved	0.009	mg/L	EPA 200.7	0.002	2015-09-10	20:33:00	HF
Potassium, K - Dissolved	0.73	mg/L	EPA 200.7	0.14	2015-09-10	20:33:00	HF
Sodium, Na - Dissolved	1.52	mg/L	EPA 200.7	0.09	2015-09-10	20:33:00	HF

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SGS

Analysis Report

September 22, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Sep 9, 2015	Sample Taken At:	CS-28
Date Received:	Sep 9, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1240
		Time Received:	1550
		Mine:	21
		Field - pH:	8.47 pH
		Field - Flow:	107.0 GPM
		Field - Conductivity:	322 umhos/cm
		Field - Temperature:	7.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530615-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	179	mg/L	SM2340-B	1	2015-09-14	11:40:00	DI
Acidity	<5	mg/L	D1067	5	2015-09-15	15:00:00	HF
Anions	3.59	meq/L	SM1030E	0	2015-09-14	11:40:00	DI
Balance	1.08	%	SM1030E	-10	2015-09-14	11:40:00	DI
Cations	3.67	meq/L	SM1030E	0	2015-09-14	11:40:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	171	mg/L	SM2320-B	5	2015-09-14	13:25:47	DI
Bicarbonate Alkalinity as CaCO3	171	mg/L	SM2320-B	5	2015-09-14	13:25:47	DI
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-09-14	13:25:47	DI
Total Dissolved Solids	206	mg/L	SM2540-C	30	2015-09-10	14:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2015-09-10	14:00:00	MS
Nitrate + Nitrite as Nitrogen	0.50	mg/L	EPA 300.0	0.05	2015-09-10	19:52:00	DI
Chloride, Cl	1	mg/L	EPA 300.0	1	2015-09-10	19:52:00	DI
Sulfate, SO4	7	mg/L	EPA 300.0	1	2015-09-10	19:52:00	DI
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-09-14	09:00:00	HF
METALS BY ICP							
Boron, B - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-10	20:33:00	HF
Barium, Ba - Dissolved	0.046	mg/L	EPA 200.7	0.002	2015-09-10	20:33:00	HF
Calcium, Ca - Dissolved	59.09	mg/L	EPA 200.7	0.03	2015-09-10	20:33:00	HF
Copper, Cu - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-10	20:33:00	HF

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Div. of Oil, Gas & Mining

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Analysis Report

December 11, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS 28	Sample ID By:	Skyline Mine
Date Sampled:	Nov 19, 2015	Sample Taken At:	CS-28
Date Received:	Nov 19, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1300
		Time Received:	1545
		Mine:	21
		Field - pH:	8.63 pH
		Field - Flow:	67.1 GPM
		Field - Conductivity:	346 umhos/cm
		Field - Temperature:	11.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531418-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	185	mg/L	SM2340-B	1	2015-12-11	12:00:00	HF
Anions	3.58	meq/L	SM1030E	0	2015-11-20	12:11:00	HF
Balance	3.27	%	SM1030E	-10	2015-11-20	12:11:00	HF
Cations	3.82	meq/L	SM1030E	0	2015-11-20	12:11:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	169	mg/L	SM2320-B	5	2015-11-25	11:12:00	HF
Bicarbonate Alkalinity as CaCO3	169	mg/L	SM2320-B	5	2015-11-25	11:12:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-11-25	11:12:00	HF
Total Dissolved Solids	196	mg/L	SM2540-C	30	2015-11-24	15:00:00	HF
Total Suspended Solids	<5	mg/L	SM2540-D	5	2015-11-24	14:20:00	HF
Nitrate + Nitrite as Nitrogen	0.86	mg/L	EPA 300.0	0.05	2015-11-19	19:46:00	HF
Chloride, Cl	1	mg/L	EPA 300.0	1	2015-11-19	19:46:00	HF
Sulfate, SO4	8	mg/L	EPA 300.0	1	2015-11-19	19:46:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-12-02	10:15:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	58.80	mg/L	EPA 200.7	0.03	2015-11-25	11:25:00	HF
Iron, Fe - Total	0.16	mg/L	EPA 200.7	0.05	2015-11-20	12:11:00	HF
Magnesium, Mg - Dissolved	9.25	mg/L	EPA 200.7	0.01	2015-11-25	11:25:00	HF
Manganese, Mn - Total	0.016	mg/L	EPA 200.7	0.002	2015-11-20	12:11:00	HF
Potassium, K - Dissolved	0.72	mg/L	EPA 200.7	0.14	2015-11-20	12:11:00	HF

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Analysis Report

December 11, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS 28	Sample ID By:	Skyline Mine
Date Sampled:	Nov 19, 2015	Sample Taken At:	CS-28
Date Received:	Nov 19, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1300
		Time Received:	1545
		Mine:	21
		Field - pH:	8.63 pH
		Field - Flow:	67.1 GPM
		Field - Conductivity:	346 umhos/cm
		Field - Temperature:	11.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531418-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	2.50	mg/L	EPA 200.7	0.09	2015-11-20	12:11:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Jun 8, 2016	Sample Taken At:	CS-28
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1300
		Time Received:	1600
		Mine:	21
		Field - pH:	8.65 pH
		Field - Flow:	1408.5 GPM
		Field - Conductivity:	271 umhos/cm
		Field - Temperature:	12.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	143	mg/L	SM2340-B	1	2016-06-27	10:00:00	DI
Anions	2.83	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Balance	0.33	%	SM1030E	-10	2016-06-27	10:00:00	DI
Cations	2.84	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	137	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Bicarbonate Alkalinity as CaCO3	137	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Total Dissolved Solids	98	mg/L	SM2540-C	30	2016-06-14	15:00:00	MS
Total Suspended Solids	8	mg/L	SM2540-D	5	2016-06-14	15:00:00	HF
Nitrate + Nitrite as Nitrogen	1.49	mg/L	EPA 300.0	0.05	2016-06-16	16:33:00	HF
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Sulfate, SO4	3	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-06-22	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	49.82	mg/L	EPA 200.7	0.03	2016-06-15	19:00:00	HF
Iron, Fe - Total	0.20	mg/L	EPA 200.7	0.05	2016-06-17	12:00:00	HF
Magnesium, Mg - Dissolved	4.49	mg/L	EPA 200.7	0.01	2016-06-15	19:00:00	HF
Manganese, Mn - Total	0.018	mg/L	EPA 200.7	0.002	2016-06-17	12:00:00	HF
Potassium, K - Dissolved	<0.14	mg/L	EPA 200.7	0.14	2016-06-15	19:00:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Jun 8, 2016	Sample Taken At:	CS-28
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1300
		Time Received:	1600
		Mine:	21
		Field - pH:	8.65 pH
		Field - Flow:	1408.5 GPM
		Field - Conductivity:	271 umhos/cm
		Field - Temperature:	12.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	<0.09	mg/L	EPA 200.7	0.09	2016-06-15	19:00:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	CS-28
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	950
		Time Received:	1440
		Mine:	21
		Field - pH:	8.53 pH
		Field - Flow:	259.7 GPM
		Field - Conductivity:	370 umhos/cm
		Field - Temperature:	6.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	187	mg/L	SM2340-B	1	2016-07-29	15:00:00	HF
Anions	3.65	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Balance	2.18	%	SM1030E	-10	2016-07-29	15:00:00	HF
Cations	3.81	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	176	mg/L	SM2320-B	5	2016-07-19	10:00:10	MS
Bicarbonate Alkalinity as CaCO3	176	mg/L	SM2320-B	5	2016-07-19	10:00:10	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-07-19	10:00:10	MS
Total Dissolved Solids	223	mg/L	SM2540-C	30	2016-07-20	16:00:00	MS
Total Suspended Solids	12	mg/L	SM2540-D	5	2016-07-20	16:00:00	MS
Nitrate + Nitrite as Nitrogen	0.59	mg/L	EPA 300.0	0.05	2016-07-19	23:11:00	HF
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Sulfate, SO4	5	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-07-26	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	63.32	mg/L	EPA 200.7	0.03	2016-07-27	15:09:00	HF
Iron, Fe - Total	0.09	mg/L	EPA 200.7	0.05	2016-07-20	11:33:00	HF
Magnesium, Mg - Dissolved	7.08	mg/L	EPA 200.7	0.01	2016-07-27	15:09:00	HF
Manganese, Mn - Total	0.011	mg/L	EPA 200.7	0.002	2016-07-20	11:33:00	HF
Potassium, K - Dissolved	0.49	mg/L	EPA 200.7	0.14	2016-07-27	15:09:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	CS-28
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	950
		Time Received:	1440
		Mine:	21
		Field - pH:	8.53 pH
		Field - Flow:	259.7 GPM
		Field - Conductivity:	370 umhos/cm
		Field - Temperature:	6.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.25	mg/L	EPA 200.7	0.09	2016-07-27	15:09:00	HF

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Analysis Report

November 15, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Oct 18, 2016	Sample Taken At:	CS-28
Date Received:	Oct 20, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1100
		Time Received:	0830
		Mine:	21
		Field - pH:	8.75 pH
		Field - Flow:	71.2 GPM
		Field - Conductivity:	369 umhos/cm
		Field - Temperature:	3.0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641666-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	180	mg/L	SM2340-B	1	2016-11-11	08:00:00	DI
Anions	3.90	meq/L	SM1030E	0	2016-11-11	08:00:00	DI
Balance	-2.72	%	SM1030E	-10	2016-11-11	08:00:00	DI
Cations	3.69	meq/L	SM1030E	0	2016-11-11	08:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	184	mg/L	SM2320-B	5	2016-10-26	09:56:00	SM
Bicarbonate Alkalinity as CaCO3	179	mg/L	SM2320-B	5	2016-10-26	09:56:00	SM
Carbonate Alkalinity as CaCO3	5	mg/L	SM2320-B	5	2016-10-26	09:56:00	SM
Total Dissolved Solids	223	mg/L	SM2540-C	30	2016-10-24	13:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-10-24	13:00:00	MS
Nitrate + Nitrite as Nitrogen	2.20	mg/L	EPA 300.0	0.05	2016-10-26	07:51:00	LR
Chloride, Cl	2	mg/L	EPA 300.0	1	2016-10-26	07:51:00	LR
Sulfate, SO4	8	mg/L	EPA 300.0	1	2016-10-26	07:51:00	LR
Phosphorus, Total	0.06	mg/L	SM4500P-E	0.05	2016-11-04	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	59.57	mg/L	EPA 200.7	0.03	2016-10-25	17:16:00	MS
Iron, Fe - Total	0.14	mg/L	EPA 200.7	0.05	2016-10-26	16:52:00	MS
Magnesium, Mg - Dissolved	7.66	mg/L	EPA 200.7	0.01	2016-10-25	17:16:00	MS
Manganese, Mn - Total	0.012	mg/L	EPA 200.7	0.002	2016-10-26	16:52:00	MS
Potassium, K - Dissolved	0.79	mg/L	EPA 200.7	0.14	2016-10-25	17:16:00	MS

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Analysis Report

November 15, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-28	Sample ID By:	Skyline Mine
Date Sampled:	Oct 18, 2016	Sample Taken At:	CS-28
Date Received:	Oct 20, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1100
		Time Received:	0830
		Mine:	21
		Field - pH:	8.75 pH
		Field - Flow:	71.2 GPM
		Field - Conductivity:	369 umhos/cm
		Field - Temperature:	3.0 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641666-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.60	mg/L	EPA 200.7	0.09	2016-10-25	17:16:00	MS

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Div. of Oil, Gas & Mining

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SGS North America Inc. | Minerals Services Division
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Lease UTU – 77114
Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
-Lab Data-
Site: CS - 27

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Div. of Oil, Gas & Mining

Analysis Report

October 14, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Sep 25, 2014	Sample Taken At:	CS-27
Date Received:	Sep 25, 2014	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1330
		Time Received:	1555
		Mine:	21
		Field - pH:	8.42 pH
		Field - Flow:	9.9 GPM
		Field - Conductivity:	337 umhos/cm
		Field - Temperature:	6.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426286-005

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	170	mg/L	SM2340-B	1	2014-10-07	12:20:47	AL
Anions	3.38	meq/L	SM1030E	0	2014-10-07	12:20:47	AL
Balance	1.75	%	SM1030E	-10	2014-10-07	12:20:47	AL
Cations	3.50	meq/L	SM1030E	0	2014-10-07	12:20:47	AL
Alkalinity, mg CaCO3/L (pH 4.5)	155	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Bicarbonate Alkalinity as CaCO3	155	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-10-01	12:30:00	AL
Total Dissolved Solids	194	mg/L	SM2540-C	30	2014-09-29	14:55:00	AL
Total Suspended Solids	24	mg/L	SM2540-D	5	2014-09-29	14:55:00	AL
Nitrate + Nitrite as Nitrogen	<0.05	mg/L	EPA 300.0	0.05	2014-09-27	01:25:00	AL
Chloride, Cl	4	mg/L	EPA 300.0	1	2014-09-27	01:25:00	AL
Sulfate, SO4	9	mg/L	EPA 300.0	1	2014-09-27	01:25:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2014-10-01	05:30:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	54.52	mg/L	EPA 200.7	0.03	2014-09-30	18:28:00	AL
Iron, Fe - Total	0.61	mg/L	EPA 200.7	0.05	2014-10-02	17:25:00	AL
Magnesium, Mg - Dissolved	8.25	mg/L	EPA 200.7	0.01	2014-09-30	18:28:00	AL
Manganese, Mn - Total	0.062	mg/L	EPA 200.7	0.002	2014-10-02	17:25:00	AL
Potassium, K - Dissolved	0.81	mg/L	EPA 200.7	0.14	2014-09-30	18:28:00	AL

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Analysis Report

October 14, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Sep 25, 2014	Sample Taken At:	CS-27
Date Received:	Sep 25, 2014	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1330
		Time Received:	1555
		Mine:	21
		Field - pH:	8.42 pH
		Field - Flow:	9.9 GPM
		Field - Conductivity:	337 umhos/cm
		Field - Temperature:	6.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1426286-005

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.75	mg/L	EPA 200.7	0.09	2014-09-30	18:28:00	AL

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Analysis Report

December 17, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Dec 2, 2014	Sample Taken At:	CS-27
Date Received:	Dec 4, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1010
		Time Received:	1550
		Mine:	21
		Field - pH:	8.61 pH
		Field - Flow:	30.5 GPM
		Field - Conductivity:	334 umhos/cm
		Field - Temperature:	-0.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427272-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	169	mg/L	SM2340-B	1	2014-12-17	14:09:28	DI
Anions	3.31	meq/L	SM1030E	0	2014-12-17	16:09:28	AL
Balance	2.65	%	SM1030E	-10	2014-12-17	16:09:28	AL
Cations	3.49	meq/L	SM1030E	0	2014-12-17	16:09:28	AL
Alkalinity, mg CaCO3/L (pH 4.5)	150	mg/L	SM2320-B	5	2014-12-16	07:00:00	HF
Bicarbonate Alkalinity as CaCO3	150	mg/L	SM2320-B	5	2014-12-16	07:00:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2014-12-16	07:00:00	HF
Total Dissolved Solids	210	mg/L	SM2540-C	30	2014-12-08	15:00:00	HF
Total Suspended Solids	<5	mg/L	SM2540-D	5	2014-12-08	15:00:00	HF
Nitrate + Nitrite as Nitrogen	0.78	mg/L	EPA 300.0	0.05	2014-12-12	03:34:00	DI
Chloride, Cl	3	mg/L	EPA 300.0	1	2014-12-12	03:34:00	DI
Sulfate, SO4	11	mg/L	EPA 300.0	1	2014-12-12	03:34:00	DI
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2014-12-17	06:00:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	54.08	mg/L	EPA 200.7	0.03	2014-12-10	13:48:00	HF
Iron, Fe - Total	0.07	mg/L	EPA 200.7	0.05	2014-12-12	18:36:00	HF
Magnesium, Mg - Dissolved	8.31	mg/L	EPA 200.7	0.01	2014-12-10	13:48:00	HF
Manganese, Mn - Total	0.010	mg/L	EPA 200.7	0.002	2014-12-12	18:36:00	HF
Potassium, K - Dissolved	0.94	mg/L	EPA 200.7	0.14	2014-12-10	13:48:00	HF

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Analysis Report

December 17, 2014

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Dec 2, 2014	Sample Taken At:	CS-27
Date Received:	Dec 4, 2014	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1010
		Time Received:	1550
		Mine:	21
		Field - pH:	8.61 pH
		Field - Flow:	30.5 GPM
		Field - Conductivity:	334 umhos/cm
		Field - Temperature:	-0.4 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1427272-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.96	mg/L	EPA 200.7	0.09	2014-12-10	13:48:00	HF

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Analysis Report

July 14, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Jun 15, 2015	Sample Taken At:	CS-27
Date Received:	Jun 16, 2015	Sample Taken By:	G.G.
Product Description:	WATER	Time Sampled:	1235
		Time Received:	1540
		Mine:	21
		Field - pH:	8.55 pH
		Field - Flow:	255.0 GPM
		Field - Conductivity:	278 umhos/cm
		Field - Temperature:	14.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1529623-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	142	mg/L	SM2340-B	1	2015-07-13	15:00:00	DI
Anions	2.82	meq/L	SM1030E	0	2015-07-13	15:00:00	DI
Balance	1.52	%	SM1030E	-10	2015-07-13	15:00:00	DI
Cations	2.91	meq/L	SM1030E	0	2015-07-13	15:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	120	mg/L	SM2320-B	5	2015-06-25	08:50:00	AL
Bicarbonate Alkalinity as CaCO3	120	mg/L	SM2320-B	5	2015-06-25	08:50:00	AL
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-06-25	08:50:00	AL
Total Dissolved Solids	180	mg/L	SM2540-C	30	2015-06-19	12:00:00	AL
Total Suspended Solids	9	mg/L	SM2540-D	5	2015-06-18	15:30:00	AL
Nitrate + Nitrite as Nitrogen	<0.05	mg/L	EPA 300.0	0.05	2015-06-17	20:27:00	AL
Chloride, Cl	12	mg/L	EPA 300.0	1	2015-06-17	20:27:00	AL
Sulfate, SO4	4	mg/L	EPA 300.0	1	2015-06-17	20:27:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-06-23	08:45:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	45.58	mg/L	EPA 200.7	0.03	2015-06-19	23:50:00	HF
Iron, Fe - Total	0.14	mg/L	EPA 200.7	0.05	2015-06-24	19:03:00	HF
Magnesium, Mg - Dissolved	6.80	mg/L	EPA 200.7	0.01	2015-06-19	23:50:00	HF
Manganese, Mn - Total	0.021	mg/L	EPA 200.7	0.002	2015-06-24	19:03:00	HF
Potassium, K - Dissolved	0.57	mg/L	EPA 200.7	0.14	2015-06-19	23:50:00	HF

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Analysis Report

July 14, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Jun 15, 2015	Sample Taken At:	CS-27
Date Received:	Jun 16, 2015	Sample Taken By:	G.G.
Product Description:	WATER	Time Sampled:	1235
		Time Received:	1540
		Mine:	21
		Field - pH:	8.55 pH
		Field - Flow:	255.0 GPM
		Field - Conductivity:	278 umhos/cm
		Field - Temperature:	14.2 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1529623-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.44	mg/L	EPA 200.7	0.09	2015-06-19	23:50:00	HF

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Analysis Report

October 02, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Sep 15, 2015	Sample Taken At:	CS-27
Date Received:	Sep 15, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1030
		Time Received:	1540
		Mine:	21
		Field - pH:	8.47 pH
		Field - Flow:	27.0 GPM
		Field - Conductivity:	346 umhos/cm
		Field - Temperature:	6.5 Deg. C

Comments: Dissolved Metals Filtered at Lab.

SGS Minerals Sample ID: 782-1530675-006

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	161	mg/L	SM2340-B	1	2015-10-01	16:57:13	DI
Acidity	<5	mg/L	D1067	5	2015-09-15	16:00:00	HF
Anions	3.30	meq/L	SM1030E	0	2015-10-01	16:57:13	DI
Balance	0.57	%	SM1030E	-10	2015-10-01	16:57:13	DI
Cations	3.34	meq/L	SM1030E	0	2015-10-01	16:57:13	DI
Alkalinity, mg CaCO3/L (pH 4.5)	145	mg/L	SM2320-B	5	2015-09-21	17:56:00	MS
Bicarbonate Alkalinity as CaCO3	145	mg/L	SM2320-B	5	2015-09-21	17:56:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-09-21	17:56:00	MS
Total Dissolved Solids	187	mg/L	SM2540-C	30	2015-09-17	16:00:00	HF
Total Suspended Solids	<5	mg/L	SM2540-D	5	2015-09-17	16:00:00	HF
Nitrate + Nitrite as Nitrogen	0.50	mg/L	EPA 300.0	0.05	2015-09-16	15:47:00	DI
Chloride, Cl	8	mg/L	EPA 300.0	1	2015-09-16	15:47:00	DI
Sulfate, SO4	9	mg/L	EPA 300.0	1	2015-09-16	15:47:00	DI
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-09-21	07:00:00	HF
METALS BY ICP							
Boron, B - Dissolved	0.02	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Barium, Ba - Dissolved	0.041	mg/L	EPA 200.7	0.002	2015-09-17	11:25:00	HF
Calcium, Ca - Dissolved	49.80	mg/L	EPA 200.7	0.03	2015-09-17	11:25:00	HF
Copper, Cu - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF

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Analysis Report

October 02, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Sep 15, 2015	Sample Taken At:	CS-27
Date Received:	Sep 15, 2015	Sample Taken By:	J.A.
Product Description:	WATER	Time Sampled:	1030
		Time Received:	1540
		Mine:	21
		Field - pH:	8.47 pH
		Field - Flow:	27.0 GPM
		Field - Conductivity:	346 umhos/cm
		Field - Temperature:	6.5 Deg. C

Comments: Dissolved Metals Filtered at Lab.

SGS Minerals Sample ID: 782-1530675-006

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Iron, Fe - Total	0.25	mg/L	EPA 200.7	0.05	2015-09-18	11:10:00	HF
Iron, Fe - Dissolved	0.09	mg/L	EPA 200.7	0.03	2015-09-17	11:25:00	HF
Lead, Pb - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Magnesium, Mg - Dissolved	8.78	mg/L	EPA 200.7	0.01	2015-09-17	11:25:00	HF
Manganese, Mn - Total	0.025	mg/L	EPA 200.7	0.002	2015-09-18	11:10:00	HF
Manganese, Mn - Dissolved	0.020	mg/L	EPA 200.7	0.002	2015-09-17	11:25:00	HF
Potassium, K - Dissolved	1.56	mg/L	EPA 200.7	0.14	2015-09-17	11:25:00	HF
Sodium, Na - Dissolved	2.08	mg/L	EPA 200.7	0.09	2015-09-22	11:10:00	HF

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SGS

Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	CS-27
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	820
		Time Received:	1440
		Mine:	21
		Field - pH:	8.52 pH
		Field - Flow:	53.9 GPM
		Field - Conductivity:	329 umhos/cm
		Field - Temperature:	6.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	164	mg/L	SM2340-B	1	2016-07-29	15:00:00	HF
Anions	3.20	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Balance	2.98	%	SM1030E	-10	2016-07-29	15:00:00	HF
Cations	3.39	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	141	mg/L	SM2320-B	5	2016-07-19	10:00:09	MS
Bicarbonate Alkalinity as CaCO3	141	mg/L	SM2320-B	5	2016-07-19	10:00:09	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-07-19	10:00:09	MS
Total Dissolved Solids	213	mg/L	SM2540-C	30	2016-07-20	16:00:00	MS
Total Suspended Solids	12	mg/L	SM2540-D	5	2016-07-20	16:00:00	MS
Nitrate + Nitrite as Nitrogen	0.64	mg/L	EPA 300.0	0.05	2016-07-19	23:11:00	HF
Chloride, Cl	9	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Sulfate, SO4	6	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-07-26	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	52.87	mg/L	EPA 200.7	0.03	2016-07-27	15:09:00	HF
Iron, Fe - Total	0.18	mg/L	EPA 200.7	0.05	2016-07-20	11:33:00	HF
Magnesium, Mg - Dissolved	7.79	mg/L	EPA 200.7	0.01	2016-07-27	15:09:00	HF
Manganese, Mn - Total	0.027	mg/L	EPA 200.7	0.002	2016-07-20	11:33:00	HF
Potassium, K - Dissolved	0.69	mg/L	EPA 200.7	0.14	2016-07-27	15:09:00	HF

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Div. of Oil, Gas & Mining

Lab Supervisor

Domenic Ibanez
Lab Supervisor

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	CS-27
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	820
		Time Received:	1440
		Mine:	21
		Field - pH:	8.52 pH
		Field - Flow:	53.9 GPM
		Field - Conductivity:	329 umhos/cm
		Field - Temperature:	6.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	2.18	mg/L	EPA 200.7	0.09	2016-07-27	15:09:00	HF

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Analysis Report

November 15, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Oct 18, 2016	Sample Taken At:	CS-27
Date Received:	Oct 20, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1015
		Time Received:	0830
		Mine:	21
		Field - pH:	8.54 pH
		Field - Flow:	9.8 GPM
		Field - Conductivity:	369 umhos/cm
		Field - Temperature:	3.5 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641666-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	174	mg/L	SM2340-B	1	2016-11-11	08:00:00	DI
Anions	3.72	meq/L	SM1030E	0	2016-11-11	08:00:00	DI
Balance	-1.54	%	SM1030E	-10	2016-11-11	08:00:00	DI
Cations	3.60	meq/L	SM1030E	0	2016-11-11	08:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	164	mg/L	SM2320-B	5	2016-10-26	09:53:00	SM
Bicarbonate Alkalinity as CaCO3	164	mg/L	SM2320-B	5	2016-10-26	09:53:00	SM
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-10-26	09:53:00	SM
Total Dissolved Solids	240	mg/L	SM2540-C	30	2016-10-24	13:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-10-24	13:00:00	MS
Nitrate + Nitrite as Nitrogen	1.39	mg/L	EPA 300.0	0.05	2016-10-26	07:51:00	LR
Chloride, Cl	8	mg/L	EPA 300.0	1	2016-10-26	07:51:00	LR
Sulfate, SO4	11	mg/L	EPA 300.0	1	2016-10-26	07:51:00	LR
Phosphorus, Total	<0.05	mg/L	SM4500P-E	0.05	2016-11-04	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	55.18	mg/L	EPA 200.7	0.03	2016-10-25	17:16:00	MS
Iron, Fe - Total	0.21	mg/L	EPA 200.7	0.05	2016-10-26	16:52:00	MS
Magnesium, Mg - Dissolved	8.81	mg/L	EPA 200.7	0.01	2016-10-25	17:16:00	MS
Manganese, Mn - Total	0.028	mg/L	EPA 200.7	0.002	2016-10-26	16:52:00	MS
Potassium, K - Dissolved	1.14	mg/L	EPA 200.7	0.14	2016-10-25	17:16:00	MS

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Analysis Report

November 15, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Oct 18, 2016	Sample Taken At:	CS-27
Date Received:	Oct 20, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1015
		Time Received:	0830
		Mine:	21
		Field - pH:	8.54 pH
		Field - Flow:	9.8 GPM
		Field - Conductivity:	369 umhos/cm
		Field - Temperature:	3.5 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641666-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	2.18	mg/L	EPA 200.7	0.09	2016-10-25	17:16:00	MS

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Jun 8, 2016	Sample Taken At:	CS-27
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1325
		Time Received:	1600
		Mine:	21
		Field - pH:	8.78 pH
		Field - Flow:	1145.8 GPM
		Field - Conductivity:	233 umhos/cm
		Field - Temperature:	15.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-005

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	116	mg/L	SM2340-B	1	2016-06-27	10:00:00	DI
Anions	2.25	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Balance	1.39	%	SM1030E	-10	2016-06-27	10:00:00	DI
Cations	2.31	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	103	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Bicarbonate Alkalinity as CaCO3	103	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Total Dissolved Solids	150	mg/L	SM2540-C	30	2016-06-14	15:00:00	MS
Total Suspended Solids	8	mg/L	SM2540-D	5	2016-06-14	15:00:00	HF
Nitrate + Nitrite as Nitrogen	0.66	mg/L	EPA 300.0	0.05	2016-06-16	16:33:00	HF
Chloride, Cl	5	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Sulfate, SO4	2	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-06-22	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	40.00	mg/L	EPA 200.7	0.03	2016-06-15	19:00:00	HF
Iron, Fe - Total	0.23	mg/L	EPA 200.7	0.05	2016-06-17	12:00:00	HF
Magnesium, Mg - Dissolved	4.02	mg/L	EPA 200.7	0.01	2016-06-15	19:00:00	HF
Manganese, Mn - Total	0.021	mg/L	EPA 200.7	0.002	2016-06-17	12:00:00	HF
Potassium, K - Dissolved	<0.14	mg/L	EPA 200.7	0.14	2016-06-15	19:00:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-27	Sample ID By:	Skyline Mine
Date Sampled:	Jun 8, 2016	Sample Taken At:	CS-27
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1325
		Time Received:	1600
		Mine:	21
		Field - pH:	8.78 pH
		Field - Flow:	1145.8 GPM
		Field - Conductivity:	233 umhos/cm
		Field - Temperature:	15.7 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-005

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	ANALYZED TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	<0.09	mg/L	EPA 200.7	0.09	2016-06-15	19:00:00	HF

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Lease UTU – 77114
Baseline Water Quality Data of Proposed Additional Water Monitoring Sites
-Lab Data-
Site: CS - 31

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Analysis Report

September 15, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-31	Sample ID By:	Skyline Mine
Date Sampled:	Aug 28, 2015	Sample Taken At:	CS-31
Date Received:	Aug 28, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1155
		Time Received:	1550
		Mine:	21
		Field - pH:	8.58 pH
		Field - Flow:	79.9 GPM
		Field - Conductivity:	423 umhos/cm
		Field - Temperature:	8.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530524-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	220	mg/L	SM2340-B	1	2015-09-09	11:00:00	DI
Acidity	<5	mg/L	D1067	5	2015-09-04	13:00:00	HF
Anions	4.14	meq/L	SM1030E	0	2015-09-09	11:00:00	DI
Balance	5.06	%	SM1030E	-10	2015-09-09	11:00:00	DI
Cations	4.58	meq/L	SM1030E	0	2015-09-09	11:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	188	mg/L	SM2320-B	5	2015-09-08	09:25:33	HF
Bicarbonate Alkalinity as CaCO3	188	mg/L	SM2320-B	5	2015-09-08	09:25:33	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-09-08	09:25:33	HF
Total Dissolved Solids	265	mg/L	SM2540-C	30	2015-09-01	13:00:00	HF
Total Suspended Solids	<5	mg/L	SM2540-D	5	2015-09-01	13:00:00	HF
Nitrate + Nitrite as Nitrogen	<0.05	mg/L	EPA 300.0	0.05	2015-09-03	19:46:00	DI
Chloride, Cl	6	mg/L	EPA 300.0	1	2015-09-03	19:46:00	DI
Sulfate, SO4	10	mg/L	EPA 300.0	1	2015-09-03	19:46:00	DI
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-09-14	09:00:00	HF
METALS BY ICP							
Boron, B - Dissolved	0.01	mg/L	EPA 200.7	0.01	2015-09-09	13:07:56	HF
Barium, Ba - Dissolved	0.057	mg/L	EPA 200.7	0.002	2015-09-09	13:07:56	HF
Calcium, Ca - Dissolved	65.63	mg/L	EPA 200.7	0.03	2015-09-09	13:07:56	HF
Copper, Cu - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-09	13:07:56	HF

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Analysis Report

September 15, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-31	Sample ID By:	Skyline Mine
Date Sampled:	Aug 28, 2015	Sample Taken At:	CS-31
Date Received:	Aug 28, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1155
		Time Received:	1550
		Mine:	21
		Field - pH:	8.58 pH
		Field - Flow:	79.9 GPM
		Field - Conductivity:	423 umhos/cm
		Field - Temperature:	8.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530524-002

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Iron, Fe - Total	0.09	mg/L	EPA 200.7	0.05	2015-09-08	10:20:00	HF
Iron, Fe - Dissolved	<0.03	mg/L	EPA 200.7	0.03	2015-09-09	13:07:56	HF
Lead, Pb - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-09	13:07:56	HF
Magnesium, Mg - Dissolved	13.55	mg/L	EPA 200.7	0.01	2015-09-09	13:07:56	HF
Manganese, Mn - Total	0.014	mg/L	EPA 200.7	0.002	2015-09-09	13:08:06	HF
Manganese, Mn - Dissolved	0.011	mg/L	EPA 200.7	0.002	2015-09-09	13:07:56	HF
Potassium, K - Dissolved	0.92	mg/L	EPA 200.7	0.14	2015-09-09	13:07:56	HF
Sodium, Na - Dissolved	3.76	mg/L	EPA 200.7	0.09	2015-09-09	13:07:56	HF

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Analysis Report

July 14, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-31	Sample ID By:	Skyline Mine
Date Sampled:	Jun 29, 2015	Sample Taken At:	CS-31
Date Received:	Jun 29, 2015	Sample Taken By:	G.G.
Product Description:	WATER	Time Sampled:	1300
		Time Received:	1550
		Mine:	21
		Field - pH:	8.78 pH
		Field - Flow:	594.8 GPM
		Field - Conductivity:	410 umhos/cm
		Field - Temperature:	11.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1529812-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	219	mg/L	SM2340-B	1	2015-07-10	07:00:00	AL
Anions	4.28	meq/L	SM1030E	0	2015-07-10	07:00:00	AL
Balance	2.79	%	SM1030E	-10	2015-07-10	07:00:00	AL
Cations	4.52	meq/L	SM1030E	0	2015-07-10	07:00:00	AL
Alkalinity, mg CaCO3/L (pH 4.5)	195	mg/L	SM2320-B	5	2015-07-06	07:45:00	HF
Bicarbonate Alkalinity as CaCO3	195	mg/L	SM2320-B	5	2015-07-06	07:45:00	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-07-06	07:45:00	HF
Total Dissolved Solids	239	mg/L	SM2540-C	30	2015-07-01	15:00:00	DI
Total Suspended Solids	<5	mg/L	SM2540-D	5	2015-07-01	15:00:00	DI
Nitrate + Nitrite as Nitrogen	<0.05	mg/L	EPA 300.0	0.05	2015-07-01	03:17:00	AL
Chloride, Cl	7	mg/L	EPA 300.0	1	2015-07-01	03:17:00	AL
Sulfate, SO4	9	mg/L	EPA 300.0	1	2015-07-01	03:17:00	AL
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-07-09	07:00:00	AL
METALS BY ICP							
Calcium, Ca - Dissolved	67.90	mg/L	EPA 200.7	0.03	2015-07-07	13:52:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2015-07-01	18:24:00	HF
Magnesium, Mg - Dissolved	11.99	mg/L	EPA 200.7	0.01	2015-07-07	13:52:00	HF
Manganese, Mn - Total	0.011	mg/L	EPA 200.7	0.002	2015-07-01	18:24:00	HF
Potassium, K - Dissolved	0.49	mg/L	EPA 200.7	0.14	2015-07-07	13:52:00	HF

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July 14, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-31	Sample ID By:	Skyline Mine
Date Sampled:	Jun 29, 2015	Sample Taken At:	CS-31
Date Received:	Jun 29, 2015	Sample Taken By:	G.G.
Product Description:	WATER	Time Sampled:	1300
		Time Received:	1550
		Mine:	21
		Field - pH:	8.78 pH
		Field - Flow:	594.8 GPM
		Field - Conductivity:	410 umhos/cm
		Field - Temperature:	11.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1529812-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	3.15	mg/L	EPA 200.7	0.09	2015-07-07	13:52:00	HF

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Div. of Oil, Gas & Mining

Lab Supervisor

Domenic Ibanez
Lab Supervisor

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-31	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	CS-31
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1330
		Time Received:	1600
		Mine:	21
		Field - pH:	8.58 pH
		Field - Flow:	2506.10 GPM
		Field - Conductivity:	331 umhos/cm
		Field - Temperature:	10.5 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-011

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	176	mg/L	SM2340-B	1	2016-06-27	10:00:00	DI
Anions	3.59	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Balance	-0.18	%	SM1030E	-10	2016-06-27	10:00:00	DI
Cations	3.58	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	167	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Bicarbonate Alkalinity as CaCO3	167	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Total Dissolved Solids	196	mg/L	SM2540-C	30	2016-06-14	15:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-06-14	15:00:00	HF
Nitrate + Nitrite as Nitrogen	0.12	mg/L	EPA 300.0	0.05	2016-06-16	16:33:00	HF
Chloride, Cl	5	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Sulfate, SO4	5	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-06-22	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	57.54	mg/L	EPA 200.7	0.03	2016-06-15	19:00:00	HF
Iron, Fe - Total	0.09	mg/L	EPA 200.7	0.05	2016-06-17	12:00:00	HF
Magnesium, Mg - Dissolved	7.89	mg/L	EPA 200.7	0.01	2016-06-15	19:00:00	HF
Manganese, Mn - Total	0.007	mg/L	EPA 200.7	0.002	2016-06-17	12:00:00	HF
Potassium, K - Dissolved	<0.14	mg/L	EPA 200.7	0.14	2016-06-15	19:00:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-31	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	CS-31
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1330
		Time Received:	1600
		Mine:	21
		Field - pH:	8.58 pH
		Field - Flow:	2506.10 GPM
		Field - Conductivity:	331 umhos/cm
		Field - Temperature:	10.5 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-011

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	ANALYZED TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.62	mg/L	EPA 200.7	0.09	2016-06-15	19:00:00	HF

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Div. of Oil, Gas & Mining

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-31	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	CS-31
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1115
		Time Received:	1440
		Mine:	21
		Field - pH:	8.75 pH
		Field - Flow:	468.5 GPM
		Field - Conductivity:	443 umhos/cm
		Field - Temperature:	9.8 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	219	mg/L	SM2340-B	1	2016-07-29	15:00:00	HF
Anions	4.15	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Balance	4.01	%	SM1030E	-10	2016-07-29	15:00:00	HF
Cations	4.50	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	189	mg/L	SM2320-B	5	2016-07-21	15:30:08	MS
Bicarbonate Alkalinity as CaCO3	189	mg/L	SM2320-B	5	2016-07-21	15:30:08	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-07-21	15:30:08	MS
Total Dissolved Solids	271	mg/L	SM2540-C	30	2016-07-20	16:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-07-20	16:00:00	MS
Nitrate + Nitrite as Nitrogen	0.22	mg/L	EPA 300.0	0.05	2016-07-19	23:11:00	HF
Chloride, Cl	6	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Sulfate, SO4	10	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-07-26	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	67.87	mg/L	EPA 200.7	0.03	2016-07-27	15:09:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2016-07-20	11:33:00	HF
Magnesium, Mg - Dissolved	12.00	mg/L	EPA 200.7	0.01	2016-07-27	15:09:00	HF
Manganese, Mn - Total	0.010	mg/L	EPA 200.7	0.002	2016-07-20	11:33:00	HF
Potassium, K - Dissolved	0.44	mg/L	EPA 200.7	0.14	2016-07-27	15:09:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-31	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	CS-31
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1115
		Time Received:	1440
		Mine:	21
		Field - pH:	8.75 pH
		Field - Flow:	468.5 GPM
		Field - Conductivity:	443 umhos/cm
		Field - Temperature:	9.8 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-004

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	2.68	mg/L	EPA 200.7	0.09	2016-07-27	15:09:00	HF

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Analysis Report

November 16, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-31	Sample ID By:	Skyline Mine
Date Sampled:	Oct 28, 2016	Sample Taken At:	CS-31
Date Received:	Oct 31, 2016	Sample Taken By:	GG
Product Description:	WATER	Time Sampled:	1005
		Time Received:	930
		Mine:	21
		Field - pH:	8.42 pH
		Field - Flow:	40.610 GPM
		Field - Conductivity:	454 umhos/cm
		Field - Temperature:	4.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641995-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	224	mg/L	SM2340-B	1	2016-11-15	11:00:00	DI
Anions	4.83	meq/L	SM1030E	0	2016-11-15	11:00:00	DI
Balance	-1.86	%	SM1030E	-10	2016-11-15	11:00:00	DI
Cations	4.66	meq/L	SM1030E	0	2016-11-15	11:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	218	mg/L	SM2320-B	5	2016-10-31	15:48:00	SM
Bicarbonate Alkalinity as CaCO3	204	mg/L	SM2320-B	5	2016-10-31	15:48:00	SM
Carbonate Alkalinity as CaCO3	13	mg/L	SM2320-B	5	2016-10-31	15:29:00	SM
Total Dissolved Solids	263	mg/L	SM2540-C	30	2016-11-01	14:00:00	MS
Total Suspended Solids	<5	mg/L	SM2540-D	5	2016-11-01	14:00:00	MS
Nitrate + Nitrite as Nitrogen	0.86	mg/L	EPA 300.0	0.05	2016-11-04	03:43:00	LR
Chloride, Cl	8	mg/L	EPA 300.0	1	2016-11-04	03:43:00	LR
Sulfate, SO4	12	mg/L	EPA 300.0	1	2016-11-04	03:43:00	LR
Phosphorus, Total	<0.05	mg/L	SM4500P-E	0.05	2016-11-04	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	68.88	mg/L	EPA 200.7	0.03	2016-11-08	15:20:00	DI
Iron, Fe - Total	0.08	mg/L	EPA 200.7	0.05	2016-11-02	15:42:00	DI
Magnesium, Mg - Dissolved	12.68	mg/L	EPA 200.7	0.01	2016-11-08	15:20:00	DI
Manganese, Mn - Total	0.013	mg/L	EPA 200.7	0.002	2016-11-02	15:42:00	DI
Potassium, K - Dissolved	0.73	mg/L	EPA 200.7	0.14	2016-11-08	15:20:00	DI

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Analysis Report

November 16, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	CS-31	Sample ID By:	Skyline Mine
Date Sampled:	Oct 28, 2016	Sample Taken At:	CS-31
Date Received:	Oct 31, 2016	Sample Taken By:	GG
Product Description:	WATER	Time Sampled:	1005
		Time Received:	930
		Mine:	21
		Field - pH:	8.42 pH
		Field - Flow:	40.610 GPM
		Field - Conductivity:	454 umhos/cm
		Field - Temperature:	4.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641995-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	3.66	mg/L	EPA 200.7	0.09	2016-11-08	15:20:00	DI

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Lease UTU – 77114

Baseline Water Quality Data of Proposed Additional Water Monitoring Sites

-Lab Data-

Site: SW5-590

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Div. of Oil, Gas & Mining

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Analysis Report

September 15, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW5-590	Sample ID By:	Skyline Mine
Date Sampled:	Aug 28, 2015	Sample Taken At:	SW5-590
Date Received:	Aug 28, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1050
		Time Received:	1550
		Mine:	21
		Field - pH:	7.47 pH
		Field - Flow:	24.0 GPM
		Field - Conductivity:	268 umhos/cm
		Field - Temperature:	3.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530524-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Iron, Fe - Total	0.09	mg/L	EPA 200.7	0.05	2015-09-08	10:20:00	HF
Iron, Fe - Dissolved	<0.03	mg/L	EPA 200.7	0.03	2015-09-09	13:07:55	HF
Lead, Pb - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-09	13:07:55	HF
Magnesium, Mg - Dissolved	6.03	mg/L	EPA 200.7	0.01	2015-09-09	13:07:55	HF
Manganese, Mn - Total	0.007	mg/L	EPA 200.7	0.002	2015-09-09	13:08:05	HF
Manganese, Mn - Dissolved	<0.002	mg/L	EPA 200.7	0.002	2015-09-09	13:07:55	HF
Potassium, K - Dissolved	0.61	mg/L	EPA 200.7	0.14	2015-09-09	13:07:55	HF
Sodium, Na - Dissolved	1.48	mg/L	EPA 200.7	0.09	2015-09-09	13:07:55	HF

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Analysis Report

September 15, 2015

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW5-590	Sample ID By:	Skyline Mine
Date Sampled:	Aug 28, 2015	Sample Taken At:	SW5-590
Date Received:	Aug 28, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1050
		Time Received:	1550
		Mine:	21
		Field - pH:	7.47 pH
		Field - Flow:	24.0 GPM
		Field - Conductivity:	268 umhos/cm
		Field - Temperature:	3.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1530524-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	128	mg/L	SM2340-B	1	2015-09-09	11:00:00	DI
Acidity	9	mg/L	D1067	5	2015-09-04	13:00:00	HF
Anions	2.40	meq/L	SM1030E	0	2015-09-09	11:00:00	DI
Balance	4.94	%	SM1030E	-10	2015-09-09	11:00:00	DI
Cations	2.65	meq/L	SM1030E	0	2015-09-09	11:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	116	mg/L	SM2320-B	5	2015-09-08	09:25:32	HF
Bicarbonate Alkalinity as CaCO3	116	mg/L	SM2320-B	5	2015-09-08	09:25:32	HF
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-09-08	09:25:32	HF
Total Dissolved Solids	180	mg/L	SM2540-C	30	2015-09-01	13:00:00	HF
Total Suspended Solids	8	mg/L	SM2540-D	5	2015-09-01	13:00:00	HF
Nitrate + Nitrite as Nitrogen	3.19	mg/L	EPA 300.0	0.05	2015-09-03	19:46:00	DI
Chloride, Cl	<1	mg/L	EPA 300.0	1	2015-09-03	19:46:00	DI
Sulfate, SO4	3	mg/L	EPA 300.0	1	2015-09-03	19:46:00	DI
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2015-09-14	09:00:00	HF
METALS BY ICP							
Boron, B - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-09	13:07:55	HF
Barium, Ba - Dissolved	0.072	mg/L	EPA 200.7	0.002	2015-09-09	13:07:55	HF
Calcium, Ca - Dissolved	41.50	mg/L	EPA 200.7	0.03	2015-09-09	13:07:55	HF
Copper, Cu - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-09-09	13:07:55	HF

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Analysis Report

January 14, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW5-590	Sample ID By:	Skyline Mine
Date Sampled:	Dec 18, 2015	Sample Taken At:	SW5-590
Date Received:	Dec 21, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1035
		Time Received:	1550
		Mine:	21
		Field - pH:	7.51 pH
		Field - Flow:	5.5 GPM
		Field - Conductivity:	284 umhos/cm
		Field - Temperature:	3.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531927-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	140	mg/L	SM2340-B	1	2016-01-07	13:00:00	HF
Acidity	<5	mg/L	D1067	5	2015-12-29	10:00:00	MS
Anions	2.68	meq/L	SM1030E	0	2016-01-07	13:00:00	HF
Balance	3.95	%	SM1030E	-10	2016-01-07	13:00:00	HF
Cations	2.90	meq/L	SM1030E	0	2016-01-07	13:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	129	mg/L	SM2320-B	5	2015-12-29	12:49:00	MS
Bicarbonate Alkalinity as CaCO3	129	mg/L	SM2320-B	5	2015-12-29	12:49:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2015-12-29	12:49:00	MS
Total Dissolved Solids	141	mg/L	SM2540-C	30	2015-12-22	11:00:00	MS
Total Suspended Solids	10	mg/L	SM2540-D	5	2015-12-22	11:00:00	MS
Nitrate + Nitrite as Nitrogen	1.79	mg/L	EPA 300.0	0.05	2016-01-01	17:00:00	HF
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-01-01	17:00:00	HF
Sulfate, SO4	3	mg/L	EPA 300.0	1	2016-01-01	17:00:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-01-05	08:00:00	HF
METALS BY ICP							
Boron, B - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-12-28	12:00:00	HF
Barium, Ba - Dissolved	0.074	mg/L	EPA 200.7	0.002	2015-12-28	12:00:00	HF
Calcium, Ca - Dissolved	44.62	mg/L	EPA 200.7	0.03	2015-12-28	12:00:00	HF
Copper, Cu - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-12-28	12:00:00	HF

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Div. of Oil, Gas & Mining

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Domenic Ibanez
Lab Supervisor

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Analysis Report

January 14, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW5-590	Sample ID By:	Skyline Mine
Date Sampled:	Dec 18, 2015	Sample Taken At:	SW5-590
Date Received:	Dec 21, 2015	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1035
		Time Received:	1550
		Mine:	21
		Field - pH:	7.51 pH
		Field - Flow:	5.5 GPM
		Field - Conductivity:	284 umhos/cm
		Field - Temperature:	3.1 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1531927-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Iron, Fe - Total	0.15	mg/L	EPA 200.7	0.05	2016-01-05	11:00:00	HF
Iron, Fe - Dissolved	<0.03	mg/L	EPA 200.7	0.03	2015-12-28	12:00:00	HF
Lead, Pb - Dissolved	<0.01	mg/L	EPA 200.7	0.01	2015-12-28	12:00:00	HF
Magnesium, Mg - Dissolved	7.00	mg/L	EPA 200.7	0.01	2015-12-28	12:00:00	HF
Manganese, Mn - Total	0.009	mg/L	EPA 200.7	0.002	2016-01-05	11:00:00	HF
Manganese, Mn - Dissolved	<0.002	mg/L	EPA 200.7	0.002	2015-12-28	12:00:00	HF
Potassium, K - Dissolved	0.59	mg/L	EPA 200.7	0.14	2015-12-28	12:00:00	HF
Sodium, Na - Dissolved	2.02	mg/L	EPA 200.7	0.09	2015-12-28	12:00:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW5-590	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	SW5-590
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1235
		Time Received:	1600
		Mine:	21
		Field - pH:	7.46 pH
		Field - Flow:	37.50 GPM
		Field - Conductivity:	251 umhos/cm
		Field - Temperature:	4.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-010

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	134	mg/L	SM2340-B	1	2016-06-27	10:00:00	DI
Anions	2.57	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Balance	1.81	%	SM1030E	-10	2016-06-27	10:00:00	DI
Cations	2.67	meq/L	SM1030E	0	2016-06-27	10:00:00	DI
Alkalinity, mg CaCO3/L (pH 4.5)	124	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Bicarbonate Alkalinity as CaCO3	124	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-06-17	13:00:00	MS
Total Dissolved Solids	150	mg/L	SM2540-C	30	2016-06-14	15:00:00	MS
Total Suspended Solids	12	mg/L	SM2540-D	5	2016-06-14	15:00:00	HF
Nitrate + Nitrite as Nitrogen	1.42	mg/L	EPA 300.0	0.05	2016-06-16	16:33:00	HF
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Sulfate, SO4	2	mg/L	EPA 300.0	1	2016-06-16	16:33:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-06-22	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	44.87	mg/L	EPA 200.7	0.03	2016-06-15	19:00:00	HF
Iron, Fe - Total	0.08	mg/L	EPA 200.7	0.05	2016-06-17	12:00:00	HF
Magnesium, Mg - Dissolved	5.40	mg/L	EPA 200.7	0.01	2016-06-15	19:00:00	HF
Manganese, Mn - Total	0.005	mg/L	EPA 200.7	0.002	2016-06-17	12:00:00	HF
Potassium, K - Dissolved	<0.14	mg/L	EPA 200.7	0.14	2016-06-15	19:00:00	HF

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Analysis Report

June 30, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW5-590	Sample ID By:	Skyline Mine
Date Sampled:	Jun 9, 2016	Sample Taken At:	SW5-590
Date Received:	Jun 9, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1235
		Time Received:	1600
		Mine:	21
		Field - pH:	7.46 pH
		Field - Flow:	37.50 GPM
		Field - Conductivity:	251 umhos/cm
		Field - Temperature:	4.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1637265-010

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	<0.09	mg/L	EPA 200.7	0.09	2016-06-15	19:00:00	HF

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Analysis Report

November 16, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW5-590	Sample ID By:	Skyline Mine
Date Sampled:	Oct 28, 2016	Sample Taken At:	SW5-590
Date Received:	Oct 31, 2016	Sample Taken By:	GG
Product Description:	WATER	Time Sampled:	955
		Time Received:	930
		Mine:	21
		Field - pH:	7.60 pH
		Field - Flow:	20.590 GPM
		Field - Conductivity:	278 umhos/cm
		Field - Temperature:	4.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641996-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	125	mg/L	SM2340-B	1	2016-11-15	14:39:00	LR
Anions	2.70	meq/L	SM1030E	0	2016-11-15	14:39:00	LR
Balance	-2.58	%	SM1030E	-10	2016-11-15	14:39:00	LR
Cations	2.57	meq/L	SM1030E	0	2016-11-15	14:39:00	LR
Alkalinity, mg CaCO3/L (pH 4.5)	130	mg/L	SM2320-B	5	2016-11-04	12:43:00	SM
Bicarbonate Alkalinity as CaCO3	130	mg/L	SM2320-B	5	2016-11-04	12:43:00	SM
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-11-04	12:43:00	SM
Total Dissolved Solids	154	mg/L	SM2540-C	30	2016-11-01	14:00:00	MS
Total Suspended Solids	26	mg/L	SM2540-D	5	2016-11-01	14:00:00	MS
Nitrate + Nitrite as Nitrogen	3.09	mg/L	EPA 300.0	0.05	2016-11-04	03:43:00	LR
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-11-04	03:43:00	LR
Sulfate, SO4	3	mg/L	EPA 300.0	1	2016-11-04	03:43:00	LR
Phosphorus, Total	<0.05	mg/L	SM4500P-E	0.05	2016-11-04	09:00:00	MS
METALS BY ICP							
Calcium, Ca - Dissolved	41.02	mg/L	EPA 200.7	0.03	2016-11-08	15:20:00	DI
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2016-11-02	15:42:00	DI
Magnesium, Mg - Dissolved	5.43	mg/L	EPA 200.7	0.01	2016-11-08	15:20:00	DI
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2016-11-02	15:42:00	DI
Potassium, K - Dissolved	0.44	mg/L	EPA 200.7	0.14	2016-11-08	15:20:00	DI

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Analysis Report

November 16, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW5-590	Sample ID By:	Skyline Mine
Date Sampled:	Oct 28, 2016	Sample Taken At:	SW5-590
Date Received:	Oct 31, 2016	Sample Taken By:	GG
Product Description:	WATER	Time Sampled:	955
		Time Received:	930
		Mine:	21
		Field - pH:	7.60 pH
		Field - Flow:	20.590 GPM
		Field - Conductivity:	278 umhos/cm
		Field - Temperature:	4.3 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1641996-001

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	1.44	mg/L	EPA 200.7	0.09	2016-11-08	15:20:00	DI

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW5-590	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	SW5-590
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1045
		Time Received:	1440
		Mine:	21
		Field - pH:	7.59 pH
		Field - Flow:	28.3 GPM
		Field - Conductivity:	279 umhos/cm
		Field - Temperature:	5.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
Hardness, mg equivalent CaCO3/L	132	mg/L	SM2340-B	1	2016-07-29	15:00:00	HF
Anions	2.58	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Balance	2.05	%	SM1030E	-10	2016-07-29	15:00:00	HF
Cations	2.69	meq/L	SM1030E	0	2016-07-29	15:00:00	HF
Alkalinity, mg CaCO3/L (pH 4.5)	125	mg/L	SM2320-B	5	2016-07-21	15:30:07	MS
Bicarbonate Alkalinity as CaCO3	125	mg/L	SM2320-B	5	2016-07-21	15:30:07	MS
Carbonate Alkalinity as CaCO3	<5	mg/L	SM2320-B	5	2016-07-21	15:30:07	MS
Total Dissolved Solids	154	mg/L	SM2540-C	30	2016-07-20	16:00:00	MS
Total Suspended Solids	8	mg/L	SM2540-D	5	2016-07-20	16:00:00	MS
Nitrate + Nitrite as Nitrogen	1.48	mg/L	EPA 300.0	0.05	2016-07-19	23:11:00	HF
Chloride, Cl	1	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Sulfate, SO4	3	mg/L	EPA 300.0	1	2016-07-19	23:11:00	HF
Phosphorus, Total	<0.05	mg/L	SM4500-P E	0.05	2016-07-26	09:00:00	HF
METALS BY ICP							
Calcium, Ca - Dissolved	43.38	mg/L	EPA 200.7	0.03	2016-07-27	15:09:00	HF
Iron, Fe - Total	<0.05	mg/L	EPA 200.7	0.05	2016-07-20	11:33:00	HF
Magnesium, Mg - Dissolved	5.76	mg/L	EPA 200.7	0.01	2016-07-27	15:09:00	HF
Manganese, Mn - Total	<0.002	mg/L	EPA 200.7	0.002	2016-07-20	11:33:00	HF
Potassium, K - Dissolved	0.48	mg/L	EPA 200.7	0.14	2016-07-27	15:09:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW5-590	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	SW5-590
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1045
		Time Received:	1440
		Mine:	21
		Field - pH:	7.59 pH
		Field - Flow:	28.3 GPM
		Field - Conductivity:	279 umhos/cm
		Field - Temperature:	5.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	ANALYZED TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	0.95	mg/L	EPA 200.7	0.09	2016-07-27	15:09:00	HF

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Analysis Report

August 08, 2016

CANYON FUEL SKYLINE MINES
HCR 35 BOX 380
ACCOUNTS PAYABLE
HELPER UT 84526

Client Sample ID:	SW5-590	Sample ID By:	Skyline Mine
Date Sampled:	Jul 14, 2016	Sample Taken At:	SW5-590
Date Received:	Jul 15, 2016	Sample Taken By:	JA
Product Description:	WATER	Time Sampled:	1045
		Time Received:	1440
		Mine:	21
		Field - pH:	7.59 pH
		Field - Flow:	28.3 GPM
		Field - Conductivity:	279 umhos/cm
		Field - Temperature:	5.6 Deg. C

Comments: Dissolved Metals Field Filtered

SGS Minerals Sample ID: 782-1638537-003

TESTS	RESULT	UNIT	METHOD	REPORTING LIMIT	ANALYZED DATE	TIME	ANALYST
METALS BY ICP (continued)							
Sodium, Na - Dissolved	0.95	mg/L	EPA 200.7	0.09	2016-07-27	15:09:00	HF

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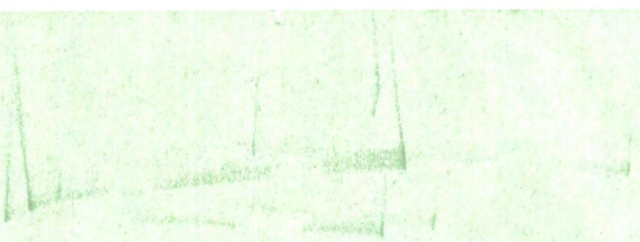
Append A-4
Vol. 2



FLAT CANYON COAL LEASE TRACT

FINAL ENVIRONMENTAL IMPACT STATEMENT

January 2002

United States
Department of
Agriculture

Forest Service

Intermountain Region

Manti-La Sal
National Forest

United States
Department of the
Interior

Bureau of Land
Management

State of Utah

Cooperating Agency: Department of the Interior, Office of Surface Mining Reclamation and Enforcement

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FINAL
ENVIRONMENTAL IMPACT STATEMENT

FLAT CANYON FEDERAL COAL LEASE TRACT (UTU-77114)

MANTI-LA SAL NATIONAL FOREST
FERRON-PRICE RANGER DISTRICT
SANPETE AND EMERY COUNTIES, UTAH

Joint Lead Agencies:

USDA Forest Service (FS)
Intermountain Region
Manti-La Sal National Forest

USDI Bureau of Land Management (BLM)
Utah State Office

Responsible Officials:

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ABSTRACT:

This Final Environmental Impact Statement (FEIS) was written in response to an application to lease the Flat Canyon Coal Lease Tract by Canyon Fuel Company, LLC. The purpose of the application is to potentially add adjacent recoverable coal reserves to the permit area for the Skyline Mine and extend the mine life for an estimated 9-12 years. The proposed action is to offer the tract for competitive leasing with special coal lease stipulations needed to protect natural resources. The FEIS evaluates the potential effects of leasing the tract by BLM and the potential effects of mining, based on a reasonably foreseeable development scenario (RFDS). The RFDS projects underground coal mining within the tract and adjacent private lands, including some minor surface developments consisting of two ventilation shafts and 10 coal exploration drill holes (development drilling). Based on the analysis, the responsible agency officials must decide whether or not to offer the tract for competitive leasing and, if offered, what special stipulations to include in the lease for protection of the coal resource and other natural resources on the Manti-La Sal National Forest.

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S-1.1 INTRODUCTION

This Final Environmental Impact Statement (FEIS) considers the environmental, social, and economic effects of offering the Flat Canyon Coal Lease Tract (UTU-77114) for leasing by the United States Department of the Interior, Bureau of Land Management (BLM), with consent by the United States Department of Agriculture, Forest Service, specifically the Manti-La Sal National Forest (FS). This analysis is tiered directly to the Final Environmental Impact Statement, Manti-La Sal National Forest, 1986 and Record of Decision and Summary, November 5, 1986 as amended. The BLM and FS jointly conducted the environmental analysis for the Flat Canyon Coal Lease Tract and prepared the FEIS. The United States Department of the Interior, Office of Surface Mining Reclamation and Enforcement (OSM) participated as a cooperating agency. The FEIS specifically addresses the consequences of implementing four alternatives, including the Proposed Action and "No Action" Alternative that involves taking no further action to evaluate or offer the tract for leasing. The analysis was initiated by the agencies in response to an application to lease the Flat Canyon Tract by Canyon Fuel Company, LLC, submitted to the BLM, Utah State Office.

Decisions to be made, authorizing actions, and a description of the Federal coal leasing process are further discussed in Sections 1.3 and 1.4.

S-1.2 PROPOSED ACTION

The proposed action is for BLM to offer the Flat Canyon Coal Lease Tract (UTU-77114) for competitive leasing in response to Canyon Fuel's application for leasing under the Lease-on-Application process contained in Federal Regulations 43 CFR 3425. The Forest Service would consent to leasing by BLM. The Tract would be offered with BLM's standard terms and conditions contained on Lease Form 3400-12 and special coal lease stipulations identified by BLM and the Forest Service for the protection of natural resources consistent with applicable laws, Forest Service and BLM policies, and the Land and Resource Management Plan, Manti-La Sal National Forest. In order to meet Canyon Fuel's need to move into the tract with underground workings in late 2001 or early 2002, the proposed lease sale would need to take place as soon as possible.

The tract was delineated by an Interagency Tract Delineation Team to assure that it is reasonable and meets requirements of the responsible agencies. The Flat Canyon Tract encompasses 2,692.16 acres of Federal coal reserves of the Wasatch Plateau Coal Field on National Forest System lands within the Manti-La Sal National Forest in Sanpete County, Utah. This area is described in the FEIS as the "Tract Area" as follows (FEIS, End of Chapter 1, Figures 1.1 and 1.2):

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T. 13 S., R. 6 E., SLM,

Section 21, lots 1-4, E1/2E1/2;

Section 28, lots 1-8, S1/2NW1/4, SW1/4;
Section 33, E1/2, E1/2W1/2, NW1/4NW1/4, SW1/4SW1/4;

T. 14 S., R. 6 E., SLM,

Section 4, lots 1-4, S1/2N1/2, S1/2;
Section 5, lots 1-4, S1/2N1/2, S1/2.

Additional non-Federal lands with non-Federal coal (both in private ownership) adjacent to the Federal coal lease tract, referred to as the "Private Lands (approximately 1,100 acres)," could be mined as a result of this lease action. They are described below:

T. 13 S., R. 6 E., SLM,

Section 29, E1/2SE1/4, SE1/4NE1/4, S1/2NE1/4NE1/4;
Section 32, E1/2E1/2.

T. 14 S., R. 6 E., SLM,

Section 3 (portion as shown on Figure 1-2)
Section 8, N1/2N1/2;
Section 9, N1/2N1/2;
Section 10 (portion shown on Figure 1-2).

The Tract area and adjacent private lands are collectively referred to in this FEIS as the "Project Area". Therefore, the total area analyzed is approximately 3,792 acres.

S-1.3 PURPOSE AND NEED

The purpose of offering the tract for competitive leasing is to provide an opportunity to develop mineable Federal coal reserves by underground methods. This coal is needed for the generation of electricity, other industrial uses, and to provide economic returns to the National, State and local economies, and to prevent bypassing mineable coal reserves adjacent to an existing mine that may otherwise not be mined.

The purpose of Canyon Fuel's application is to obtain the right to mine known Federal coal reserves in the Flat Canyon Tract, immediately to the west of the current permit area for their Skyline Mine. If leased, Canyon Fuel would extend their underground coal workings to the west into the Flat Canyon Tract and beyond into private (fee) coal reserves. Two coal seams could be mined over the majority of the project area (Flat Canyon Tract and adjacent non-Federal lands). Recoverable coal reserves in the tract and adjacent area are estimated at approximately 36 million tons. At an annual production rate of 3 to 4 million tons, the proposal could extend the life of the Skyline Mine by 9-12 years.

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A review of the Forest Plan showed that the proposed lease tract area is available for further consideration for coal leasing through application of the Unsuitability Criteria (43 CFR 3464) and an appropriate environmental analysis (Letter to the Utah State Director of BLM from the Forest Supervisor, Manti-La Sal National Forest 2820-4, January 21, 2000).

If the tract is not leased within the approximate proposed time frame, it is likely that the mineable Federal coal reserves in the tract would be bypassed and not mined in the foreseeable future.

S-1.4 DECISIONS TO BE MADE, AUTHORITIES, AND PERMITS

The USDI, Bureau of Land Management (BLM) is the leasing authority for all Federal coal reserves under the Mineral Leasing Act of 1920, as amended. The BLM Utah State Director must decide:

- whether or not to offer the Flat Canyon Tract for competitive leasing.
- what terms, conditions, and stipulations are needed on the lease to ensure compliance with the Mineral Leasing Act of 1920, as amended.

The USDA, Forest Service is the Surface Management Agency. The Forest Supervisor, Manti-La Sal National Forest, must decide:

- whether or not to consent to leasing by BLM, under authority of the Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1975.
- what special coal lease stipulations are needed for the protection of non-mineral resources.

If consent to leasing is given, the Forest Supervisor is also consenting to underground mining and subsidence of the land surface consistent with the lease stipulations imposed for the protection of National Forest resources.

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Before any mining can take place on a Federal coal lease, a mine permit must be obtained by the lessee or operator.

The Surface Mining Control and Reclamation Act of 1977, as amended (SMCRA) gives the Office of Surface Mining Reclamation and Enforcement (OSM) primary responsibility to administer programs that regulate surface coal mining operations and the surface effects of underground coal mining operations in the United States. Pursuant to Section 503 of SMCRA, the Utah Division of Oil, Gas, and Mining (DOGM) developed, and the Secretary of the Interior approved, Utah's permanent regulatory program authorizing Utah DOGM to regulate surface

coal mining operations and the surface effects of underground coal mining on private and State lands within the State of Utah. In March 1987, pursuant to Section 523(c) of SMCRA, Utah DOGM entered into a cooperative agreement with the Secretary of the Interior authorizing Utah DOGM to regulate surface coal mining operations and the surface effects of underground coal mining on Federal lands within the State.

Pursuant to the cooperative agreement, Federal coal lease holders in Utah must submit a permit application package (PAP) to OSM and Utah DOGM for proposed mining and reclamation operations on Federal lands in the State. Utah DOGM reviews the PAP to ensure that it complies with the approved Utah State permanent program and other statutes. If it does comply, Utah DOGM issues the applicant a permit to conduct coal mining operations. OSM and other Federal agencies review the PAP to ensure that it contains the necessary information for compliance with the coal lease, the Mineral Leasing Act of 1920, as amended (MLA), the National Environmental Policy Act of 1969, as amended (NEPA), and other applicable Federal laws and their attendant regulations. OSM recommends to the Assistant Secretary of the Interior, Land and Minerals Management: (1) approval of the MLA mining plan, (2) approval of the MLA mining plan with conditions, or (3) disapproval of the MLA mining plan. Before making a recommendation on the mining plan, OSM obtains input from certain other Federal agencies, including the surface management agency.

The BLM is responsible for monitoring and enforcement of lease terms, conditions, and special stipulations, including required mitigations. The Forest Service cooperates with BLM by conducting field inspections of lease areas and operations.

Utah DOGM enforces the performance standards and permit requirements during the mine's operation and has primary authority in environmental emergencies. OSM retains oversight responsibility of this enforcement. The surface management agency has authority in emergency situations in which Utah DOGM or OSM inspectors cannot act before environmental harm or damage occurs. UDOGM conducts frequent inspections of operations for compliance. The Forest Service cooperates with them regarding enforcement.

Resource monitoring, including subsidence, water monitoring, and vegetation monitoring is conducted by the lessee/operator in compliance with the mine permit and other permits issued for operations. The regulatory agencies take periodic samples to verify the lessee/operator monitoring data.

S-1.5 REASONABLY FORESEEABLE DEVELOPMENT

The Reasonably Foreseeable Development/Mining Scenario (RFDS) has been developed by the BLM in consultation with Canyon Fuel and Norwest Mine Services, Inc. NorWest Mine Services, Inc. prepared the scenario, predicted the location and amount of mining-induced subsidence and seismicity, conducted an analysis of the physical effects of mining to the geology, topography, and facilities/structures in and adjacent to the project area, and prepared

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Technical Reports under the direction of the agencies. The NorWest Technical Reports are referenced throughout the FEIS. The following is a summarized description of the Reasonably Foreseeable Mining Scenario. A detailed description of the predicted development of the proposed tract area and adjacent private lands and mineral estates are contained in the Technical Reports prepared by Norwest Mine Services, Inc. (Project File).

The RFDS is conceptual in nature and was developed for the purpose of determining the effects of leasing and subsequent mining. It presents the most likely mining scenario based on current information available from the Skyline Mine, but it is recognized that changes to locations of main entry systems and panels could be necessary based on actual conditions encountered underground. In order to adequately evaluate potential effects, with the knowledge that some aspects could change, the RFDS and effects analysis assume that the scenario with the most surface effect could occur.

The geologic conditions predicted in the Tract indicate that mining conditions would be relatively similar to those that have been experienced in the Skyline Mines, except that the reserves become progressively deeper towards the West. All mining would be done by underground methods with surface disturbance being limited to ancillary facilities. No surface mining methods would be used and the existing portal and support facilities in Eccles Canyon would be used. The RFDS for future mining in the Tract has been developed on the assumption that longwall mining would be carried out on a similar basis to that successfully employed at Skyline. Several northeast-southwest trending faults occur within the project area. The vertical offset of each fault is not specifically known at this time but it is conceivable that the offset could be large enough to influence the mining scenario. Due to the uncertainties, the RFDS was developed assuming that they would not change the mining scenario, but their existence and potential to influence mining is recognized.

The main underground mining access to the Tract is planned in the Lower O'Connor B Seam by the westerly extension of the current main development entries in the Skyline Mine (FEIS, End of Chapter 1, Figure 1.2).

For Maximum Economic Recovery (MER), it has been assumed that a Main Development Corridor would be located below or under the west canyon slope of Upper Huntington Creek, as this would afford protection of this perennial drainage from subsidence, while allowing efficient recovery. A corridor about 1,600 feet wide has been identified where the mains would be located that allows for a sufficient number of entries and pillars with adequate dimensions to ensure long-term stability.

The main development system would be connected to ventilation shaft(s). Sub-mains would also be needed for access to production areas. Mining of the majority of the project area would generally be at greater depths than in the current permit area, varying from about 1,000 feet to over 2,000 feet.

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Access to the Flat Canyon and Lower O'Connor 'A' Seams would be from underground, by developing rock entries at a slope to access mains in the lower seam. The lower main development entries and pillars would be driven underneath those in the upper seam and pillars would be vertically aligned to minimize adverse stress interactions and optimize coal recovery.

Production is planned by longwall methods similar to those currently being used in the Skyline Mine. It is expected that panels would be about 800 feet wide and their length would vary from about 3,000 to 15,000 feet, depending upon selected mine layout and both geological and operational constraints.

The most likely orientation of longwall panels would be approximately E-W, which has been shown to be successful at Skyline. Previous mining experience has also shown that an orientation approximately N-S could also be acceptable. Other geological and operational constraints, such as the location and offset of faults, may influence the final choice of panel orientation. Protection of surface structures and resources could also provide additional constraints on the location, orientation, and sequence of longwall extraction.

Mine production is planned from a single longwall section, in conjunction with production from continuous miners driving development entries. Additional production may come from room-and-pillar extraction, although a depth limitation of 1,800 feet for this method has been assumed. There are two mineable seams over the majority of the area and the upper coal bed (Lower O' Connor B Seam) would be mined first, followed by the lower coal bed (Flat Canyon Seam). The areas that could be potentially mined in the Lower O'Connor B Seam (Upper Seam Mining Zone) are shown on Figure 1.3 in the FEIS at the end of Chapter 1. The potential mining area for the Flat Canyon Seam (Lower Seam Mining Zone) is shown on Figure 1.4.

The BLM has identified in the Tract Delineation Report longwall mining reserves of about 36 million tons. At an estimated annual production rate of three to four million tons, this could extend the life of the Skyline Mine by nine to twelve years.

Reasonable equipment constraints for the definition of the minimum and maximum extraction heights for full extraction longwall mining have been assumed for evaluation of impacts due to subsidence. For the upper seam, an operational height range from 7.5 to 12.5 feet is reasonable (BLM). The lower seam is thinner and longwall equipment with a height range from 6 ft. to 10 ft. is reasonable (BLM). These are not definitive height restrictions and it is possible that longwall mining of the two seams, based upon variations in geologic conditions and proper equipment selection, extraction heights could range from 6 to 13 feet (BLM).

For the prediction of subsidence, it has been assumed that a three-entry gate road system would be used between longwall panels with a combination of yield and rigid pillars. This is considered to be a conservative assumption, as other options might include two or three entry gate roads with yield pillars that would be expected to produce lower differential subsidence.

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Areas not amenable to longwall mining, due to their shape, size, coal thickness or surface protection requirements, have been evaluated on the assumption that they would be mined by room and pillar using full or partial extraction methods.

Access to the Flat Canyon Tract can be obtained through the coal in the western part of the Skyline Mine permit area, utilizing full support room-and-pillar first mining. This would allow for the coal within the Flat Canyon Tract to be more easily accessed and for a higher percentage of the coal to be extracted (mains/submains and barrier pillars would be within the present active leases). It would also allow coal from a fee lease that adjoins the southern portion of the tract to be potentially mined past the western boundary of Electric Lake. The access under Huntington Canyon would be with full-support room-and-pillar first mining.

The coal thins to the north, south, and west of the Flat Canyon Tract. The existing Skyline Mine is on the east; therefore, there are no additional tracts that can be leased from this location as a logical extension of the mine.

The mineable coal seams do not crop out or come in contact with the surface within the tract. The only alternative access to the coal reserves from the ground surface would be by construction of a shaft. The only potential site for a new mine and shaft lies on fairly level ground between Electric Lake and Boulger Reservoir. The shaft would have to be 1,200 feet deep. Surface support facilities, including a loadout, would have to be constructed. The coal would have to be trucked out. State Route 264 is not designed for coal-hauling trucks. The roads would have to be reconstructed. There is no electricity, so an electric powerline of 46 KVA would need to be built. The total cost of such a facility could exceed 100 million dollars (NorWest, 2000). The economic viability of a new mine being constructed to extract a maximum of 36 million tons of coal is highly improbable.

In order to meet Federal requirements for proper ventilation, one or two ventilation shafts (exhaust) would be necessary. A primary ventilation shaft would be located in Swens Canyon (Figure 1.2). A secondary ventilation shaft could be needed. It could be located in the upper Boulger Canyon area (Figure 1.2). Each shaft or vent hole would be 5-8 feet in diameter. Due to the blowing (positive) ventilation system at the mine, no fans would be needed and air would be exhausted from the shafts. An evase protected by a fence would be the only facilities at the surface location. A short access road of less than 1,000 feet would be constructed to each site for the drill rig. Each pad would disturb approximately less than 1 acre and each access road would disturb approximately 0.46 acre. The total disturbance for both vents would then be 2.9 acres. The roads would be reclaimed by providing necessary drainage to prevent erosion and facilitate establishment of vegetation, then closed to continued use for the life of the mine. The vents would be inspected twice a month on foot. The roads would be reopened for access to the shafts to plug and reclaim them. The access roads would then be closed and completely recontoured and reclaimed upon abandonment.

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Water encountered underground in the project area would either continue to be discharged at the mine water discharge point at the mine in Eccles Canyon or diverted to a new discharge point

below the high water line of Electric Lake. Changing the point of diversion would require reclassification of Huntington Creek by the State of Utah and issuance of a new Utah Point Discharge Elimination System (UPDES) permit. Authority to allow this lies with the State of Utah. The BLM and Forest Service must be consulted for comment, but the Federal Agencies do not have direct authority to approve or disapprove this action.

The potential exists for up to 10 exploration drill holes to be drilled during the life of the tract. The total disturbance for each site is estimated at 0.92 acres (100 ft. x 200 ft. pad and 1,000 ft. x 20 ft. road disturbance per exploration site). Multiplied by 10 sites the total disturbance would be 9.2 acres.

S-1.6 ISSUES

The issues addressed in the analysis were identified through project scoping. They drive data collection and the subsequent analysis process. The issues that were determined to be significant form the foundation by which alternatives to the proposed action were developed. Other issues, not determined to be significant, are no less important but did not drive identification of alternatives to the proposed action. Both significant and non-significant issues are addressed in detail in the analysis.

S-1.6.1 Physical Changes to the Environment Caused by Mining

Leasing and subsequent mining would cause physical changes to the environment that are not issues in themselves but would cause most of the effects to resources and must be understood before the issues become clear to the reader. These changes and how they are measured (Measures) and discussed in the analysis are shown below:

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- Construction of surface facilities needed to mine the project area would disturb the ground surface and cause human activities in the area.
  Measures: Activity levels, Area of disturbance (acres) by activity, Duration of activities/disturbance.

- Mining of the underground coal reserves can cause subsidence, seismicity, and cracking of the ground surface.
  Measures: Location and amount of subsidence expected (measured in feet), Maximum Credible Mining-Induced Seismic Event by range of magnitude and probability (Richter, % probability), The amount of energy transferred through rock at distance from the seismic event locations, Location and severity of cracks (primarily based on monitoring at Skyline Mine), Connection between surface and underground cracks relative to depth of cover, Angle-of Draw, Tension and compression zones, Perception of seismic events by people.

- Water is encountered in the underground workings and discharged to the surface environment into receiving water bodies (streams/lakes).
  Measures: Amount of water discharged, location of discharge, quality of water.

- Mining equipment and materials are used and consumed in the mining process and are incorporated into the underground mine workings as permanent additions to the underground environment.
  Measures: Type of materials, Estimated amount, Purpose of the materials.

S-1.6.2 Issues

The affects analysis addresses each issue. It was necessary to determine how the issues would be measured and compared relative to the alternatives. For this purpose, evaluation criteria were developed. The issues are listed and described in this section and the evaluation criteria are identified and discussed below the issue statements. The issues are grouped by functional area and significant issue statements are underlined.

Structures and Facilities

- Mining-induced subsidence and seismicity could damage the Boulger Dam (including the fish ladder) and Reservoir (Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

- Mining-induced subsidence could damage State Highway 264 (Significant Issue) and Forest Roads (Non-Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

- Extension of the mine life would increase the length of time that mining related traffic volumes would occur on State Highways (Non-Significant Issue).
  Evaluation Criteria: Length of extended use, Approx. traffic volumes.

- Mining-induced subsidence and seismicity could damage facilities at the Flat Canyon Campground (Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

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- Mining-induced subsidence could damage recreation cabins and/or camp facilities and roads on adjacent private lands that are mined as a result of leasing the Flat Canyon Tract (Non-Significant Issue).

  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

Surface and Ground Water

Surface Water

- Prolonged and increased discharge of mine water into Eccles Creek could change water quality in Eccles Creek, other downstream drainages, and Scofield Reservoir. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).

  Evaluation Criteria: Potential changes in water quality by affected parameters and duration.

- A new mine water discharge point at the north end of Electric Lake would involve changing all or some of the discharge from Eccles Creek in the Price River Watershed to the Huntington Canyon Watershed. This could decrease flow in the Price River Watershed and increase flow in the Huntington Canyon Watershed (Significant Issue).

  Evaluation Criteria: Change in mine water discharge to each watershed (gpm, acre-feet), Expected change in flow duration and base flows in Eccles, Muddy, and Huntington Creeks (gpm, acre-feet, %), Expected change to inflow and discharge (%, acre-feet) to/from Scofield Reservoir and Electric Lake.

- Changing some or all of the mine water discharge from Eccles Creek to Electric Lake could change water quality in the receiving streams/water bodies (Significant Issue).

  Evaluation Criteria: Water quality of the discharge water vs. water quality standards associated with the most restrictive of the designated beneficial uses of the receiving waters (meets/does not meet), Change in receiving stream water quality (parameters with and without limits specific to beneficial use standards including TDS, phosphorous, metals, TMDL, and drinking water standards) addressed in part by estimating volume of discharge water as percentage of resulting total flows and determining whether discharge water is being diluted or receiving waters are being "contaminated", Change in lake chemistry, including water column and lake bed sediments.

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- Subsidence of perennial streams and the Boulger Dam/Reservoir could intercept flowing/impounded water and divert it underground, changing the hydrology (Significant Issue).

  Evaluation Criteria: Changes in flow by quantity and duration, Probability,

Ground Water

- Subsidence could change the flow of springs and seeps, affecting the flow of springs and their receiving streams. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).

  Evaluation Criteria: Changes in flow and duration, Probability

- Interception of ground water in underground mine workings and subsequent discharge to Eccles Creek (Existing NPDES Permit) could cause diversions of surface and ground water from the Huntington Canyon Drainage to the Price River Drainage. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Significant Issue).

  Evaluation Criteria: Potential diversions, Estimates of amount of water encountered/discharged, Amount and location of discharge to surface waters.

- Equipment and materials spilled, used, and/or abandoned in underground mine workings could change ground water quality and any connected surface water sources. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).

  Evaluation Criteria: Description of potential changes in quality by affected parameter and duration.

Vegetation

- Subsidence and other mining-caused changes to surface and ground water could affect vegetation, especially riparian vegetation/wetlands (Significant Issue).

  Evaluation Criteria: Riparian vegetation, wetlands, and other species and area (acres) affected, Changes in species diversity and wetland quality.

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- Construction of a pipeline and/or roads in or across riparian areas and/or wetlands could destroy vegetation and related habitat and increase downstream sediment (Non-Significant Issue).

  Evaluation Criteria: Area disturbed, Duration of loss (vegetation and habitat), Estimate of sediment production.

Wildlife

- Exploration drilling, construction of mine vent holes, and reclamation activities could temporarily disrupt use of summer habitat by terrestrial species (Non-Significant Issue).
  Evaluation Criteria: Effects, Area affected (acres), Duration of effects and avoidance by affected species.

- Any changes in stream gradient/morphology, water flow, and quality in perennial drainages, Boulger Reservoir, or riparian vegetation/wetlands could affect habitat for terrestrial and aquatic species. Includes changes in morphology due to flow changes and subsidence (Significant Issue).
  Evaluation Criteria: Changes to habitat, productivity, and populations, Length of stream habitat affected (miles), Duration of effects.

- Changes to flow in drainages and points of mine water discharge would affect aquatic wildlife species and habitat (Significant Issue).
  Evaluation Criteria: Water quality of discharge water vs. aquatic life standards and other published sensitivity data for both acute and chronic levels, Possible increases in contaminants to Electric Lake and changes to habitat quality.

Recreation

- Damage to recreation facilities and temporary closures (Boulger Dam/Reservoir, Flat Canyon Campground, Roads) could cause, displacement of recreation use to other areas, and/or loss of use during repairs/replacement and closure (Significant Issue).
  Evaluation Criteria: Duration of loss or displacement of recreation opportunity, Recreation capacity lost or displaced (Recreation Visitor Days or RVDs), Revenue lost by Concessionaire.

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- Subsidence could cause surface disruption and seismic events that could cause safety hazards and disrupt the recreation experience (Non-Significant Issue).
  Evaluation Criteria: Safety hazard.

- Traffic and heavy equipment operation related to exploration drilling and drilling/construction of mine vent holes could temporarily disrupt dispersed recreation (Non-Significant Issue).
  Evaluation Criteria: Recreation Visitor Days (RVDs) affected, Duration of displaced use, Quality of recreation experience perceived by visitors.

Visual Quality

- Equipment and ground disturbance related to drilling exploration holes, construction of ventilation shafts, and reclamation would temporarily (construction phase) decrease visual quality (Non-Significant Issue).
  Evaluation Criteria: Changes in scenic quality with duration, Does or does not meet Visual Quality Objectives.

- Ventilation shaft facilities, access roads, and any visible emissions (water vapor) would decrease visual quality for the life of the facilities (Non-Significant Issue).
  Evaluation Criteria: Visibility, Changes in scenic quality with duration, Does or does not meet Visual Quality Objectives.

Transportation

- Extension of the mine life would increase the length of time that mining-related traffic volumes would occur on State Highways (non-significant Issue).
  Evaluation Criteria: Length of extended use, Approx. traffic volumes.

Cultural Resources

- Construction of surface facilities and mining-induced subsidence could damage cultural resources.
  Evaluation Criteria: Types of sites, Potential for damage.

Paleontological Resources

- Underground mining, subsidence, and construction of surface facilities could damage paleontological resources.
  Evaluation Criteria: Types of resources, Potential for damage.

Socio-economics

- Leasing of the tract would extend the life of the Skyline Mine, provide an important energy resource, and result in social and economic benefits. If the mine closes, there could be a loss of jobs and socioeconomic benefits (Significant Issue).
  Evaluation Criteria: Coal produced (tons), Skyline Mine life (years), Employment (person/years), Royalties/Bonus Bids.

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S-1.7 ALTERNATIVES ANALYZED

Alternatives were developed to address the significant issues associated with the project and to meet the requirements of NEPA. The alternatives addressed cover both ends of the spectrum regarding the possibilities for leasing/mining. Alternative A (No Action) presents the effects of

not leasing the Tract. Alternative B, at the other end of the spectrum is a leasing scenario with no special stipulations, representing the full-mining scenario where mining would be conducted to maximize efficiency and coal recovery without specific measures to protect surface resources. Alternative B' (B Prime) is a derivative of B that would result in the same mining scenario without restrictions to prevent subsidence of sensitive resource areas, but differs in that it includes Special Coal Lease Stipulations (SCLS) that would require specific monitoring and mitigations in the event that specific effects occur. Alternative C lies in between, representing a leasing scenario where SCLSs would be included in the lease and subsidence of sensitive resources and facilities/structures would not be allowed regardless of the potential level of effects to them. To provide information to the public and decision makers, so that combinations of these alternatives can be considered, each of the sensitive resources and structures/facilities are addressed individually in the analysis. All of the following alternatives are considered in the EIS.

ALTERNATIVE A, NO ACTION - The no action alternative provides a baseline for estimating the effects of the action alternatives. Under this alternative the lease tract would not be offered for leasing and there would be no mining.

ALTERNATIVE B, OFFER THE TRACT FOR LEASING AS DELINEATED/WITHOUT SPECIAL LEASE STIPULATIONS - Under this alternative the tract would be offered for competitive leasing, as delineated by the Tract Delineation Team, with BLM standard lease terms and conditions only, as displayed in Appendix B. No special coal lease stipulations would be included in the lease to be offered. Longwall (full-extraction) mining would be allowed throughout the tract resulting in subsidence of perennial drainages, Boulger Dam and Reservoir, Flat Canyon Campground, State Route 264 (other than along Upper Huntington Creek), and structures on private lands within the project area. It would be analyzed as the basis for comparison with other action alternatives that would include special stipulations needed to protect non-mineral resources and uses.

This alternative does not specifically meet Forest Plan requirements because it does not include any of the 17 Special Coal Lease Stipulations (SCLSs) prescribed for coal leases on National Forest System lands, on an as needed basis (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4). Special stipulations were not included for the purpose of disclosing the effects of not including them

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ALTERNATIVE B' (B PRIME), OFFER THE TRACT AS DELINEATED WITH SPECIAL COAL LEASE STIPULATIONS BUT WITHOUT RESTRICTIONS ON MINING THAT WOULD CAUSE SUBSIDENCE OF SENSITIVE SURFACE RESOURCES - Under this alternative, the tract would be offered for competitive leasing, as delineated, with BLM standard lease terms and conditions and special stipulations to protect non-mineral resources and uses. Special coal lease stipulations for this alternative are included in Appendix C. The mining scenario would be the same as Alternative B, without restrictions on subsiding sensitive resources, but would include lease stipulations that require mitigation of effects. In some cases, the opportunity exists to include similar requirement in the mine permit

during the mining plan review and permitting process. For the purposes if this analysis, it is assumed that similar measures not specifically required by law or regulation would not be applied.

This Alternative B' would be consistent with Forest Plan direction (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4).

ALTERNATIVE C, OFFER THE TRACT FOR LEASING AS DELINEATED/WITH SPECIAL LEASE STIPULATIONS (Do Not Allow Subsidence of Perennial Drainages, Boulger Dam and Reservoir, or Flat Canyon Campground) - Under this alternative, the tract would be offered for competitive leasing, as delineated, with BLM standard lease terms and conditions and special stipulations to protect non-mineral resources and uses. Special coal lease stipulations for this alternative are included in Appendix C. Subsidence of perennial drainages, Boulger Dam and Reservoir, State Route 264, and Flat Canyon Campground would not be allowed. Subsidence of structures on private lands within the project area could occur, if the lessee/operator obtains permission from private coal estate owner(s), under agreement with the private surface estate owner(s).

This alternative would be consistent with Forest Plan direction (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4).

OTHER ACTION ALTERNATIVES – Alternatives B and C define the least and most restrictive action alternatives regarding leasing/mining and resource protection. Other alternatives can be considered in the decisions, as needed, to address significant social and environmental issues or opportunities. In formulating other alternatives for consideration in the EIS, the Forest Service and BLM can look at the tract boundary and potential restrictions on underground mining and surface occupancy needed to protect non-mineral resources and uses. Sensitive resource areas were specifically and individually evaluated under Alternatives B and C such that the effects can be adequately considered and disclosed if a decision that combines aspects of the evaluated alternatives is selected. If selected, this alternative would contain Special Coal Lease Stipulations (SCLSs) consistent with Forest Plan direction and would not require Forest Plan amendments.

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S-1.8 AFFECTED ENVIRONMENT AND EFFECTS OF IMPLEMENTATION

The effects of mining would involve surface disturbance related to the construction and operation of exploration drill holes, two ventilation shafts, the associated access roads, and surface subsidence caused by extraction of the underground coal seams. If leased, the life of the Skyline Mine would be increased by as much as 12 years, extending the effects of the existing mining operation by approximately the same length of time.

Table 2.1 (Chapter 2 of the FEIS), Comparison of Alternatives, Mining Outcomes and Direct Physical Effects of Leasing/Mining, is a table that displays the outcomes of mining and the physical changes to the environment likely to occur from leasing and mining as anticipated in the Reasonably Foreseeable Development Scenario for each alternative. These changes are not in themselves identified as issues, but would cause changes to resources and the socioeconomic setting and, therefore, form the basis for the identified issues. This information sets the stage for Table 2.2 (Chapter 2 of the FEIS), Comparison of Alternatives, Effects by Resource/Issue that summarizes the effects to other resources. This table is a summary of the effects by each alternative and resource/issue.

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1.0 INTRODUCTION

This Final Environmental Impact Statement (FEIS) considers the environmental, social, and economic effects of offering the Flat Canyon Coal Lease Tract (UTU-77114) for leasing by the United States Department of the Interior, Bureau of Land Management (BLM), with consent by the United States Department of Agriculture, Forest Service, specifically the Manti-La Sal National Forest (FS). This analysis is tiered directly to the Final Environmental Impact Statement, Manti-La Sal National Forest, 1986 and Record of Decision and Summary, November 5, 1986 as amended. The BLM and FS jointly conducted the environmental analysis for the Flat Canyon Coal Lease Tract and prepared the FEIS. The United States Department of the Interior, Office of Surface Mining Reclamation and Enforcement (OSM) participated as a cooperating agency. The FEIS specifically addresses the consequences of implementing four alternatives, including the Proposed Action and "No Action" Alternative that involves taking no further action to evaluate or offer the tract for leasing. The analysis was initiated by the agencies in response to an application to lease the Flat Canyon Tract by Canyon Fuel Company, LLC, submitted to the BLM, Utah State Office.

Decisions to be made, authorizing actions, and a description of the Federal coal leasing process are further discussed in Sections 1.3 and 1.4.

1.1 PROPOSED ACTION

The proposed action is for BLM to offer the Flat Canyon Coal Lease Tract (UTU-77114) for competitive leasing in response to Canyon Fuel's application for leasing under the Lease-on-Application process contained in Federal Regulations 43 CFR 3425. The Forest Service would consent to leasing by BLM. The Tract would be offered with BLM's standard terms and conditions contained on Lease Form 3400-12 and special coal lease stipulations identified by BLM and the Forest Service for the protection of natural resources consistent with applicable laws, Forest Service and BLM policies, and the Land and Resource Management Plan, Manti-La Sal National Forest. In order to meet Canyon Fuel's need to move into the tract with underground workings in late 2001 or early 2002, the proposed lease sale would need to take place as soon as possible.

The tract was delineated by an Interagency Tract Delineation Team to assure that it is reasonable and meets requirements of the responsible agencies. The Flat Canyon Tract encompasses 2,692.16 acres of Federal coal reserves of the Wasatch Plateau Coal Field on National Forest System lands within the Manti-La Sal National Forest in Sanpete County, Utah. This area is described in the FEIS as the "Tract Area" as follows (Figures 1.1 and 1.2):

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T. 13 S., R. 6 E., SLM,

Section 21, lots 1-4, E1/2E1/2;
Section 28, lots 1-8, S1/2NW1/4, SW1/4;
Section 33, E1/2, E1/2W1/2, NW1/4NW1/4, SW1/4SW1/4;

T. 14 S., R. 6 E., SLM,

Section 4, lots 1-4, S1/2N1/2, S1/2;
Section 5, lots 1-4, S1/2N1/2, S1/2.

Additional non-Federal lands with non-Federal coal (both in private ownership) adjacent to the Federal coal lease tract, referred to as the "Private Lands (approximately 1,100 acres)," could be mined as a result of this lease action. They are described below:

T. 13 S., R. 6 E., SLM,

Section 29, E1/2SE1/4, SE1/4NE1/4, S1/2NE1/4NE1/4;
Section 32, E1/2E1/2.

T. 14 S., R. 6 E., SLM,

Section 3 (portion as shown on Figure 1-2)
Section 8, N1/2N1/2;
Section 9, N1/2N1/2;
Section 10 (portion shown on Figure 1-2).

The Tract area and adjacent private lands are collectively referred to in this FEIS as the "Project Area". Therefore, the total area analyzed is approximately 3,792 acres.

1.2 PURPOSE AND NEED

The purpose of offering the tract for competitive leasing is to provide an opportunity to develop mineable Federal coal reserves by underground methods. This coal is needed for the generation of electricity, other industrial uses, and to provide economic returns to the National, State and local economies, and to prevent bypassing mineable coal reserves adjacent to an existing mine that may otherwise not be mined.

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The purpose of Canyon Fuel's application is to obtain the right to mine known Federal coal reserves in the Flat Canyon Tract, immediately to the west of the current permit area for their Skyline Mine. If leased, Canyon Fuel would extend their underground coal workings to the west into the Flat Canyon Tract and beyond into private (fee) coal reserves. Two coal seams could be mined over the majority of the project area (Flat Canyon Tract and adjacent non-Federal lands). Recoverable coal reserves in the tract and adjacent area are estimated at approximately 36 million tons. At an annual production rate of 3 to 4 million tons, the proposal could extend the life of the Skyline Mine by 9-12 years.

A review of the Forest Plan showed that the proposed lease tract area is available for further consideration for coal leasing through application of the Unsuitability Criteria (43 CFR 3464) and an appropriate environmental analysis (Letter to the Utah State Director of BLM from the Forest Supervisor, Manti-La Sal National Forest 2820-4, January 21, 2000).

If the tract is not leased within the approximate proposed time frame, it is likely that the mineable Federal coal reserves in the tract would be bypassed and not mined in the foreseeable future.

1.3 DECISIONS TO BE MADE, AUTHORITIES, AND PERMITS

The USDI, Bureau of Land Management (BLM) is the leasing authority for all Federal coal reserves under the Mineral Leasing Act of 1920, as amended. The BLM Utah State Director must decide:

- whether or not to offer the Flat Canyon Tract for competitive leasing.
- what terms, conditions, and stipulations are needed on the lease to ensure compliance with the Mineral Leasing Act of 1920, as amended.

The USDA, Forest Service is the Surface Management Agency. The Forest Supervisor, Manti-La Sal National Forest, must decide:

- whether or not to consent to leasing by BLM, under authority of the Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1975.
- what special coal lease stipulations are needed for the protection of non-mineral resources.

If consent to leasing is given, the Forest Supervisor is also consenting to underground mining and subsidence of the land surface consistent with the lease stipulations imposed for the protection of National Forest resources. However, the permitting agencies must consult with the Forest Service prior to issuing permits.

Before any mining or surface disturbing activities, such as coal exploration drilling, can take place on a Federal coal lease, the lessee or operator must obtain approval of their Permit Application Package and obtain a permit to mine. If not already adequately considered under the environmental analysis for leasing, additional environmental analyses would be completed as the basis for the decisions of the responsible Federal agencies and consent/concurrence of the surface management agency, in this case the Forest Service.

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The Surface Mining Control and Reclamation Act of 1977, as amended (SMCRA) gives the Office of Surface Mining Reclamation and Enforcement (OSM) primary responsibility to administer programs that regulate surface coal mining operations and the surface effects of underground coal mining operations in the United States. Pursuant to Section 503 of SMCRA, the Utah Division of Oil, Gas, and Mining (DOGM) developed, and the Secretary of the Interior approved, Utah's permanent regulatory program authorizing Utah DOGM to regulate surface coal mining operations and the surface effects of underground coal mining on private and State lands within the State of Utah. In March 1987, pursuant to Section 523(c) of SMCRA, Utah DOGM entered into a cooperative agreement with the Secretary of the Interior authorizing Utah DOGM to regulate surface coal mining operations and the surface effects of underground coal mining on Federal lands within the State.

Pursuant to the cooperative agreement, Federal coal lease holders in Utah must submit a permit application package (PAP) to OSM and Utah DOGM for proposed mining and reclamation operations on Federal lands in the State. Utah DOGM reviews the PAP to ensure that it complies with the approved Utah State permanent program and other statutes. If it does comply, Utah DOGM issues the applicant a permit to conduct coal mining operations. OSM and other Federal agencies review the PAP to ensure that it contains the necessary information for compliance with the coal lease, the Mineral Leasing Act of 1920, as amended (MLA), the National Environmental Policy Act of 1969, as amended (NEPA), and other applicable Federal laws and their attendant regulations. OSM recommends to the Assistant Secretary of the Interior, Land and Minerals Management: (1) approval of the MLA mining plan, (2) approval of the MLA mining plan with conditions, or (3) disapproval of the MLA mining plan. Before making a recommendation on the mining plan, OSM obtains input from certain other Federal agencies, including the surface management agency.

The BLM is responsible for monitoring and enforcement of lease terms, conditions, and special stipulations, including required mitigations. The Forest Service cooperates with BLM by conducting field inspections of lease areas and operations.

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Utah DOGM enforces the performance standards and permit requirements during the mine's operation and has primary authority in environmental emergencies. OSM retains oversight responsibility of this enforcement. The surface management agency has authority in emergency situations in which Utah DOGM or OSM inspectors cannot act before environmental harm or damage occurs. UDOGM conducts frequent inspections of operations for compliance. The Forest Service cooperates with them regarding enforcement.

Resource monitoring, including subsidence, water monitoring, and vegetation monitoring is conducted by the lessee/operator in compliance with the mine permit and other permits issued for operations. The regulatory agencies take periodic samples to verify the lessee/operator monitoring data.

1.4 INCORPORATION BY REFERENCE

To decrease the size of this document and degree of redundancy to the contents of other documents, some material tiers to or incorporates other materials by reference. Material specially cited or otherwise used in preparation of this document is hereby incorporated by reference.

Information in this document tiers to the direction contained in the Forest Plan, as amended and its Record of Decision (1986). Information in the Forest Plan Final Environmental Impact Statement is hereby incorporated by reference.

The Technical Reports prepared by NorWest Mine Services, Inc. (NorWest, 2000 and amendment (NorWest, 2000a) for this analysis under direction of the Forest Service and Bureau of Land Management are hereby incorporated by reference.

The entirety of the supporting project record on file at the Forest Supervisor's Office, Manti-La Sal National Forest, 599 West Price River Drive, Price, Utah, 84501 is hereby incorporated without further reference.

1.5 SCOPE OF THE PROJECT

The scope of the project refers to the geographic boundaries of the proposal, including any connected or cumulative actions. The scope of actions addressed in this document is limited to the specific proposal to lease the Flat Canyon Federal Coal Lease Tract.

This document does not constitute a general management plan for the area. It discloses and evaluates potential effects that could be caused by the site-specific issues associated with the proposed leasing action and reasonably foreseeable mining of the project area and includes all lands that may reasonably be affected from implementation of the alternatives.

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1.6 LEASING PROCESS

The coal leasing process, lease administration, and enforcement are described in Federal Regulations 43 CFR 3400. The Flat Canyon Tract would be processed under the leasing procedures contained in 43 CFR 3425, Leasing-on-Application.

Under this process, evaluation of a coal lease tract for potential leasing is initiated by an application to lease by the coal industry. The BLM initiates evaluation of the application by prioritizing applications on record based on the date submitted, market conditions, and need by the proponents to obtain additional reserves to allow continued mining from adjacent mines.

The tract boundaries to be considered for leasing by the BLM are determined by a Tract Delineation Team consisting of representatives of the BLM, the surface management agency, and the State. In this case the surface management agency is the Forest Service. The team considers the proponent's application and other factors such as adjacent coal reserves, accessibility to reserves, geologic conditions, and environmental factors in the delineation process to ensure that the tract is in the public's interest.

Once the tract is delineated, the BLM and Surface Management Agency review market conditions, current land and resource management plans, and management direction for leasing and mining. This review is conducted to determine if the proposed lease area is available for further consideration for leasing

After it is determined that the tract is available for further consideration for leasing and consistent with general management direction, an environmental analysis is conducted. Prior to starting the analysis, adequate information regarding coal reserves and the environment must be compiled to meet data adequacy requirements set by the Uinta-Southwestern Utah Coal Region. Usually the proponent collects and compiles this data and submits it to the BLM and the surface management agency. Once data adequacy is met, the data are supplemented by agency inventories and an environmental analysis is conducted.

An environmental analysis must be completed consistent with requirements of the National Environmental Policy Act of 1969. A coal lease suitability analysis, required under Federal Regulations at 43 CFR 3461, is conducted and documented. In this case, the BLM and Forest Service jointly prepare an Environmental Impact Statement and suitability analysis. The Office of Surface Mining Reclamation and Enforcement participates as a cooperating agency.

If cleared for leasing, the BLM will hold a competitive lease sale at the BLM Utah State Office in Salt Lake City in accordance with requirements and procedures set forth in Federal Regulations 43 CFR 3420.

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No mining may occur on a lease until the lessee/operator submits a complete and technically adequate Permit Application Package/Mining and Reclamation Plan and a permit to mine is issued.

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1.7 CURRENT AND PAST MINING

Canyon Fuel is mining the area to the east of the tract, and east of Upper Huntington Creek and Electric Lake by underground methods, using state-of-the art longwall mining technology. This area contains five Federal coal leases that are included in the current approved permit area for Canyon Fuel's Skyline Mine. Figures 1.1 and 3.1 show the permit area. The underground workings in the permit area at the Skyline Mine are accessed through portal facilities located in

Eccles Canyon, approximately 2.5 miles east of the northern portion of the Flat Canyon Tract. The main portals are located in Eccles Canyon and North Fork of Eccles Canyon. A ventilation breakout is located in the South Fork of Eccles Canyon. An overland conveyor system transfers coal from the portal facilities on National Forest System lands to coal storage and loadout facilities (truck and train) at the mouth of Eccles Canyon below the Forest boundary on privately owned lands, a distance of approximately 2.5 miles along State Route 264 (paved highway). The Skyline Mine currently produces about 3-4 million tons of coal per year. A more detailed discussion of past and current mining at the Skyline Mine is contained in Chapter 3.

1.8 REASONABLY FORESEEABLE DEVELOPMENT

The Reasonably Foreseeable Development/Mining Scenario (RFDS) has been developed by the BLM in consultation with Canyon Fuel and Norwest Mine Services, Inc. NorWest Mine Services, Inc. prepared the scenario, predicted the location and amount of mining-induced subsidence and seismicity, conducted an analysis of the physical effects of mining to the geology, topography, and facilities/structures in and adjacent to the project area, and prepared Technical Reports under the direction of the agencies. The NorWest Technical Reports are referenced throughout the FEIS. The following is a summarized description of the Reasonably Foreseeable Mining Scenario. A detailed description of the predicted development of the proposed tract area and adjacent private lands and mineral estates are contained in the Technical Reports prepared by Norwest Mine Services, Inc. (Project File).

The RFDS is conceptual in nature and was developed for the purpose of determining the effects of leasing and subsequent mining. It presents the most likely mining scenario based on current information available from the Skyline Mine, but it is recognized that changes to locations of main entry systems and panels could be necessary based on actual conditions encountered underground. In order to adequately evaluate potential effects, with the knowledge that some aspects could change, the RFDS and effects analysis assume that the scenario with the most surface effect could occur.

The geologic conditions predicted in the Tract indicate that mining conditions would be relatively similar to those that have been experienced in the Skyline Mines, except that the reserves become progressively deeper towards the West. All mining would be done by underground methods with surface disturbance being limited to ancillary facilities. No surface mining methods would be used and the existing portal and support facilities in Eccles Canyon would be used. The RFDS for future mining in the Tract has been developed on the assumption that longwall mining would be carried out on a similar basis to that successfully employed at Skyline. Several northeast-southwest trending faults occur within the project area. The vertical offset of each fault is not specifically known at this time but it is conceivable that the offset could be large enough to influence the mining scenario. Due to the uncertainties, the RFDS was developed assuming that they would not change the mining scenario, but their existence and potential to influence mining is recognized.

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The main underground mining access to the Tract is planned in the Lower O'Connor B Seam by the westerly extension of the current main development entries in the Skyline Mine. To provide sufficient capacity for ventilation, access, escape, and haulage, it is probable that all of the six entries in the existing mains would be developed into the new area (Figure 1.2).

For Maximum Economic Recovery (MER), it has been assumed that a Main Development Corridor would be located below or under the west canyon slope of Upper Huntington Creek, as this would afford protection of this perennial drainage from subsidence, while allowing efficient recovery. A corridor about 1,600 feet wide has been identified where the mains would be located that allows for a sufficient number of entries and pillars with adequate dimensions to ensure long-term stability.

The main development system would be connected to ventilation shaft(s). Sub-mains would also be needed for access to production areas. Mining of the majority of the project area would generally be at greater depths than in the current permit area, varying from about 1,000 feet to over 2,000 feet.

Access to the Flat Canyon and Lower O'Connor 'A' Seams would be from underground, by developing rock entries at a slope to access mains in the lower seam. The lower main development entries and pillars would be driven underneath those in the upper seam and pillars would be vertically aligned to minimize adverse stress interactions and optimize coal recovery.

Production is planned by longwall methods similar to those currently being used in the Skyline Mine. It is expected that panels would be about 800 feet wide and their length would vary from about 3,000 to 15,000 feet, depending upon selected mine layout and both geological and operational constraints.

The most likely orientation of longwall panels would be approximately E-W, which has been shown to be successful at Skyline. Previous mining experience has also shown that an orientation approximately N-S could also be acceptable. Other geological and operational constraints, such as the location and offset of faults, may influence the final choice of panel orientation. Protection of surface structures and resources could also provide additional constraints on the location, orientation, and sequence of longwall extraction.

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Mine production is planned from a single longwall section, in conjunction with production from continuous miners driving development entries. Additional production may come from room-and-pillar extraction, although a depth limitation of 1,800 feet for this method has been assumed. There are two mineable seams over the majority of the area and the upper coal bed (Lower O' Connor B Seam) would be mined first, followed by the lower coal bed (Flat Canyon Seam). The areas that could be potentially mined in the Lower O'Connor B Seam (Upper Seam Mining Zone) are shown on Figure 1.3. The potential mining area for the Flat Canyon Seam (Lower Seam Mining Zone) is shown on Figure 1.4.

The BLM has identified in the Tract Delineation Report longwall mining reserves of about 36 million tons. At an estimated annual production rate of three to four million tons, this would extend the life of the Skyline Mine from nine to twelve years.

Reasonable equipment constraints for the definition of the minimum and maximum extraction heights for full extraction longwall mining have been assumed for evaluation of impacts due to subsidence. For the upper seam, an operational height range from 7.5 to 12.5 feet is reasonable (BLM). The lower seam is thinner and longwall equipment with a height range from 6 ft. to 10 ft. is reasonable (BLM). These are not definitive height restrictions and it is possible that longwall mining of the two seams, based upon variations in geologic conditions and proper equipment selection, extraction heights could range from 6 to 13 feet (BLM).

For the prediction of subsidence, it has been assumed that a three-entry gate road system would be used between longwall panels with a combination of yield and rigid pillars. This is considered to be a conservative assumption, as other options might include two or three entry gate roads with yield pillars that would be expected to produce lower differential subsidence.

Areas not amenable to longwall mining, due to their shape, size, coal thickness or surface protection requirements, have been evaluated on the assumption that they would be mined by room and pillar using full or partial extraction methods.

Access to the Flat Canyon Tract can be obtained through the coal in the western part of the Skyline Mine permit area, utilizing full support room-and-pillar first mining. This would allow for the coal within the Flat Canyon Tract to be more easily accessed and for a higher percentage of the coal to be extracted (mains/submains and barrier pillars would be within the present active leases). It would also allow coal from a fee lease that adjoins the southern portion of the tract to be potentially mined past the western boundary of Electric Lake. The access under Huntington Canyon would be with full-support room-and-pillar first mining.

The coal thins to the north, south, and west of the Flat Canyon Tract. The existing Skyline Mine is on the east; therefore, there are no additional tracts that can be leased from this location as a logical extension of the mine.

The mineable coal seams do not crop out or come in contact with the surface within the tract. The only alternative access to the coal reserves from the ground surface would be by construction of a shaft. The only potential site for a new mine and shaft lies on fairly level ground between Electric Lake and Boulger Reservoir. The shaft would have to be 1,200 feet deep. Surface support facilities, including a loadout, would have to be constructed. The coal would have to be trucked out. State Route 264 is not designed for coal-hauling trucks. The roads would have to be reconstructed. There is no electricity, so an electric powerline of 46 KVA would need to be built. The total cost of such a facility could exceed 100 million dollars (NorWest, 2000). The economic viability of a new mine being constructed to extract a maximum of 36 million tons of coal is highly improbable.

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In order to meet Federal requirements for proper ventilation, one or two ventilation shafts (exhaust) could be necessary. A primary ventilation shaft could be located in Swens Canyon (Figure 1.2). A secondary ventilation shaft could be needed. It could be located in the upper Boulger Canyon area (Figure 1.2). Each shaft or vent hole would be 5-8 feet in diameter. Due to the blowing (positive) ventilation system at the mine, no fans would be needed and air would be exhausted from the shafts. An evase protected by a fence would be the only facilities at the surface location. A short access road of less than 1,000 feet would be constructed to each site for the drill rig. Each pad would disturb approximately less than 1 acre and each access road would disturb approximately 0.46 acre. The total disturbance for both vents would then be 2.9 acres. The roads would be reclaimed by providing necessary drainage to prevent erosion and facilitate establishment of vegetation, then closed to continued use for the life of the mine. The vents would be inspected twice a month on foot. The roads would be reopened for access to the shafts to plug and reclaim them. The access roads would then be closed and completely recontoured and reclaimed upon abandonment.

No additional mine facilities would be needed in Eccles Canyon to mine the project area. Water encountered underground in the project area would either continue to be discharged at the mine water discharge point at the mine in Eccles Canyon or diverted to a new discharge point below the high water line of Electric Lake. Changing the point of diversion would require reclassification of Huntington Creek by the State of Utah and issuance of a new Utah Point Discharge Elimination System (UPDES) permit. Authority to allow this lies with the State of Utah. The BLM and Forest Service must be consulted for comment, but the Federal Agencies do not have direct authority to approve or disapprove this action.

The potential exists for up to 10 exploration drill holes to be drilled during the life of the tract. The total disturbance for each site is estimated at 0.92 acres (100 ft. x 200 ft. pad and 1,000 ft. x 20 ft. road disturbance per exploration site). Multiplied by 10 sites the total disturbance would be 9.2 acres.

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1.9 CONFORMANCE WITH LAND USE PLANS

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1.9.1 Availability

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The Forest Plan consistency review was completed and documented in a letter from the Forest Supervisor, Manti-La Sal National Forest, to the Utah State Director of BLM, dated January 21, 2000 (Project File). It was determined that the tract is available for further consideration for coal leasing under the Land and Resource Management Plan, Manti-La Sal National Forest, 1986 (Forest Plan) and the Record of Decision for the Forest Plan and Final Environmental Impact Statement, dated November 5, 1986.

The tract lies with the Huntington Canyon-Gentry Mountain Coal Multiple-Use Evaluation Area evaluated in the Manti-La Sal National Forest Land and Resource Management Plan, 1986

(Forest Plan). Issues and concerns that must be evaluated for tracts in this area include water quality, traffic, visual quality, and recreation thresholds. The Forest Plan states that the area is available for further lease action consideration. Further lease actions utilizing Huntington Canyon for transportation and mine development, other than supplying existing operations, would be delayed until it is determined that unacceptable impacts to existing resources would not occur.

The Flat Canyon Tract has been proposed for leasing by Canyon Fuel to provide additional coal reserves for the Skyline Mine that can be accessed from underground workings in the adjacent Skyline Mine Permit area.

1.9.2 Forest Plan Emphasis and Direction

The tract includes RNG (Range), DRS (Developed Recreation Sites), TBR (Timber), and WPE (Watershed Protection/Improvement) Forest Plan Management Units.

RNG Management Unit

Emphasis is on production of forage and cover for domestic livestock and wildlife. Direction states that appropriate mitigation measures must be used to assure continued livestock access and use. Those authorized to conduct development would be required to replace losses through appropriate mitigations, where site-specific development adversely affects long-term production or management.

DRS Management Unit

Management emphasis for DRS units is on developed recreation. The Flat Canyon Tract includes the Flat Canyon Campground DRS Management Unit. Mineral leasing is allowed where it is determined that stipulated methods of development and extraction would not adversely affect recreation values to any significant degree.

TBR Management Unit

Emphasis is on management for the production and use of wood-fiber for a variety of wood products. There is no specific direction for mineral activities in TBR Management Units. General policy requires mineral operators to pay the fair market value of merchantable timber removed or destroyed for mineral activities, and reclamation measures include planting to replace timber.

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WPE Management Unit

Emphasis is on watershed protection/improvement. This includes areas where watershed treatments have occurred and other resource use is limited to protect the watershed investments.

Other uses can occur so long as the use or its rehabilitation does not degrade the watershed treatment.

Land Uses

The Boulger Canyon dam, reservoir, and associated dispersed recreation area and Flat Canyon Campground lie within the tract. The lease must contain stipulations to protect or mitigate impacts to these facilities and provide for public safety.

1.10 Data Adequacy Standards

It has been determined that there is sufficient coal and environmental resource data to meet Uinta-Southwestern Utah Coal Region Data Adequacy Standards (Canyon Fuel Company, LLC Data Adequacy Submittal and Supplement, Third-Party Contractor Technical Reports).

1.11 Unsuitability Assessment

The unsuitability assessment and consultations required under 43 CFR 3461) have been completed. The unsuitability assessment is contained in Appendix F. Consultation letters and responses are contained in the project file. No areas of the project area were determined to be unsuitable for leasing.

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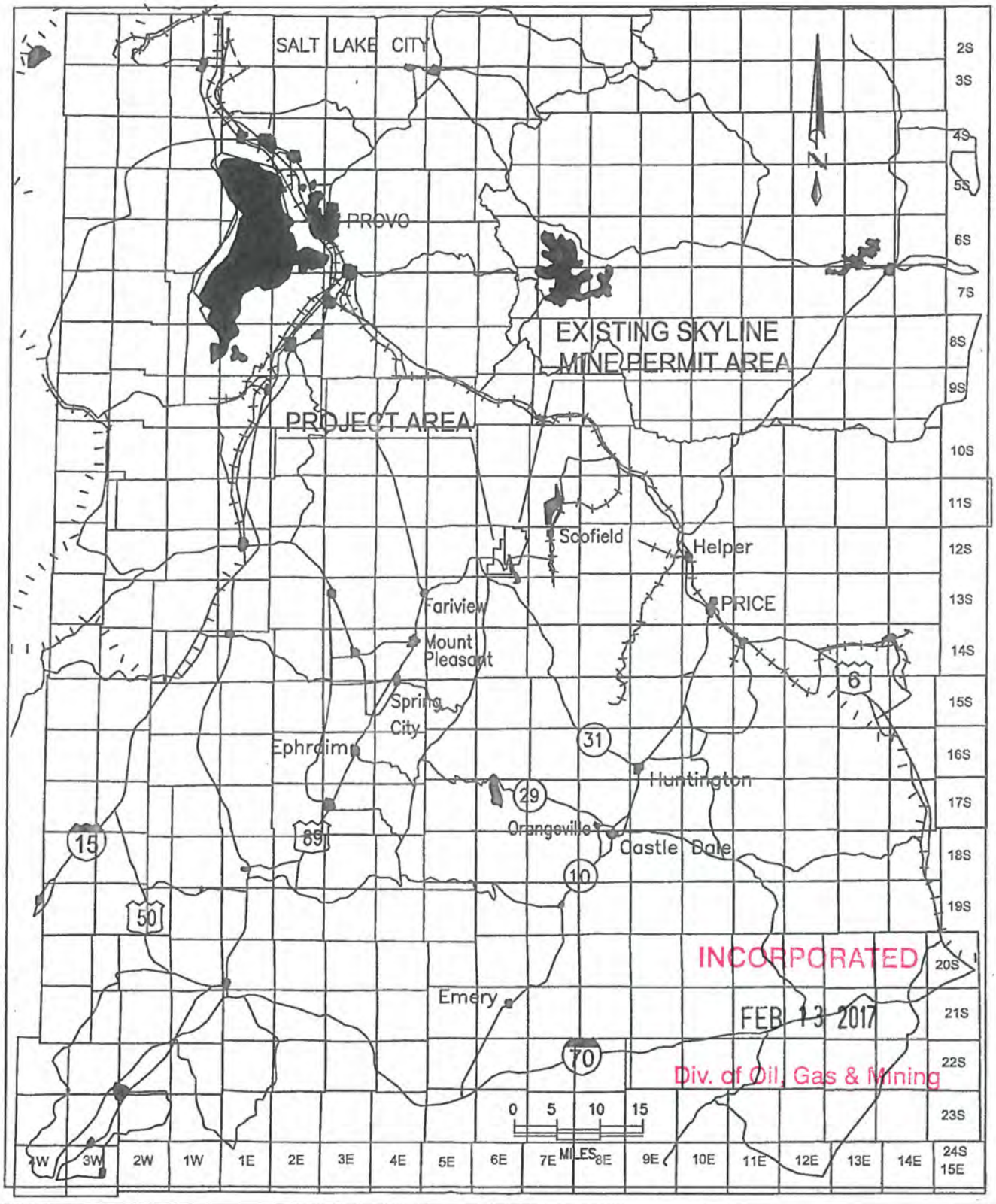
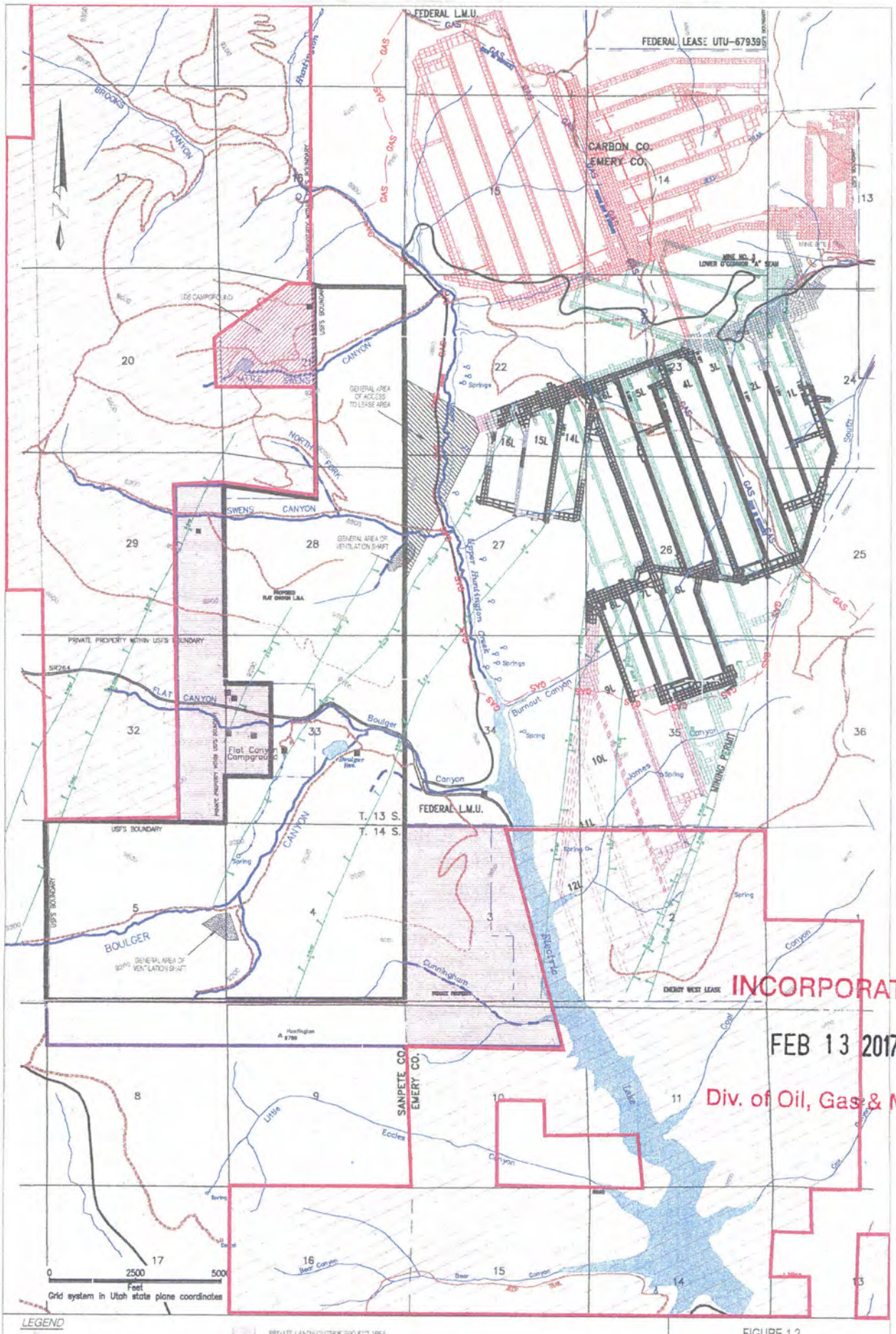


LEGEND

- RAILROAD
- HIGHWAY
- ROAD
- LAKE/RIVER
- CITY
- PROJECT AREA
- 50 U.S. HIGHWAY
- 10 STATE HIGHWAY
- 15 INTERSTATE HIGHWAY

FIGURE 1.1
PROJECT LOCATION MAP

DATE: 3/19/1999
FILE: 2273F1.DWG



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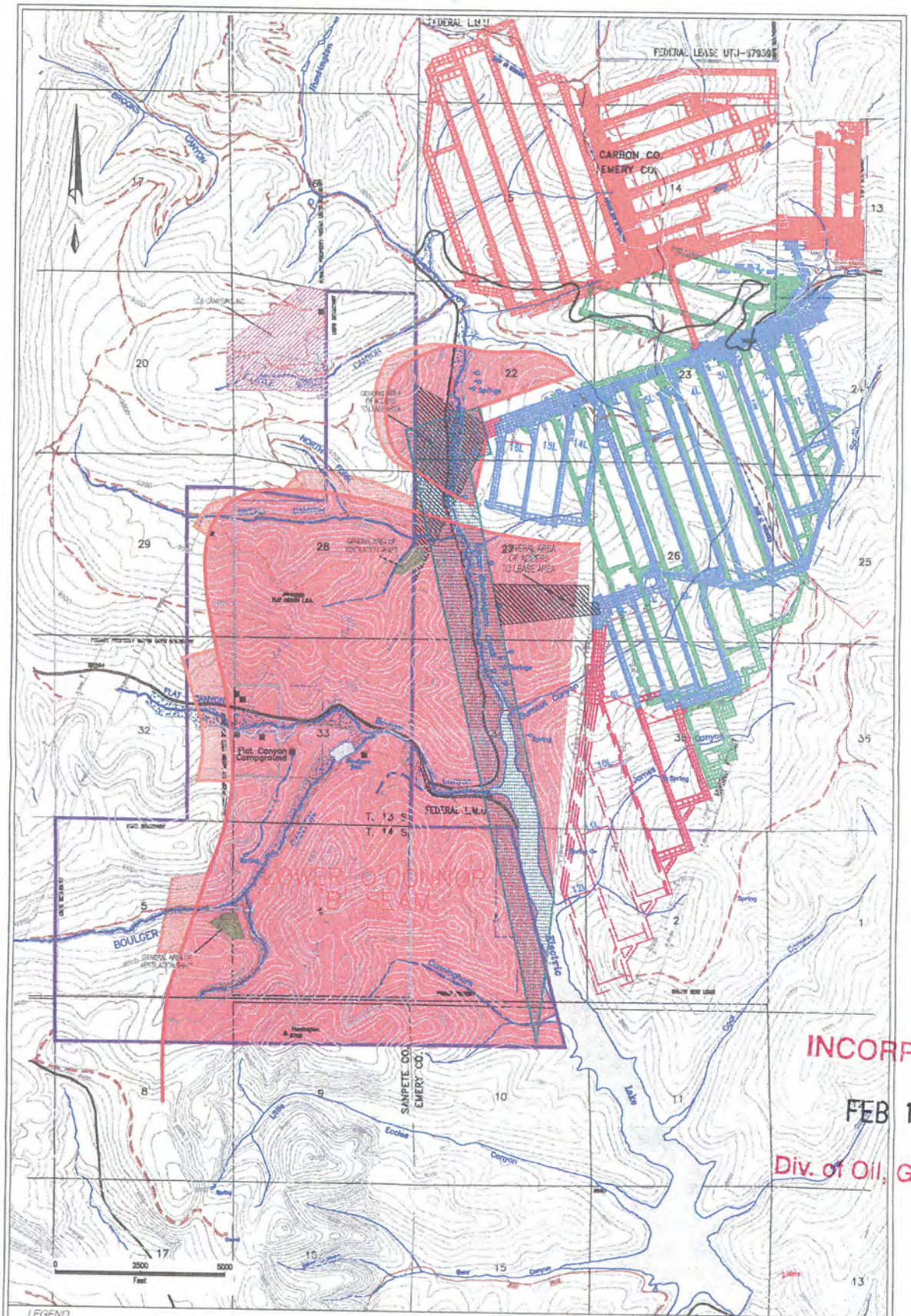
LEGEND

- FLAT CANYON COAL LEASE TRACT
- PRIVATE LANDS IN PROJECT AREA
- CABIN - BUILDING
- PAVED HIGHWAY
- UNPAVED HIGHWAY
- PRIVATE LANDS OUTSIDE PROJECT AREA
- GAS PIPELINE (operational)
- GAS PIPELINE (NOT in service)
- WATER PIPELINE
- EXISTING MINE WORKINGS MINE 1
- EXISTING MINE WORKINGS MINE 2
- EXISTING MINE WORKINGS MINE 3
- PROPOSED MINE WORKINGS MINE 2
- MAJOR FAULTS
- PERENNIAL STREAM
- POSSIBLE PERENNIAL STREAM
- RIVER CREEK
- LAKE RESERVOIR

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

FIGURE 1.2
DETAILED
PROJECT LOCATION MAP

DATE: 10/18/2000 SCALE 1"=2640'
FILE: VW1-2.DWG



LEGEND

LSA
REASONABLY FORESEEABLE DEVELOPMENT AREA
CABIN / BUILDING
PAVED HIGHWAY
UNPAVED HIGHWAY
RIVER/CREEK
LAKE/RESERVOIR
GAS PIPELINE (operational)
GAS PIPELINE (not in service)
WATER PIPELINE
EXISTING MINE WORKINGS, MINE 1
EXISTING MINE WORKINGS, MINE 2
EXISTING MINE WORKINGS, MINE 3
PROPOSED MINE WORKINGS, MINE 2 (existing, east)
ESTIMATED PERIMETER OF PERENNIAL STREAM ALLUVIUM
MAJOR FAULTS
PERENNIAL STREAM
POSSIBLE PERENNIAL STREAM
LONGWALL MINEABLE ZONE (LOWER COCKINGS)
ROOM AND PILLAR MINEABLE ZONE (LOWER COCKINGS)
MAIN DEVELOPMENT CORRIDOR (MAINS AND BARRIER PILLARS)
GENERAL AREA OF ACCESS TO LEASE AREA

FIGURE 1.3
UPPER SEAM
MINING ZONE

FILE: MINING.DWG	SCALE 1" = 2640'
DATE: 10/17/2000	

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

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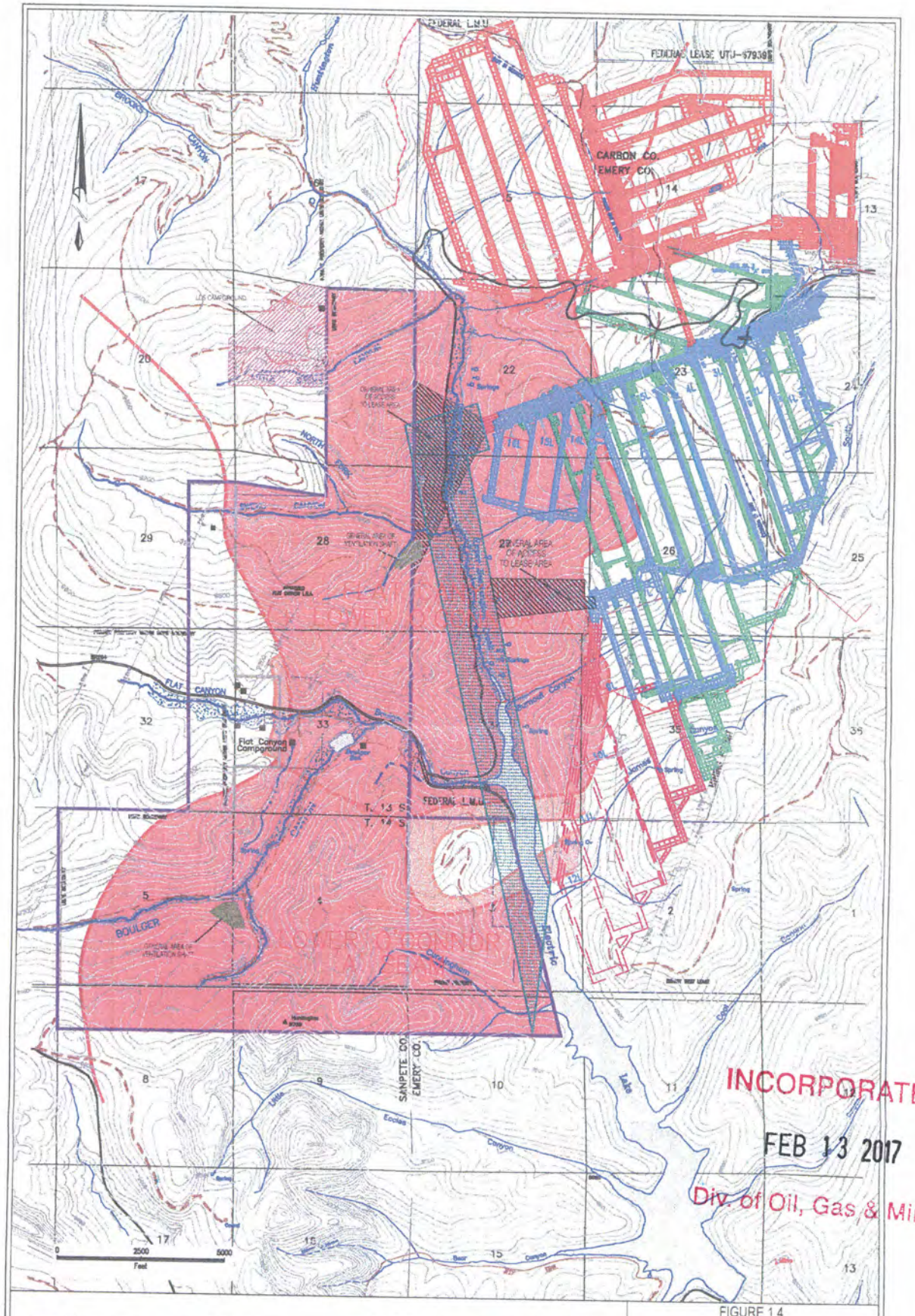

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FIGURE 1.4
LOWER SEAM
MINING ZONES

FILE: MINING.DWG	SCALE: 1" = 2640'
DATE: 10/17/2000	

2.0 PROJECT SCOPING, ISSUES, AND ALTERNATIVES

Chapter 2 describes the scoping process used to obtain public and agency comments regarding issues, the comments received, and the issues and alternatives identified during the scoping process.

2.1 PUBLIC INVOLVEMENT/PROJECT SCOPING

Public involvement is an important part of the environmental analysis process. The public involvement plan describes the methods and techniques that were used to involve the public in the analysis. It allows the public to participate actively in the analysis and to communicate their concerns regarding the proposed action. In addition, involvement of local, State, and other Federal agencies helps the responsible officials to anticipate the effects and benefits that could occur from the project and to make necessary plans and changes in public policy.

The FS and BLM initiated scoping (30 day comment period) by publication of a Notice of Intent to Prepare an EIS in the *Federal Register* on March 17, 2000. A legal notice informing the public of the intent to evaluate the Flat Canyon Coal Lease Tract, prepare an EIS, and requesting issues and concerns, were published in the *Sun Advocate* Newspaper (publication of record) and the *Emery County Progress* (supplemental publication) on March 14, 2000. The legal notice was also published in the *Mt. Pleasant Pyramid* on March 15, 2000. A letter was sent to 100 agencies, individuals, and organizations on March 13, 2000 briefly explaining the proposed action and requesting comments regarding issues and concerns. The comment period ended at the close of business on April 18, 2000. The project was listed on the Forest Internet website and Quarterly Schedule of Proposed Actions. In addition, the proposed project was explained to local resource user organizations at the quarterly water users meetings and Emery County Public Lands Council meetings.

A letter was sent to the owners of private lands within and adjacent to the project area on October 30, 2000 informing them of the project and requesting comments followed by phone calls. Only one letter of response was received from the LDS Church asking for some additional information that was provided by telephone. The conversations with landowners divulged that they generally wanted to see the Federal and private lands mined. Some were concerned about potential damages to buildings from subsidence but felt that any necessary repairs would be made by the mining operator. At least two of the landowners were concerned about potential effects to springs within and adjacent to their property. One landowner was concerned about potential lowering of the private roads that cross Flat Canyon due to subsidence and that it would be difficult to relocate them because of the wetlands issue.

Nine letters and two phone calls were received in response to scoping. The Interdisciplinary Team (IDT) evaluated comments and identified the proposed issues based on the comments and concerns identified by participating agencies. The issues were approved by the agency responsible officials on June 8, 2000.

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The Draft EIS was released for a 45-day public review in May 2001. The 45-day review period started on May 19, 2001, the day after the Environmental Protection Agency published the Notice of Availability in the *Federal Register* (Vol. 66, No. 97/Friday, May 18, 2001/Notices). The comment period ended at close of business on the 45th day, July 2, 2001. On May 8, 2001, copies of the DEIS were sent to individuals, agencies, and companies who responded to scoping, all agencies with direct interest or authority regarding the proposed action, and anyone who requested a copy for review prior to the date of the letter. Additional copies were provided to those requesting a copy for review after the letter was sent. Notices of Availability were published in the *Sun Advocate* Newspaper (publication of record) and the *Emery County Progress* (supplemental publication) on May 15, 2001. The Notice of Availability was also published in the *Mt. Pleasant Pyramid,* on May 16, 2001. Approximately 120 copies of the DEIS were distributed as described above. Comments and responses regarding the adequacy of the DEIS are contained in Chapter 5 of the FEIS.

2.2 LEASING/MINING OUTCOMES AND PHYSICAL EFFECTS

Leasing and subsequent mining would cause physical changes to the environment that would result in effects to resources. These changes and how they are measured (Measures) and discussed in the analysis are shown below:

- Leasing of the Flat Canyon Tract would extend mining into additional areas, increase the life of mining operations at the Skyline Mine, and increase the amount of coal mined.
  Measures: Mining method, Time of extended mining at Skyline Mine (years) Amount of coal mined (tons).

- Construction of surface facilities needed to mine the project area would disturb the ground surface and cause human activities in the area.
  Measures: Activity levels, Area of disturbance (acres) by activity, Duration of activities/disturbance.

- Mining of the underground coal reserves can cause subsidence, seismicity, and cracking of the ground surface.
  Measures: Location and amount of subsidence expected (measured in feet), Maximum Credible Mining-Induced Seismic Event by range of magnitude and probability (Richter, % probability), The amount of energy transferred through rock at distance from the seismic event locations, Location and severity of cracks (primarily based on monitoring at Skyline Mine), Connection between surface and underground cracks relative to depth of cover, Angle-of Draw, Tension and compression zones, Perception of seismic events by people.

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- Water is encountered in the underground workings and discharged to the surface environment into receiving water bodies (streams/lakes).
  Measures: Amount of water discharged, location of discharge, quality of water.

- Mining equipment and materials are used and consumed in the mining process and are incorporated into the underground mine workings as permanent additions to the underground environment.
  Measures: Type of materials, Estimated amount, Purpose of the materials.

2.3 ISSUES ADDRESSED IN DETAIL

The issues addressed in the analysis were identified through project scoping. They drive data collection and the subsequent analysis process. The issues that were determined to be significant form the foundation by which alternatives to the proposed action were developed. Other issues, not determined to be significant, are no less important but did not drive identification of alternatives to the proposed action. Both significant and non-significant issues are addressed in detail in the analysis.

The affects analysis addresses each issue. It was necessary to determine how the issues would be measured and compared relative to the alternatives. For this purpose, evaluation criteria were developed. The issues are listed and described in this section and the evaluation criteria are identified and discussed below the issue statements. The issues are grouped by functional area and significant issue statements are underlined.

2.3.1 Structures and Facilities

- Mining-induced subsidence and seismicity could damage the Boulger Dam (including the fish ladder) and Reservoir (Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

- Mining-induced subsidence could damage State Highway 264 (Significant Issue) and Forest Roads (Non-Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

- Extension of the mine life would increase the length of time that mining related traffic volumes would occur on State Highways (Non-Significant Issue).
  Evaluation Criteria: Length of extended use, Approx. traffic volumes.

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- Mining-induced subsidence and seismicity could damage facilities at the Flat Canyon Campground (Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

- Mining-induced subsidence could damage recreation cabins and/or camp facilities and roads on adjacent private lands that are mined as a result of leasing the Flat Canyon Tract (Non-Significant Issue).
  Evaluation Criteria: Type and risk of damage (Damage description, Probability), Cost of repair, Public safety hazard, Time needed for repairs/Duration of lost use, Cost of lost use.

2.3.2 Surface and Ground Water

Surface Water

- Prolonged and increased discharge of mine water into Eccles Creek could change water quality in Eccles Creek, other downstream drainages, and Scofield Reservoir. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).
  Evaluation Criteria: Potential changes in water quality by affected parameters and duration.

- A new mine water discharge point at the north end of Electric Lake would involve changing all or some of the discharge from Eccles Creek in the Price River Watershed to the Huntington Canyon Watershed. This could decrease flow in the Price River Watershed and increase flow in the Huntington Canyon Watershed (Significant Issue).
  Evaluation Criteria: Change in mine water discharge to each watershed (gpm, acre-feet), Expected change in flow duration and base flows in Eccles, Muddy, and Huntington Creeks (gpm, acre-feet, %), Expected change to inflow and discharge (%, acre-feet) to/from Scofield Reservoir and Electric Lake.

- Changing some or all of the mine water discharge from Eccles Creek to Electric Lake could change water quality in the receiving streams/water bodies (Significant Issue).
  Evaluation Criteria: Water quality of the discharge water vs. water quality standards associated with the most restrictive of the designated beneficial uses of the receiving waters (meets/does not meet), Change in receiving stream water quality (parameters with and without limits specific to

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beneficial use standards including TDS, phosphorous, metals, TMDL, and drinking water standards) addressed in part by estimating volume of discharge water as percentage of resulting total flows and determining whether discharge water is being diluted or receiving waters are being "contaminated", Change in lake chemistry, including water column and lake bed sediments.

- Subsidence of perennial streams and the Boulger Dam/Reservoir could intercept flowing/impounded water and divert it underground, changing the hydrology (Significant Issue).
  Evaluation Criteria: Changes in flow by quantity and duration, Probability,

Ground Water

- Subsidence could change the flow of springs and seeps, affecting the flow of springs and their receiving streams. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).
  Evaluation Criteria: Changes in flow and duration, Probability

- Interception of ground water in underground mine workings and subsequent discharge to Eccles Creek (Existing NPDES Permit) could cause diversions of surface and ground water from the Huntington Canyon Drainage to the Price River Drainage. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Significant Issue).
  Evaluation Criteria: Potential diversions, Estimates of amount of water encountered/discharged, Amount and location of discharge to surface waters.

- Equipment and materials spilled, used, and/or abandoned in underground mine workings could change ground water quality and any connected surface water sources. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).
  Evaluation Criteria: Description of potential changes in quality by affected parameter and duration.

2.3.3 Vegetation

- Subsidence and other mining-caused changes to surface and ground water could affect vegetation, especially riparian vegetation/wetlands (Significant Issue).
  Evaluation Criteria: Riparian vegetation, wetlands, and other species and area (acres) affected, Changes in species diversity and wetland quality.

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- Construction of a pipeline and/or roads in or across riparian areas and/or wetlands could destroy vegetation and related habitat and increase downstream sediment (Non-Significant Issue).
  Evaluation Criteria: Area disturbed, Duration of loss (vegetation and habitat), Estimate of sediment production.

2.3.4 Wildlife

- Exploration drilling, construction of mine vent holes, and reclamation activities could temporarily disrupt use of summer habitat by terrestrial species (Non-Significant Issue).
  Evaluation Criteria: Effects, Area affected (acres), Duration of effects and avoidance by affected species.

- Any changes in stream gradient/morphology, water flow, and quality in perennial drainages, Boulger Reservoir, or riparian vegetation/wetlands could affect habitat for terrestrial and aquatic species. Includes changes in morphology due to flow changes and subsidence (Significant Issue).
  Evaluation Criteria: Changes to habitat, productivity, and populations, Length of stream habitat affected (miles), Duration of effects.

- Changes to flow in drainages and points of mine water discharge would affect aquatic wildlife species and habitat (Significant Issue).
  Evaluation Criteria: Water quality of discharge water vs. aquatic life standards and other published sensitivity data for both acute and chronic levels, Possible increases in contaminants to Electric Lake and changes to habitat quality.

2.3.5 Recreation

- Damage to recreation facilities and temporary closures (Boulger Dam/Reservoir, Flat Canyon Campground, Roads) could cause, displacement of recreation use to other areas, and/or loss of use during repairs/replacement and closure (Significant Issue).
  Evaluation Criteria: Duration of loss or displacement of recreation opportunity, Recreation capacity lost or displaced (Recreation Visitor Days or RVDs), Revenue lost by Concessionaire.

- Subsidence could cause surface disruption and seismic events that could cause safety hazards and disrupt the recreation experience (Non-Significant Issue).
  Evaluation Criteria: Safety hazard.

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- Traffic and heavy equipment operation related to exploration drilling and drilling/construction of mine vent holes could temporarily disrupt dispersed recreation (Non-Significant Issue).
  Evaluation Criteria: Recreation Visitor Days (RVDs) affected, Duration of displaced use, Quality of recreation experience perceived by visitors.

2.3.6 Visual Quality

- Equipment and ground disturbance related to drilling exploration holes, construction of ventilation shafts, and reclamation would temporarily (construction phase) decrease visual quality (Non-Significant Issue).
  Evaluation Criteria: Changes in scenic quality with duration, Does or does not meet Visual Quality Objectives.

- Ventilation shaft facilities, access roads, and any visible emissions (water vapor) would decrease visual quality for the life of the facilities (Non-Significant Issue).
  Evaluation Criteria: Visibility, Changes in scenic quality with duration, Does or does not meet Visual Quality Objectives.

2.3.7 Transportation

- Extension of the mine life would increase the length of time that mining-related traffic volumes would occur on State Highways (non-significant Issue).
  Evaluation Criteria: Length of extended use, Approx. traffic volumes.

2.3.8 Cultural and Historic Resources

- Construction of surface facilities and mining-induced subsidence could damage cultural resources.
  Evaluation Criteria: Types of sites, Potential for damage.

2.3.9 Paleontological Resources

- Underground mining, subsidence, and construction of surface facilities could damage paleontological resources.
  Evaluation Criteria: Types of resources, Potential for damage.

2.3.10 Socio-economics

- Leasing of the tract would extend the life of the Skyline Mine, provide an important energy resource, and result in social and economic benefits. If the mine closes, there could be a loss of jobs and socioeconomic benefits (Significant Issue).

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Evaluation Criteria: Coal produced (tons), Skyline Mine life (years), Employment (person/years), Royalties/Bonus Bids.

2.4 ISSUES IDENTIFIED BUT NOT CARRIED THROUGH THE ANALYSIS

The issues discussed below were considered but not identified as issues to be discussed in detail or carried through the analysis:

Roadless/Unroaded Areas

- There are no inventoried roadless areas or contiguous unroaded areas of 1,000 acres or more in the vicinity of the project area.

Range

- Mining-induced subsidence and construction of surface facilities could damage range improvements and facilities. Construction of surface facilities could interfere with livestock trailing or grazing.

  The Flat Canyon Tract includes portions of the Swens Canyon, Boulger Canyon, Eccles Canyon, and Bear Canyon Sheep and Goat Allotments. The allotments are used in conjunction with adjacent non-Federal lands. The allotments are managed under the deferred rotation system. Sheep are allowed to graze at different times during the summer season, depending on the place of each allotment for a given year in the rotation. The allotments combined support approximately 2,000 animal unit months (AUMs) per year. No range improvements were identified in the Flat Canyon Tract that could be damaged by subsidence and no effects to forage are anticipated. The amount and duration of construction and operation of vent holes and exploration holes is negligible relative to the grazing area and is not considered to have measurable effects.

Survey Markers

- Mining-induced subsidence and construction of surface facilities could damage survey markers and monuments

  It is general practice in leases, mine plans, and permits to require identification, monitoring, and repair/replacement of survey markers if they are damaged.

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Lands and Special Uses (Facilities/Withdrawals)

- Mining-induced subsidence and seismicity could damage the dam at Beaver Dams Reservoir and Electric Lake.

  Neither dam would be mined-under or subsided. Beaver Dams Reservoir lies approximately 1.3 miles to the east of the project area. Electric Lake Dam lies approximately 2.0 miles south of the project area. The Maximum Credible Event (MCE) of Richter 3.45 would not produce ground shaking or vibration sufficient to cause damage to these facilities, considering their distance from the project area. The dams could withstand vibrations of up to 0.1g without damage and the MCE would produce vibrations less than 0.1g at distances greater than 5,500 feet (NorWest, 2000a). Neither of these facilities would sustain damage even if the MCE occurred at the closest point within the project area.

- Coal leasing/mining could conflict with a Bureau of Reclamation Withdrawal in Sections 4 and 5, T. 14 S., R. 6 E., in the proposed lease area.

  Consultation with the Bureau of Reclamation has determined that there would be no conflicts since there are no plans to develop this area.

Noxious Weeds (Vegetation)

- Surface disturbing activities could cause the introduction or spread of noxious weeds.

  Noxious weeds occur in the project area. Under all action alternatives, approval of surface disturbing operations would include requirements to prevent the introduction and spread of noxious weeds. In addition, reclamation standards require eradication of noxious weeds if they occur in the disturbed areas.

The general comments received during scoping that did not result in an issue statement involved issues that are beyond the scope of the analysis as follows:

Comment (EPA): "The DEIS should disclose that researchers have found coal combustion to be a significant source of CO2 a greenhouse gas which contributes to global warming."

Response: It is recognized that combustion of coal for electrical power generation at coal-fired power generation plants will result in release of greenhouse gasses, including CO2, methane, and nitrous oxide. Information obtained from PacifiCorp (personal communication with Tom Wiscomb, October 2001). PacifiCorp's data shows that the following Emission Factors:

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Carbon Dioxide	4,810 lbs. CO2/ton coal
Methane	0.04 lbs. CH4/ton coal
Nitrous Oxide	0.08 lbs. N2O/ton coal
Hydrofluouocarbons	No emission factor available
Perfluorocarbons	No emission factor available
Sulfur Hexafluoride	None

In regard to global climate change, scientists have debated the potential effects for the last decade and studies with conflicting conclusions continue to be published. According to the US Environmental Protection Agency (http://www.epa.gov/globalwarming/uncertainties.html) it is known that human activities are adding greenhouse gasses to the atmosphere, and that these gasses tend to warm the earth. However it is not known to what degree human-generated greenhouse gasses are responsible for the global warming trend. This is because other factors, natural and human, affect the earth's temperature. Scientific understanding of factors such as natural climatic variations, changes in the sun's energy, and the cooling effects of pollutant aerosols are not well understood. There is scientific uncertainty regarding how much warming would occur, how fast warming would occur and what the potential adverse and beneficial effects would be. It is beyond the scope of this document to predict what potential effects burning of the coal from the project area for generation of electricity would have on the global climate. The local coal fired power plants will continue to burn coal at the current or increased rate regardless where the coal comes from. If not mined from the project area, coal would be imported from other areas with potentially greater effects due to burning of lower quality coals.

Comment (UEC): "Finally, UEC is concerned about the impact fossil fuels such as coal are having on the climate. We are also troubled by the fact that coal is a major contributor to environmental problems such as acid rain which has been a major concern in the eastern United States for some time. Opening up additional public lands to coal production discourages development of cleaner alternatives to coal as a source of energy and is, in our opinion, bad public policy."

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Response: The quality of the coal in the Flat Canyon Tract is low in ash and sulfur (i.e. compliance coal). These coals are desirable for power plants because they produce very few particulates, relatively little sulfur dioxide, and decrease the potential for acid rain relative to other coals. Coal in the tract contains less than 0.5 percent sulfur. It is reasonably foreseeable that the coal would be burned to produce electricity at power plants in Utah and western Nevada. Emissions at these plants are

reduced by scrubber technology and are regulated through air quality standards. If Flat Canyon Tract coal is not mined and burned, coal from other sources with higher potential for producing pollutants would most likely be purchased and burned in these or other plants. The issues of climate changes and global warming from combustion of fossil fuels are considered beyond the scope of this analysis.

Comment (UEC): "The UEC asks the Forest Service and BLM to take into consideration current and future demand for coal when making its decision regarding this lease. Is demand for this fossil fuel keeping up with supply or is supply currently struggling to keep up with demand? If a careful examination of current and likely economic conditions and energy demands indicate the expansion of this mine is not necessary at this time there is no need to move ahead with the lease."

Response: Canyon Fuel Company, LLC has demonstrated that there is current and foreseeable future demand for coal to justify consideration of the Flat Canyon Tract at this time. Their mining sequence demonstrates that it is most logical and economic to extend existing underground workings into the tract at this time while developing coal reserves in the southern portion of the existing permit area. If not mined in the current sequence of mining, the coal would most likely be bypassed and rendered inaccessible considering current mining technology and safety requirements. If the coal is not leased and developed from underground workings in the Skyline Mine, it is not likely that it would ever be recovered due to the lack of economic access to the minable reserves from adjacent areas.

Effects to air Quality from Operations at the Skyline Mine Portal and Loadout Facilities

Emissions at the Skyline Mine facilities currently meet air quality standards and the Permit-to-Construct issued by the Utah Department of Air Quality. The proposed action would not lead to additional emissions but would extend the life of operations. It is not expected that operations would lead to any violations of the Clean Air Act.

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2.5 ALTERNATIVES ANALYZED

Alternatives were developed to address the significant issues associated with the project and to meet the requirements of NEPA. The alternatives addressed cover both ends of the spectrum regarding the possibilities for leasing/mining. Alternative A (No Action) presents the effects of not leasing the Tract. Alternative B, at the other end of the spectrum is a leasing scenario with

no special stipulations, representing the full-mining scenario where mining would be conducted to maximize efficiency and coal recovery without specific measures to protect surface resources. Alternative B' (B Prime) is a derivative of B that would result in the same mining scenario without restrictions to prevent subsidence of sensitive resource areas, but differs in that it includes Special Coal Lease Stipulations (SCLS) that would require specific monitoring and mitigations in the event that specific effects occur. Alternative C lies in between, representing a leasing scenario where SCLSs would be included in the lease and subsidence of sensitive resources and facilities/structures would not be allowed regardless of the potential level of effects to them. To provide information to the public and decision makers, so that combinations of these alternatives can be considered, each of the sensitive resources and structures/facilities are addressed individually in the analysis. All of the following alternatives will be considered in the EIS.

ALTERNATIVE A, NO ACTION - The no action alternative provides a baseline for estimating the effects of the action alternatives. Under this alternative the lease tract would not be offered for leasing and there would be no mining.

ALTERNATIVE B, OFFER THE TRACT FOR LEASING AS DELINEATED/WITHOUT SPECIAL LEASE STIPULATIONS - Under this alternative the tract would be offered for competitive leasing, as delineated by the Tract Delineation Team, with BLM standard lease terms and conditions only, as displayed in Appendix B. No special coal lease stipulations would be included in the lease to be offered. Longwall (full-extraction) mining would be allowed throughout the tract resulting in subsidence of perennial drainages, Boulger Dam and Reservoir, Flat Canyon Campground, State Route 264 (other than along Upper Huntington Creek), and structures on private lands within the project area. It would be analyzed as the basis for comparison with other action alternatives that would include special stipulations needed to protect non-mineral resources and uses.

This alternative does not specifically meet Forest Plan requirements because it does not include any of the 17 Special Coal Lease Stipulations (SCLSs) prescribed for coal leases on National Forest System lands, on an as needed basis (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4). Special stipulations were not included for the purpose of disclosing the effects of not including them

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ALTERNATIVE B' (B PRIME), OFFER THE TRACT AS DELINEATED WITH SPECIAL COAL LEASE STIPULATIONS BUT WITHOUT RESTRICTIONS ON MINING THAT WOULD CAUSE SUBSIDENCE OF SENSITIVE SURFACE RESOURCES - Under this alternative, the tract would be offered for competitive leasing, as delineated, with BLM standard lease terms and conditions and special stipulations to protect non-mineral resources and uses. Special coal lease stipulations for this alternative are included in Appendix C. The mining scenario would be the same as Alternative B, without restrictions on subsiding sensitive resources, but would include lease stipulations that require mitigation of effects. In some cases, the opportunity exists to include similar requirement in the mine permit during the mining plan review and permitting process. For the purposes if this analysis, it is

assumed that similar measures not specifically required by law or regulation would not be applied.

This Alternative B' would be consistent with Forest Plan direction (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4).

ALTERNATIVE C, OFFER THE TRACT FOR LEASING AS DELINEATED/WITH SPECIAL LEASE STIPULATIONS (Do Not Allow Subsidence of Perennial Drainages, Boulger Dam and Reservoir, or Flat Canyon Campground) - Under this alternative, the tract would be offered for competitive leasing, as delineated, with BLM standard lease terms and conditions and special stipulations to protect non-mineral resources and uses. Special coal lease stipulations for this alternative are included in Appendix C. Subsidence of perennial drainages, Boulger Dam and Reservoir, State Route 264, and Flat Canyon Campground would not be allowed. Subsidence of structures on private lands within the project area could occur, if the lessee/operator obtains permission from private coal estate owner(s), under agreement with the private surface estate owner(s). This alternative would be consistent with Forest Plan direction (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4).

OTHER ACTION ALTERNATIVES – Alternatives B and C define the least and most restrictive action alternatives regarding leasing/mining and resource protection. Other alternatives can be considered in the decisions, as needed, to address significant social and environmental issues or opportunities. In formulating other alternatives for consideration in the EIS, the Forest Service and BLM can look at the tract boundary and potential restrictions on underground mining and surface occupancy needed to protect non-mineral resources and uses. Sensitive resource areas were specifically and individually evaluated under Alternatives B and C such that the effects can be adequately considered and disclosed if the decisions involve a combination of the evaluated alternatives.

If selected, this alternative would contain Special Coal Lease Stipulations (SCLSs) consistent with Forest Plan direction and would not require Forest Plan amendments.

2.6 ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER ANALYSIS

Alternative tract boundaries were considered but changing tract boundaries would not address any specific issues or change the overall affects of mining. A full spectrum of alternatives was addressed in the analysis allowing the responsible officials to select one of the alternatives analyzed in detail or an additional alternative incorporating specific elements of those analyzed.

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2.7 PAST, PRESENT, REASONABLY FORESEEABLE FUTURE ACTIONS

CEQ regulations (40 CFR 1508.7) define cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal of non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

Past, present, and reasonably foreseeable future actions in the project area have been developed in support of the EIS. The action, year of occurrence, and estimates of residual, current, or anticipated effects are presented in tables provided in Appendix A. Actions are grouped by resource. The sum of the effects of these actions, in addition to the anticipated direct and indirect effects of the proposed action, will form the basis for the cumulative effects analysis.

2.8 SUMMARY COMPARISON OF ALTERNATIVES RELATIVE TO THE OUTCOMES AND PHYSICAL EFFECTS OF LEASING/MINING

Table 2.1, Comparison of Alternatives, Mining Outcomes and Direct Physical Effects of Leasing/Mining, is a table that displays the outcomes of mining and the physical changes to the environment likely to occur from leasing and mining as anticipated in the Reasonably Foreseeable Development Scenario for each alternative. These changes are not in themselves identified as issues, but would cause changes to resources and the socioeconomic setting and, therefore, form the basis for the identified issues. This information sets the stage for the next section in this Chapter, Summary Comparison of Alternatives Relative to the Issues.

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Table 2.1. Comparison of Alternatives, Direct Physical Changes Due to Mining

PHYSICAL CHANGE	ALTERNATIVES		
	Alternative A	Alternatives B and B'	Alternative C
MINING			
General	No mining of Federal or non-Federal coal in project area.	Two seams mined with limited room-and-pillar mining. 36 million tons recoverable. Extend mine life 9 to 12 years..	Two seams mined (mainly longwall, some partial extraction room-and pillar mining below perennial drainages) and other protected structures). 18 to 20 million tons recoverable. Extend mine life by 5 to 7 years. The potential of receiving bids on the tract is reduced.
Mine Discharge Water	No change. Discharge recently increased from 500 gpm to 2,600 gpm.	Possibility of changing the mine water discharge location from Eccles Creek to Electric Lake. Discharge could increase from 2,600 gpm to a maximum of 4,000 gpm.	Same as Alternatives B and B' Same as Alternatives B and B'
Vent Shafts	No effect	Two air vent shafts with temporary access roads. Temporary disturbance of 2.9 acres (2.0 acres for pads and 0.92 acres for access roads). Possibility of pumping mine water discharge from Swens Canyon Shaft to Electric Lake requiring new buried pipeline from shaft along Swens Canyon Road and SR-264.	Same as Alternative B and B'
Exploration Holes	No effect	About 10 additional boreholes with temporary surface disturbance of 9.2 acres (4.6 acres for pads and 4.6 acres for access roads)	Same as Alternatives B and B'

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PHYSICAL CHANGE	ALTERNATIVES		
	Alternative A	Alternatives B and B'	Alternative C
SUBSIDENCE			
Longwall and Room-and-Pillar Mining (other than full-support mains).	No effect	Longwall subsidence of 2 to 14 ft, generally with flexure of ground surface producing localized slope changes of up to 3% and tension fractures in zones of high differential subsidence expected to be less than 1% of the mined area.	Same as Alternatives B and B' in areas where longwall extraction is allowed and no impact in areas with full-support mining. Area of differential subsidence would be increased as compared to Alternatives B and B' because full-extraction mining would be split into three blocks separated by subsidence protection zones.
Full-support mains	Same as Alternatives B and B' since mains under Upper Huntington Creek could still be driven to access coal reserves in existing permit area.	Full-support mains would be driven across/under Upper Huntington Creek to access the Flat Canyon Tract project area then south under the west slope of Upper Huntington Canyon to set up longwall panels. Full-support mains are designed to be stable and prevent caving and subsidence. Geotechnical design/models show safety factors in excess of 1.74 (1.0 considered stable). Empirical data from existing mines shows mains to be stable for at least 70 years and predictions indicate that they would be stable over 200 years. In unlikely event that pillars fail, they would fail over hundreds to thousands of years. Maximum subsidence, if pillars fail over large area, would be 4.7 ft. considering two seams of stacked mains.	Same as Alternatives B and B'. Same as Alternatives B and B'. Same as Alternatives B and B'.

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PHYSICAL CHANGE	ALTERNATIVES		
	Alternative A	Alternatives B and B'	Alternative C
Natural Slopes	Subsidence in existing permit area has not caused slope instability or movement of naturally unstable areas.	No accelerated slope instability expected.	Same as Alternatives B and B'.
SEISMICITY			
General	No mining-induced seismic events generated from mining in project area. Seismic events from mining in adjacent area would continue. Maximum Credible Event (MCE) of Richter 3.45 at a rate of one event with magnitude greater than 2 every 5 days.	Longwall mining induced seismicity expected with increased potential at depths below 1500 ft. Maximum Credible Event (MCE) of Richter 3.45. Frequency of events over extended mine life expected to be about one event with magnitude greater than 2 every 5 days. Human response to ground vibrations from seismicity is expected to result in events being distinctly felt by campers, forest visitors and cabin dwellers about once every 5 days within 3,500 ft. of longwall mining areas.	Same as Alternatives B and B'.
Natural Slopes	Same as Alternatives B and B'	No effect. Vibration levels are too low for potential impact to slope stability. Confirmed by no evidence of slope failure due to past mining at Skyline Mine.	Same as Alternatives B and B'.

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2.9 SUMMARY COMPARISON OF ALTERNATIVES RELATIVE TO RESOURCES CATEGORIES/ISSUES

This section presents a summary of effects related to resources categories/issues, most of which would result from the physical changes to the environment from mining that are expected to occur under the Reasonably Foreseeable Development Scenario if the Flat Canyon Tract is leased. The physical effects and outcomes of mining are discussed above in Section 2.7 and presented in Table 2.1. Table 2.2 displays the effects of implementing each of the three alternatives analyzed. The effects are subdivided by resource groups, addressing each issue and general aspect of each alternative needed to be able to show the differences. It is a tabular presentation of the information presented in Chapter 4, Effects of Implementation.

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Table 2.2 Comparison of Alternatives, Effects by Resource/Issue

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
FACILITIES				
Boulger Dam and Reservoir (Subsidence Pt. 6)				
Subsidence damage	No effect	Subsidence of up to 13 feet with high to very high differential subsidence. Dam could fail with downstream effects and potential hazard.	Subsidence of up to 13 feet with high to very high differential subsidence. Dam would be intentionally breached to prevent downstream effects and hazard.	No effect from subsidence
Seismicity damage		Based on the MCE, the dam would experience greater than 0.1g if the event occurs within 5,500 ft., and could fail with downstream effects and potential hazards.	Same as Alternative B, except downstream effects and associated hazard would be eliminated by taking the dam out of service prior to mining.	Same as Alternative B'.
Lost use		Dam would be out of service for up to 12 years. Damage estimated at about $390,000.	Dam would be taken out of service for up to 12 years, then repaired and improved by the lessee/operator at a cost of about $390,000.	Same as Alternative B', except the dam could be out of service for 5 to 8 years.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Highway SR 264 (Subsidence Pts. 5 and 6)				
Subsidence damage	No effect	Longwall mining subsidence of 2 to 14 ft., with the possibility of minor cracking of surface in some isolated areas. Two major culverts could be damaged. Damage estimated at $52,000.	Subsidence and damage to the road are the same as Alternative B. SCLS #13 would require monitoring and repair by lessee/operator. Total cost estimated at $52,000. Repairs could include filling cracks and regrading in some areas with resurfacing of road and replacement of culverts, but without long-term effects.	No effect. No longwall mining within the subsidence angle-of-draw. Projected full support pillars would not cause subsidence. No cracks expected.
Safety hazard	No effect	Safety hazard exists without close monitoring and immediate repairs.	Safety hazard effectively avoided by monitoring and immediate repairs.	No effect
Seismicity damage		No effects from mining-induced seismicity.	No effects from mining-induced seismicity.	No effects from mining-induced seismicity.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Unpaved Roads (FS and pvt.)				
Subsidence damage	No effect	Small cracks 2 inches or less expected in tensile zones. Larger cracks are possible but not likely.	Subsidence and damage same as Alternative B.	Same as Alternative B'.
Safety hazard		Minor safety risk to motorists.	Monitoring required. Some repair work required in tensile zones to fill cracks and maintain slopes and drainage with temporary safety measures required. Cost of repair estimated at less than $10,000.	Same as Alternative B'.
Seismicity damage		No effect from seismicity.	No effect from seismicity.	No effect from seismicity.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Flat Canyon Campground (Subsidence Pts. 5, 6, and 8)				
Subsidence damage	No effect	Longwall mining subsidence of 2 to 14 ft. with very low to moderate differential subsidence. Minor cracking of surface expected in some areas. Water tank, water pipelines, tables, toilets, septic tank/drain field, spring collection system, and retaining wall could be damaged. Minor cracking of roads could occur. Damage costs are estimated at $150,000 by the Forest Service.	Same as Alternative B except that SCLS #13 would require monitoring and repair by the lessee/operator. Repair costs are estimated at $150,000.	No effect. Protected with no subsidence of the structures allowed. No possibility of cracks or subsidence damage to facilities provided pillar dimensions are adequate.
Seismicity damage		Longwall mining induced seismicity has the potential to vibrate structures once every 5 days at a Peak Particle Velocity (PPV) of over 1 in/sec within a range of 3,500 ft. from mining areas. Some minor cosmetic damage may result with a very low possibility of structural damage to buildings for infrequent larger events. No damage to the water system is expected.	Same as Alternative B, except that lessee/operator would be required to monitor and repair damage.	Same as Alternative B'.
		Some effects to recreation use at this facility are expected. See Recreation.	Some effects to recreation use at this facility are expected. See Recreation.	No effect

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Flat Canyon Cabins (Subsidence Pt. 5)				
Subsidence damage	No effect	Longwall mining subsidence of 2 to 4 ft., with very low to low differential subsidence. Potential for tensile strain and induced slope changes with the possibility of cracks. Lost use of facilities during active subsidence. Cost of repairs could reach $360,000.	Same as Alternative B. Cabins, land surface, and coal estates are in private ownership. It is assumed that monitoring and repairs would be agreed upon by coal operator and owners as required under state law.	Most cabins protected due to no longwall mining allowed for protection of perennial drainage. Two cabins north of canyon may be subject to tensile strains at edge of stacked pillars with some mitigation required. Repair requirements are same as Alternatives B'.
Seismicity damage	No effect	Longwall mining induced seismicity has the potential to vibrate structures once every 5 days. Some minor cosmetic damage may result with a very low possibility of structural damage to buildings for infrequent larger events. No damage to the water systems is expected.	Same as Alternative B.	Same as Alternatives B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Swens Canyon Cabins (Subsidence Pt. 3)				
Subsidence Damage	No effect	Longwall mining subsidence of 4 to 10 ft. with very low to high differential subsidence. Pillars at edge of longwall area could result in higher tensile strains with the possibility of damage and lost use during active subsidence. Estimated repair cost included with Flat Canyon cabins above.	Same as Alternative B. Cabins, land surface, and coal estates are in private ownership. It is assumed that monitoring and repairs would be agreed upon by coal operator and owners as required under state law.	Similar to Alternative B, but could be located above pillars giving rise to greater tensile zone and greater potential for damage.
Seismicity damage		Same as discussion for Flat Canyon cabins.	Same as discussion for Flat Canyon cabins.	Same as Alternatives B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Hunt Dam and Reservoir				
Subsidence damage	No effect	No effect from subsidence. Closest mining and subsidence would be over 1,000 ft. distance.	Same as Alternative B.	Same as Alternatives B and B'.
Seismicity damage	No effect. Nearest mining is more than 5,500 ft. away.	Mining-induced seismicity could damage the dam. If the MCE of magnitude 3.45 occurs within 5,500 ft. the dam would experience greater than 0.1g. It could potentially be taken out of service during active mining within 5,500 ft. resulting in a loss of use. If damaged, repairs would be required. Cost could reach $390,000. It is assumed that an agreement would be reached between the lessee/operator and private landowner to prevent downstream effects and make repairs.	Same as Alternative B.	Same as Alternatives B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
SURFACE WATER				
Prolonged and increased mine water discharge to Eccles Creek and Scofield Reservoir	Discharge increased from less than 1,000 gpm to 10,000-15,000 gpm after August 2001. Could stop in 2003 if mine closes.	If Electric Lake UPDES Permit obtained, discharge to Eccles Creek would continue at approx. 10,000 gpm. No change from Alternative A, except discharge prolonged 9-12 years. If Electric Lake UPDES Permit Denied, mine water discharge and flow to Eccles Creek could increase by 7,000 gpm to a maximum of 22,000 gpm and last an additional 9-12 years.	Same as Alternative B.	Same as Alternatives B and B' except that mine water discharge could occur for a shorter time (extended mine life of 5 to 7 years).
	Chemical quality generally consistent with beneficial use standards, occasional exceedance of phenol, total phosphorous, and TDS. Significant erosion of Mud Creek channel and resulting sediment increases to Scofield Reservoir.	Chemical quality remain generally the same and could improve. Phosphorous loading to Scofield Reservoir possible but not likely due to recent decreased phosphorous levels of discharge waters. If Electric Lake UPDES Permit obtained, stream morphology effects to Eccles and Mud Creeks same as Alternative A. If Electric Lake UPDES Permit Denied, erosion of Mud Creek and sediment transport to Scofield Reservoir would increase relative to Alternative A.	Same as Alternative B.	Same as Alternative B and B', but for a shorter time (5-7 years).

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
A new mine water discharge point in Electric Lake, Changing some or all of the mine water discharge from Eccles Creek to Electric Lake	Flow Current ground water discharge from James Canyon wells to Electric Lake is 2,000-4,000 gpm. Expected to stabilize at 5,000 gpm. Expected to continue to 2003. Quality Negligible change since ground water discharged is very good quality.	Flow If Electric Lake UPDES Permit issued, 12,000 mine water discharged to Electric Lake for 9-12 years. Increase of 19,350 ac-ft annual increase representing 33% of Electric Lake capacity. If Electric Lake UPDES denied, no change to Electric Lake but flow to Eccles Creek increased by 7,000-12,000 gpm for 9-12 years for a total of 22,000 gpm. Increase of 12,000 gpm is 19,350 ac-ft annually, representing 26% of Scofield Reservoir capacity. Quality Possible, but unlikely, increase in phosphorous in Electric Lake. Possible, but unlikely, accelerated eutrophication. Water temperature increase at discharge outlet.	Flow Same as Alternative B. Quality Same as Alternative B, but some mitigations potentially required if eutrophication occurs.	Flow Same as Alternative B', except that discharge would occur for a shorter time (5-7 years).. Quality Same as Alternative B', but for a shorter time (5-7 years).

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence of perennial streams and Boulger Res. could intercept water and divert it underground.	No effect	No loss of water expected due to deep overburden and sealing characteristics of clay in shales. If it should occur, state appropriated waters would be replaced by the lessee/operator's expense.	Same as Alternative B, except that SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems.	No effect because subsidence would be prevented except for the Cunningham Drainage. No loss of water expected due to deep overburden and sealing characteristics of clay in shales. In the event that loss occurs due to mining, SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems.
GROUND WATER				
Subsidence could change flow of springs/seeps, affecting flow of springs and receiving streams. Also water rights.	No effect	Spring locations could shift, though unlikely, and no loss of water expected due to sealing characteristics of clay in shales. Lessee/operator required to replace state appropriated water if affected. No loss of water related to water rights anticipated.	Same as Alternative B except that SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems. Same as Alternative A.	Same as Alternative B', except that fewer springs would be subjected to subsidence. Same as Alternatives B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Interception of mine water and discharge to Eccles Creek diverts water from Huntington Canyon drainage to Price River drainage (Transmountain Diversion)	No effect	Deep aquifers associated with channel sands are discontinuous. Ground water and mine water tested at 4,000 to over 10,000 years old and transmissivity of rock layers (vertical and horizontal) is extremely slow, so any effect would not be quantifiable or perceptible. Ground/mine water too deep to be issuing to Huntington Creek Watershed. Negligible effect.	Same as Alternative B.	Same as Alternatives B and B'.
Water Quality Effects from Equipment Left Underground	No effect	Local ground water quality could be degraded by oils and other fluids (battery acid, transmission oil, diesel fuel, lubricants, etc.) if leaked underground and slow corrosion/oxidation of metals left underground. See mine water discharge in Surface Water Section. Connection with surface waters is very slow and unlikely, therefore effects are expected to be negligible.	Same as Alternative B, but SCLS #19 would require removal of equipment unless specifically approved. Less potential for contamination because equipment and materials left underground would be limited to inert materials, corrosion/oxidation resistant metals, and non-polluting fluids.	Same as Alternative B'.
VEGETATION				
Disturbance from Surface Facilities	No effect	Temporary (3-5 yrs.) removal of 2.9 acres of vegetation for vent shafts and 9.2 acres for exploration drill holes. Long-term (12-15 years) of vegetation affected for vent shafts of less than 1 acre.	Same as Alternative B.	Same as Alternatives B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence disturbance.	No effect	Changes in stream morphology in Swens Canyon, Little Swens Canyon, Boulger Canyon, and Flat Canyon could result in loss of streambank riparian vegetation from scouring. Increase in pond areas could increase riparian over the long-term after all subsidence is complete (increased land/water contact area). Spring locations could shift causing associated localized riparian vegetation to shift. Temporary loss during adjustment.	Same effects as Alternative B but SCLS #3 and #7 require vegetation baseline information and monitoring necessary to quantify changes. Same as Alternative B, except SCLS #3 and #7 would require vegetation baseline information and monitoring necessary to quantify changes.	No effect Same as Alternative B', but fewer springs subjected to subsidence.
Increased discharge to Eccles Creek if Electric Lake UPDES Permit not issued.	No Effect	Increase of discharge to Eccles Creek from 10,000 -15,000 gpm to 22,000 gpm. Could increase headcutting in Eccles and Mud Creeks. This could cause loss of riparian vegetation for many years, until channels stabilize and vegetation recovers.	Same as Alternative B.	Same as Alternatives B and B'.
Threatened, Endangered, and Sensitive Species	No effect	No effect	No effect	No effect

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
WILDLIFE				
Terrestrial				
Disturbance from Surface Facilities	No effect	Short-term loss of habitat for exploratory drilling and construction/drilling of vent shafts due to avoidance. Sensitive bird species (individuals) could be affected during nesting season, causing abandonment. No effect to Threatened or Endangered Species. Activities would be postponed in critical habitat to avoid effects.	Same as Alternative B, except SCLS #14 reduces effects to sensitive species and species of high interest by imposing appropriate timing restrictions on construction and drilling operations. Does not affect operation of vent holes, once constructed. Same as Alternative B.	Same as Alternative B'. Same as Alternatives B and B'.
Subsidence/Seismicity	No effect	No effect	No effect	No effect
Aquatic				
Disturbance from Surface Facilities	No effect	Crossing Boulger Canyon and Swens Canyon could add minor amounts of sediment to creeks. Use of bridges or bottomless arches would reduce streambed disturbance, therefore negligible effect to habitat.	Same as Alternative B.	Same as Alternatives B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence caused changes in stream gradient/morphology/flow/quality could affect habitat.	No effect	Stream morphology changes and sediment additions in streams could decrease habitat quality and productivity for aquatic species in perennial drainages with gradients of 5% or less including the majority of Boulger Creek, (4.0 miles), lower portions of Swens (0.5 mile) and Little Swens (0.5 mile) Canyons, and in Flat Canyon (1.5 miles). Individuals affected but population viability not lost. Recovery could take 10-30 years after subsidence. No flow changes expected (see Surface and Ground Water). Macroinvertebrate indices could fall below Forest Plan Standards for 10-30 years.	Same effects as Alternative B, but SCLS #3 and #7 would require monitoring to quantify effects to habitat and aquatic species and potentially require measures to mitigate effects. Measures would only partially decrease effects. Unlikely that Macroinvertebrate indices could fall below Forest Plan Standards but probably for less time than Alternative A due to mitigation measures.	No effect except for Cunningham Drainage. Negligible effects because stream gradient is steeper than 5% (similar to Burnout Canyon).
Seismicity	No effect	No effect	No effect	No effect

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Mine Water Discharge	Increased discharge to Eccles Creek and Scofield Reservoir from less than 1,000 gpm to 10,000 to 15,000 gpm not evaluated. Decrease in aquatic habitat anticipated.	Mine water discharge increased by 9-12 years. Discharge to Eccles Creek could increase to 22,000 gpm if Electric Lake UPDES Permit not approved. Changes to stream morphology and riparian vegetation in Eccles and Mud Creeks could cause habitat degradation for many years. Quality changes expected to be negligible. If discharge to Electric Lake approved, effects to Eccles Creek and Scofield Reservoir same as Alternative A. If discharge to Electric Lake is approved, degradation of water quality from mine water discharge could occur due to phosphorous and associated eutrophication, but not likely due to recent improved quality of discharge water.	Same as Alternative B.	Same as Alternatives B and B', but mine water discharge would occur for a shorter time (5-7 years)..
RECREATION				
Disturbance from Surface Facilities	No effect	Single-season degradation of recreation experience in Boulger Canyon and Swens Canyons during construction of vent shafts. One to two season degradation of recreation experience for coal drilling in any specific area.	Same as Alternative B. Same as Alternative B.	Same as Alternatives B and B'. Same as Alternative B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence				
Boulger Reservoir	No effect	Long-term (up to 12 years) loss/displacement of fishing opportunity (5,000 RVDs/year and total of 60,000 RVDs) due to potential damage to dam. Failure of dam could cause a safety hazard to fishermen and sightseers in the stream channel downstream. Increased fishing pressure on Beaver Dams Reservoir, Gooseberry Reservoir, and Electric Lake.	Same as Alternative B except the safety hazard would be avoided by requiring the dam to be breached prior to mining.	No effect
Flat Canyon Campground		See the facilities section for description of damages. Loss of one season of use for each of the two seams for a total of two seasons of lost use (3,000 RVDs/season for a total of 6,000 RVDs). Potential safety hazard to people using the facilities.	Same as Alternative B, except safety hazard would be avoided by closing campground during active subsidence.	No effect

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Seismicity				
Boulger Reservoir	No effect	Dam could be damaged by seismicity (see Facilities). Long-term (up to 12 years) loss/displacement of fishing opportunity (5,000 RVDs/year and total of 60,000 RVDs). Potential safety hazard to fishermen and sightseers in channel downstream. Increased fishing pressure on Beaver Dams Reservoir, Gooseberry Reservoir, and Electric Lake.	Same as Alternative B, except safety hazard avoided by requiring dam to be breached prior to mining.	Same as Alternative B'.
Flat Canyon Campground	No effect	Some minor potential for damage (see Facilities) that could cause a low safety hazard.	Safety hazard avoided because campground closed due to subsidence concerns. Campground closed for two seasons (see subsidence above).	No effect.
Dispersed recreation	Events greater than magnitude 2 could be perceived once every 5 days within 3,500 ft. of existing permit area.	Human response to ground vibrations from seismicity is expected to result in events being distinctly felt by campers, forest visitors and cabin dwellers about once every 5 days within 3,500 ft. of longwall mining areas. Events could occur for 9 12 years.	Same as Alternative B.	Same as Alternative B' but length of time that events could occur and be felt is decreased to 5-7 years.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
VISUAL QUALITY				
Disturbance from Surface Facilities	No effect	Consistent with Visual Quality Objectives. Drilling operations for coal exploration and vent shafts would be visible along SR-264 for one season for each specific hole/vent.	Same as Alternative B.	Same as Alternatives B and B'.
		Vent shafts in Swens and Boulger Canyons would be visible over the long-term (12 years) from the immediate vicinity. Both screened from view from SR-264. Water vapor plumes would be visible from SR-264 and SR-31 on infrequent occasions.	Same as Alternative B.	Same as Alternative B and B' but for less time (5-7 years).
		Drained Boulger Reservoir could be a visual detraction to visitors along SR-264 (12 years).	Same as Alternative B.	Same as Alternatives B and B' but for less time (5-7 years).
TRANSPORTATION				
Extended Mine Life	No effect	Existing mine related traffic on SR-264 and SR-31 (total of about 56 cars/trucks per day) would be extended for another 9-12 years.	Same as Alternative B.	Same as Alternatives B and B' except traffic use would be extended by 5-7 years.
Disturbance from Surface Facilities	No effect	Addition of drilling traffic for two – three seasons (one season for individual vents/hole) on SR-264, SR-31, private roads, and Forest Development Roads.	Same as Alternative B.	Same as Alternative B'.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Subsidence	No effect	Minor cracks could occur on SR-264 that would need repairs. Larger cracks are expected on Forest Development roads and private roads on ridge tops that could present short-term hazard. Private roads that cross Flat Canyon Creek could be flooded requiring work to raise running surface to above water levels.	Same as Alternative B. SCLS #13 would require monitoring and repair of cracks by lessee/operator to avoid hazards. Same as Alternative B. SCLS #13 would require monitoring and repair of cracks by lessee/operator to avoid hazards. Same as Alternative B.	Same as Alternative B'. Same as Alternative B', except fewer roads would be subjected to subsidence. No effect.
Seismicity	No effect	No effect.	No effect.	No effect.
SOCIO-ECONOMIC				
Lease Bonus Bid	No Bonus Bid	Bonus Bid	Same as Alternative B.	Bonus bid but less than Alternatives B and B'. Potential for receiving bids is reduced.
Life of Mine, Employment, and Support Services Jobs Extended	No extension. Loss of 220 jobs in 2003. This does not consider the potential for mining U 67939.	Mine life including 220 jobs extended up to 12 years.	Same as Alternative B.	Mine life including 220 jobs extended 5 to 7 years.
Coal Production	None	36 million tons	Same as Alternative B.	18-20 million tons
Value of Coal Recovered	None	$612 million	Same as Alternative B.	$306 - $340 million
Royalties	None	$49 million	Same as Alternative B.	$24 - $27 million

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
CULTURAL AND HISTORIC RESOURCES				
Disturbance from Surface Facilities	No effect.	Site surveys required and sites would be avoided or recovered on Fed. lands. Sites on private lands subject to landowner discretion.	Same as Alternative B.	Same as Alternatives B and C.
Subsidence	No effect.	Site surveys required and sites on Federal lands would be protected, repaired or recovered. Disposition of sites on private lands subject to discretion of landowner. Historic log structures not likely damaged. Rock foundations could be cracked. Historic roads and trails not likely affected. Lithic scatters not likely affected.	Same as Alternative B. SCLS #1 serves as a notice to lessee that surveys and protection required on Federal lands. Same as Alternative B. Federal sites protected, repaired, or recovered. Same as Alternative B. Same as Alternative B.	No effect. Structures located in subsidence protection zones. For other sites, Same as Alternative B'. Same As Alternative B'. Same as Alternative B'. Same as Alternative B'.
Seismicity	No effect.	No effect.	No effect.	No effect.
PALEONTOLOGICAL RESOURCES				
Mining	No effect.	Some dinosaur footprints, bone fragments, and vegetation imprints with low scientific value destroyed in the underground coal seam during mining.	Same as Alternative B	Same as Alternatives B and C.

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RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
Disturbance from Surface Facilities	No effect	Surveys would be conducted and sites would be avoided or recovered.	Same as Alternative B	Same as Alternatives B and C.
Subsidence	No effect	No effect to buried dinosaur fossils. Pleistocene mammal fossils buried in glacial materials could be displaced by subsidence. Not likely that bones would be broken.		No effect to buried dinosaur fossils. Very low potential for displacement of Pleistocene mammal fossils because high occurrence potential areas lie within subsidence protection zones.
Seismicity	No effect.	No effect.	No effect.	No effect.

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3.0 AFFECTED ENVIRONMENT

This chapter presents a description of those aspects of the current human and natural environment likely to be affected by the proposed action and alternatives evaluated in the analysis. This provides the basic information on current conditions that is used for comparison when presenting changes that are likely to occur from the proposed action in Chapter 4. Those aspects of the current environment likely to be affected are related to the specific issues identified in Chapter 2, presented under subheadings for the functional area or resource area involved. This chapter does not present a discussion of the effects of the proposed action or alternative. The affects analysis is presented in Chapter 4 under similar functional area or resource category subheadings.

3.1 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1.1 Physiography

The tract lies in the interior of the Wasatch Plateau, a sub-province of the Colorado Plateau Physiographic Province. The Wasatch Plateau has also been described as lying in a transition zone between the Colorado Plateau Physiographic Province to the east and the Great Basin Physiographic Province to the west since it exhibits characteristics of each.

The Wasatch Plateau was uplifted then exposed to accelerated wind and water erosion. It overlooks Castle Valley to the east and the Sanpete and Sevier Valleys to the west. The eastern margin of the Plateau is defined by abrupt erosional escarpments or cliffs. The western margin is less abrupt since it is controlled by the westerly dip of the rock layers and the Wasatch Monocline (single-limbed fold). The rock layers along the central and eastern portions of the Plateau dip gently to the west. West of the Plateau's crest, the rock layers tilt more abruptly to the west plunging into the Sanpete and Sevier Valleys. North-south trending normal faults are common throughout the plateau.

The Plateau has been incised by numerous deep canyons shaped by the advance of glaciers and by wind and water erosion. Huntington Canyon drains the eastern flank of the Plateau. Upper Huntington Creek along the eastern boundary of the project area lies at the headwaters of Huntington Canyon, trending north-south.

The project area lies along the western slope of Upper Huntington Creek and the tributaries that drain the west slope of Huntington Canyon. The major tributaries generally trend east-west. From north to south they include Little Swens and Swens Canyons, Flat Canyon, and Boulger Canyon.

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The project area is situated on the western limb of the Clear Creek Anticline and the dip of the rock layers is generally toward the west. Dips range from 3 to 6 degrees. To the west of the project area the eastern bounding fault of the Gooseberry Graben (downthrown block of land between two faults) has a displacement ranging from 850 to 1,180 feet. The geomorphology of the project area suggests the probability of at least three northeast-southwest trending fault zones.

Other minor fault orientations occur in an east-west direction that usually have less than 10 feet of vertical displacement. Phlogopite mica-rich igneous dikes known as lamprophyres that trend nearly east-west occur within the project area.

The Wasatch Plateau was glaciated at least twice during the Pleistocene Epoch and the last glacial episode ended approximately 15,000 years ago. This is evident in the project area by the U-shaped canyons scoured by the advancing glaciers and low rounded hills along the flanks of the canyons and present stream channels formed by earth materials deposited when the glaciers retreated.

3.1.2 Geology

Bedrock formations were deposited during the Late Cretaceous and Tertiary periods. Multiple transgressions and regressions of the Western Cretaceous Interior Seaway resulted in the deposition of a heterogeneous sequence of rock types that are both horizontally and vertically discontinuous. On the terrestrial side of the shoreline (Wasatch Plateau area) sediment deposition occurred in lacustrine (lake), fluvial (river and stream), floodplain, and swamp environments. Beach sands accumulated along the shoreline. Offshore, sands swept from the beaches and were laid down as bars and blankets of sand in the near-shore shallow marine waters. Muds and clays were deposited in deeper, quieter portions of the sea.

The rock layers exposed in and adjacent to the project area are described below from oldest (lowest elevation) to youngest (highest elevation) as follows (Figures 3.1 and 3.2):

Star Point Sandstone (Cretaceous) - This unit is not exposed in the project area but forms the foundation below the coal seams and forms prominent cliffs to the east. It is a marine shoreface deposit formed by accumulation of beach sands of the Cretaceous seaway. The sandstone consists of two massive units, the Storrs Tongue and the underlying Panther Tongue, which intertongue with the overlying Blackhawk Formation. Both Tongues consist of massive buff-colored sandstone units with a thickness of approximately 1,300 feet. The Storrs Tongue pinches out westward within the Flat Canyon Tract.

Blackhawk Formation (Cretaceous) – The Blackhawk Formation crops out within the project area and forms the canyon bottoms and lower and lower-intermediate slopes of the canyons. It is easily eroded and forms slopes. It is approximately 1,900 feet thick and consists of lenticular sandstone, siltstone, and claystone or shale. The lower portion is the coal-bearing section of mining interest. None of the coal seams crop out at the surface within the project area. They are buried by varying thicknesses of overburden within the project area, ranging from approximately 800 feet along the eastern boundary to over 2,000 feet along the western boundary. Within the bottom 100 feet of the Blackhawk there are several coal seams between the Storrs and Panther Tongues. Of these seams only the lowest-lying Flat Canyon Seam is mineable.

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The upper coal-bearing unit of the Blackhawk Formation, immediately above the Storrs Tongue, contains three mineable seams, but only the Lower O'Connor B seam is mineable under the majority of the Tract. The Lower O'Connor A Seam is not considered mineable until it merges with, and becomes part of, the Flat Canyon Seam in the central and northern section of the project area, although there may be areas with mineable thickness in the southern section.

Other coal seams occur in the upper part of the Blackhawk, but these are typically discontinuous and only locally of mineable thickness.

The coals are classified as low-sulfur, high-volatile "B" bituminous. Sulfur content is less than 0.5 percent by weight.

Castlegate Sandstone (Cretaceous) – The Castlegate Sandstone is a cliff-forming massive unit in most of the Wasatch Plateau. In the project area it does not form prominent cliffs but forms steep slopes. The thickness is 220 to 320 feet and forms the steep intermediate slopes of the canyons.

Price River Formation (Cretaceous) – The Price River Formation is a slope-forming unit that is poorly exposed in the project area because of vegetation and the thick soil mantle. It consists of sandstone and mudstone about 220-280 feet thick. It forms the gently sloping upper slopes of the canyons in the project area, mostly indiscernible from the overlying North Horn Formation.

North Horn Formation (Cretaceous-Tertiary) – The North Horn Formation is a slope-former that caps the upland ridge tops in the project area. It consists of interbedded lacustrine limestone, sandstone, and mudstone or shale. It is approximately 1,350 feet thick.

Alluvium and Colluvium (Quaternary) – Alluvial (stream gravels) are found in the canyon bottoms. Soil and colluvium are relatively thick and drape most of the slopes.

Glacial Deposits (Quaternary) – Glacial deposits in the project area consist of terminal, recessional, and ground moraines. Morainal deposits are most notable in Boulger Canyon but are found in the other drainages. Boulger Dam was constructed on a very prominent terminal moraine.

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3.1.3 Coal Reserves, Mining, Subsidence, and Seismicity

Previous mining in the vicinity of the Tract has been at the Skyline Mining Complex with surface facilities located east of the Tract in Eccles Canyon. Coal was extracted from underground using the longwall mining method (See Appendix D for a description of mining

methods and subsidence). Coal extraction involved common infrastructure. Mining occurred in three separate coal seams that partially overlap. Historically, production has utilized two sets of longwall mining equipment operating concurrently in separate mine levels. However, current production is from a single longwall face operating in the Lower O'Connor B Seam of the Skyline No.2 Mine. The relation of the existing mine workings to the Tract is shown on the Location Map presented in Figure 1.2.

The longwall mining method requires continuous miners to create development entries used for access to longwall mining areas. The coal is then fully extracted using longwall face equipment from panels about 800 ft. wide and up to 15,000 ft. long. The continuous miners can also be used to extract coal by methods using partial or full-extraction where feasible. Previous mining at Skyline has included continuous mining areas for development of longwall panels.

The Skyline No.3 Mine has been restricted to extraction of the Lower O'Connor A Seam in the northern section of the current lease. In the central and southern sections of the current lease the No.1 Mine workings in the Upper O'Connor Seam have been mined and production is now from the Lower O'Connor B Seam below. In this area extraction of multiple seams has been carried out, with the seams extracted sequentially from the top down with extraction heights of up to 14 feet in a single seam and up to 25 feet where both seams have been mined.

Full extraction longwall mining results in failure of the immediate roof strata, leading to fracture and flexure of the overburden rocks progressing upwards and resulting in surface subsidence. The degree of subsidence varies with mining layout, thickness of extraction, and amount of overburden. With the overburden depths at Skyline, flexure of the rock strata occurs near the surface due to differential subsidence, generally without fracture. However, in some isolated areas tension fractures can open up where the degree of tension is more pronounced and the strain is not uniformly distributed, such as where strong rock beds are located near the surface or above stacked barrier pillars (barrier pillars in two overlapping mined coal seams are located one directly above the other).

The dynamic subsidence resulting from a longwall face passing beneath the surface produces a zone of flexure where tension can sometimes result in minor cracking of the surface that is soon followed by a zone of compression where the fractures close and rapidly heal.

Permanent tensile zones are observed above coal pillars left underground at the edge of longwall extraction areas and if fractures open up in these areas they may take longer to heal. The experience of longwall mining at Skyline is that very few tensile fractures are observed following extraction of a single seam at depths greater than 600 feet. The majority of cracks are associated with mining of the lower seam and are located where differential subsidence is concentrated at pillars which are vertically aligned in both seams. These conditions give rise to the highest degree of flexure with associated tensile zones near surface.

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Although the vertically aligned or stacked pillars produce the greatest zones of tension, the formation of fractures does not generally occur unless the surface has little lateral constraint, as

in the case of ridges. Of the total area mined at Skyline, less than 0.5% has produced tensile fractures. The majority of this area was associated with an area known as Trough Springs Ridge.

Sometimes it is necessary to leave pillars between two adjacent longwall areas. This can result in increased tension, such as that experienced at Trough Springs Ridge above a fire barrier pillar left in both seams. In this case major fractures were observed after mining of the lower seam in an area where strong sandstone beds were located near the surface on a ridge where lateral constraint was absent. Tension fractures opened up in a zone that was 1500 feet long with fractures that were from several inches to 5 feet wide and up to 200 feet long. The fractures created a short-term safety hazard, but were mitigated by filling with soil. No long-term adverse impact is expected. In this area up to 23 feet of coal was extracted in two seams with depths from 650 to 1100 feet.

An expanded zone of fracturing can increase the potential for vertical groundwater permeability. Experience at Skyline with longwall mining of two seams below Burnout Canyon has shown that no long-term adverse effects have been observed with surface waters and near surface aquifers. This has included a section above the same fire barrier that led to the Trough Springs Ridge tension cracks opening up. Overburden in the Burnout Canyon area has been as low as 600 feet with extraction of up to 23 feet and subsidence of up to 14 feet observed.

Subsidence can also have adverse effects on slope stability, but no major slope failures have been observed at Skyline. Undermining of State Highway SR 264 has also taken place with minor damage observed that required repair without long term impact.

Mining induced seismicity has also been experienced as a direct result of longwall mining at Skyline. A study of this phenomenon was carried out from 1986 to 1996 while the Skyline Mine was operating in the northern section of the current mining lease (Arabasz et. al., 1996). During this time one longwall unit was operating at depths ranging from 1200 feet to 2000 feet while a second longwall unit was operating at depths ranging from 400 to 1300 feet.

Results of the study indicated a very strong correlation between mining induced seismicity and longwall production at depths greater than 1500 feet. During this time the Mine was experiencing stress-related problems caused by coal bumps at depth in the Skyline No.3 Mine. No surface damage associated with this mining was reported, although mining was not carried out in close vicinity to sensitive structures. A large campground, small dam, and private cabins were location within 7,000 feet of these mine workings. The mining was also in the vicinity of Highway SR264 and a gas transmission pipeline. There was no reported damage due to seismicity. The natural slopes in the area are similar to those in the Tract and no evidence was reported of slope instability as a result of seismicity.

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Current mining is projected to continue with extraction of the Lower O'Connor B Seam in a limited area at the southern end of the current lease and a new lease is required if the mine life is to be extended.

3.1.4 Facilities/Structures

This section presents a description of the facilities in and adjacent to the project area that could be affected by leasing/mining. These facilities are also discussed from the perspective of their managed uses by specific resource category in the appropriate resource subheadings. The associated resource subheadings are shown in parenthesis ( ) by the title. These facilities are shown on Figure 1.2.

Mainline #41 Gas Transmission Pipeline (Lands and Special-Uses)

The Mainline 41 buried natural gas transmission pipeline in the project area runs in Burnout Canyon and then under Highway SR 264 on the west side of the Upper Huntington Creek valley floor. This segment of the pipeline was constructed in 1990 as a rerouted segment of the existing Mainline 41 gas pipeline. It was completed to allow mining and subsidence of the original pipeline corridor by Canyon Fuel Skyline Mine. The original corridor lies in the Skyline Mine Permit Area more than one mile east of the project area. It follows the tops of Trough Springs Ridge and Granger Ridge. The original corridor on the ridge tops was reactivated in 2000 after mining was completed and subsidence stabilized. In addition, a new gas pipeline (Mainline 204) was constructed next to Mainline 41 in 2001. The rerouted segment under Highway SR 264 was abandoned in 2000. There are currently no plans to reactivate this abandoned pipeline for natural gas transmission. Effects to this pipeline were therefore not identified as an issue, but it is discussed for information purposes.

Electric Lake Dam (Lands and Special-Uses)

This is an earth and rock dam located about 2 miles south of the Tract. It was constructed by Utah Power and Light Company (currently PacifiCorp) in 1974 to provide water to the Huntington Canyon Coal-Fired Power Plant in Huntington Canyon near Deer Creek. Capacity is 31,500 acre-feet. The reservoir encompasses approximately 400 acres. It is operated by PacifiCorp under a special-use permit issued by the Forest Service. Operation of the dam and water discharge is coordinated with the Forest Service, responsible agencies of the State of Utah, and local water users associations. Water monitoring above the reservoir, in the reservoir and below the reservoir in Huntington Creek is being conducted by PacifiCorp in accordance with requirements of the special-use permit.

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Boulger Dam & Reservoir (Recreation)

The Dam was constructed in 1938 to create a fish pond at the junction of Boulger Canyon and Flat Canyon. A cross-section through the Dam shows homogeneous earth-fill constructed on the original streambed with a nominal key trench into the foundation materials. As originally constructed, the Dam was approximately 220 ft long, a maximum of 16 ft high, with a crest width of 10 ft. The slope of the upstream face was 3H:1V with 3 ft. of riprap protection, and the downstream face was 2H:1V. A note on the original drawing indicates organic soils were removed prior to fill placement in 6-inch layers compacted by roller, with coarser material in the

downstream half of the Dam. An overflow masonry chute spillway was constructed on the right abutment at a grade of approximately 8-10%. The chute was provided with 3 ft. deep cut-offs at the top, Dam centerline and bottom of the chute. The Utah Division of Water Rights listing indicates a drainage area of 3.1 square miles and a maximum storage of 45 acre-ft.

In 1994, the chute spillway was replaced with a reinforced concrete fish ladder, a toe drain was installed to control seepage and the riprap was upgraded on the upstream face. The fish ladder was constructed in 10 ft. sections and was provided with strip foundations at the top and bottom of the chute constructed at a 10% grade. The 1994 modifications were designed by the Forest Service and funded by Canyon Fuel for offsite mitigation of potential effects of mining in Burnout Canyon.

No descriptive information on the foundation or sub-surface conditions is available from drill holes or test pits, and no qualitative data has been located on the Dam fill or foundation materials. Other than the toe seepage that indicates a phreatic surface at ground level at the downstream toe, there is no recorded information on the phreatic surface through the dam.

Construction of the fish ladder effectively resulted in lowering of the water level in the reservoir. Over the past 62 years of operation there has likely been significant siltation of the reservoir. The combination of these two factors has likely reduced the maximum storage to less than the original capacity of 45 acre-ft., but no measurements have been carried out to confirm a more definitive figure.

A typical cross section through the highest part of the Dam was prepared based on the available information. Consistent with the descriptive data, a homogeneous fill section placed on stream bed material has been assumed, with a phreatic surface profile typical of a non-zoned construction. Reasonably conservative shear strength parameters were assigned to the various materials, although it should be noted that the nature of the foundation remains highly speculative and has been based on inspection of near surface materials in the vicinity of the Dam.

Limit equilibrium analyses of the structure under normal and extreme loading conditions was carried out by Norwest Mine Services, Inc. (NorWest, 2000) to investigate the potential for both circular and composite (part circular/part linear) failure surfaces to develop through the upstream and down stream slopes. The results of the analyses show that under normal conditions the structure is stable with factors of safety of 2.5 and 1.3 for the upstream and downstream slopes respectively. An acceptable factor of safety for normal conditions is generally 1.5, thus the downstream face with a 2H:1V slope and high phreatic surface is likely already below normal standards.

State Highway 264 (Transportation)

This is a paved, all-weather State highway maintained by the Utah Department of Transportation.

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This paved two-lane highway runs east-west through the center of the Tract along Flat Canyon as shown on Figure 1.2. The road runs along the base of the Canyon over terminal moraine-type deposits at the lower east end and over alluvial sand deposits further west.

The road construction comprises flexible asphalt surfacing over granular roadbase material. Drainage is provided by inside ditches, collection inlets, culverts, and outlet structures. The estimated thickness of the surficial materials under the constructed roadway is up to 90 ft.

Flat Canyon Campground & Facilities (Recreation)

The Flat Canyon Campground facility is operated by the Manti-La Sal National Forest and consists of camping areas with associated freshwater impoundments and toilet facilities.

The Campground is located at the junction of Flat Canyon and Boulger Canyon overlooking the Boulger Dam and Reservoir. There are several prepared campsites located within a forested area on a gentle slope, together with centrally located restrooms. Water supply to the campground is from a spring located approximately 3,000 ft. southwest along Boulger Canyon. Access roads to the campsites and the sites themselves are all of flexible construction. Details of the restroom facilities, indicate a wood frame superstructure supported on a 6.5 inch reinforced concrete pad integral with a below grade storage vault approximately 12 ft. long, 7 ft. wide and 4 ft. deep.

A small aluminum tied-back retaining wall impounds a small headpond at the spring location that feeds into a short length of 4" cast iron pipe to a valve and vent, and then into a 2" galvanized steel pipe to the campground. At the campground, the galvanized steel pipe feeds into a buried 3,000-gallon fiberglass tank that in turn feeds 7 hydrants and the restrooms. The system is gravity fed and contours shown on the plans supplied by the Forest Service indicate a head differential of approximately 5 ft.

Private Cabins & Buildings (Recreation, Transportation))

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Within the area influenced by mining in the project area there are a number of privately owned cabins in Flat Canyon and Swens Canyon. The cabins include access roads and spring developments.

The four private cabins within the project area in Flat Canyon and the one in Swens Canyon are relatively modest log or timber frame structures supported on concrete strip or pad foundations. There are some other properties further along Flat Canyon and up Little Swens Canyon, but these are outside the area under consideration.

Hunt Reservoir Dam (Recreation)

This is a small earthen dam located at Camp Shalom in Swens Canyon outside of the project area but within the cumulative effects area regarding mining-induced seismicity. The capacity of the reservoir is small and is operated to contain water only during the summer use season for the

camp facilities. The camp facilities are extensive with several buildings, native surface access roads, camp loops, and a trail system.

3.1.5 Surface Water

Climate/Rainfall

The study area is located in an area of subalpine climate. Precipitation is measured at the Skyline Mine surface facility in Eccles Canyon east of the study area. Between 1985 and 1995 the annual (calendar year) precipitation ranged from 17.2 to 29.4 and averaged 23.9 inches (Mayo and Associates, 1996). Monthly average temperatures at the mine range from 8.0 to 74.4 °F (CFC, 1999).

The National Resource Conservation Service (NRCS) maintains two high elevation precipitation stations east of the study area. During the period 1961-1990 (NRCS, 1995) the average annual precipitation was 29 inches at the Mammoth-Cottonwood Station (elevation 8,800 feet), and 33 inches at the Red Pine Ridge Station (elevation 9,200).

The project area is in a region that experienced several extremely wet years during the early and mid 1980s, followed by an extended drought from 1987 to 1993. Since 1993, the region has enjoyed mostly wet conditions. However, beginning in January 2000 the region entered a drought period. It is important to note that most baseline hydrologic collection occurred during the moderately wet period in the late 1990s.

Project Area Drainage

The project area that includes the Flat Canyon Tract and adjacent private lands that could be mined in conjunction with the tract lies almost entirely within the Huntington Creek Watershed. A small portion of the project area along the southwest boundary lies within the Price River Watershed.

All surface waters in the project area, with a single exception, drain into Upper Huntington Creek, which is a tributary of the San Rafael River. The San Rafael River flows into the Green River approximately 80 miles southeast of the study area. A small portion (< 6%) of the study project area is in the Upper Gooseberry Creek drainage. Upper Gooseberry Creek flows into Fish Creek above the Scofield Reservoir on the Price River. The Price River flows into the Green River approximately 60 miles southeast of the project area. The region of investigation for this analysis is an area of approximately 12.7 square miles. Perennial stream reaches have been identified in Boulger, Flat, Swens, Little Swens, and Cunningham Canyons. Upper Huntington Creek, which defines the northern and eastern boundaries of the study area, is also a perennial stream. In order to simplify the characterization and analysis of surface water systems in the study area, the surface water drainages have been divided into sub-basins. These sub-

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basins are shown on Figure 3.3. Also shown on this Figure are the reaches of the individual streams that have been classified as perennial for this analysis.

Several drainages that have not previously been classified as perennial were determined to possibly be perennial as a part of this study. These reaches are shown on Figure 3.3. Determinations of possibly perennial reaches were based on field observations of streamflow and vegetation types and through inspection of aerial photographs.

Both ephemeral and perennial drainages in the project area are supported in the late winter and spring months by the annual snowmelt event. Because of the large quantities of snowmelt water relative to the amount of groundwater that can be stored and discharged from shallow groundwater systems in the area, perennial streams commonly have high-flow discharge rates that exceed their low-flow baseflow discharge rates by many times.

Perennial streams in the project area exist where 1) there is adequate groundwater recharge and subsurface storage capacity in the drainage basins to sustain discharge from shallow groundwater systems throughout the year and 2) there is a low-permeability confining layer beneath the stream that prevents downward percolation of water in the stream channel (i.e. the stream is perched).

Field observations during 1997-2000 suggest that the perennial streams in the project area are generally gaining streams. Observations of stream conditions in the springtime and late fall suggest that this condition persists throughout the year. The streams gain flow from discharge from shallow groundwater systems in the form of springs, seeps, and discharge directly to the stream channel. These are common along the lengths of the perennial drainages. Figure 3.4 shows water monitoring points, including streams, springs, wells, and water discharge points.

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The specific characteristics of each sub-basin in the project area are described below.

Flat Canyon Sub-Basin

The Flat Canyon sub-basin includes an area of 1.76 square miles, which is approximately 13.8% of the study area. The gradient in Flat Canyon, approximately 0.93%, is the lowest of any of the sub-basins in the project area. Flat Canyon is so called because of the broad, flat-bottomed valley floor through which Flat Canyon Creek flows. The broad riparian corridor in Flat Canyon is up to 1,000 feet wide. Flat Canyon Creek in its upper reaches, where it meanders through the broad alluvial valley, is an E5 stream type. This reach is dominated by run features. The channel substrate underlying the creek in Flat Canyon consists primarily of thick saturated glacio-lacustrine sediments. The sediments along the margin of the canyon are approximately 80 feet thick, consisting mostly of sand.

In the lower reaches of Flat Canyon Creek, the channel is more deeply incised and the gradient is much steeper (3%). This reach is a B3 type (Rosgen, 1996), which consists primarily of riffles with less than 5% pools. The banks in this reach are well vegetated and stable. The substrate in

lower Flat Canyon Creek consists primarily of cobbles and boulders. It appears well armored and stable.

The north-facing canyon walls in Flat Canyon are vegetated with dense conifer forests. Portions of these conifer stands have recently undergone logging. The south facing canyon walls are vegetated primarily with scattered, dense stands of quaking aspen. Flat Canyon creek is separated from the underlying coal seams by 1,000 to 1,800 feet of overburden.

Discharge and water quality at Flat Canyon Creek were measured in October 1999 and July 2000 (NorWest, 2000a). The October discharge measurement was 91 gpm while the July measurement was 215 gpm. The water in Flat Canyon Creek during October was of the calcium-bicarbonate chemical type with a TDS concentration of 169 mg/l.

Boulger Canyon Sub-Basin

The Boulger Canyon sub-basin, which occupies approximately 3.92 square miles, or 30.8% of the study area, is the largest of the sub-basins. Included in this area are the upper drainage (above Boulger Reservoir), which is approximately 3.22 square miles in area, and the lower drainage, which occupies an area of approximately 0.70 square miles (Figure 3.3). Boulger Creek is a third order stream that flows to the northeast where it joins Flat Canyon Creek and then flows into Electric Lake. The gradients on Boulger Creek are steeper than are those of the adjacent Flat Canyon creek. The gradient on the main reach below the confluence of the two forks and above the reservoir averages 1.7%.

The reach of Boulger Creek extending from below the upper forks to Electric Lake contains sections that are C3, E3, and B3 (Rosgen, 1996). The stream in this area, which meanders tightly, is 8-10 feet wide and is dominated by riffles and runs with a channel depth ranging from 6 inches to 2 feet. The substrate in areas of low gradient appears stable and well armored. It is composed of approximately 50% cobbles, 15% gravel, and 35% sand/silt. The stream banks in this portion of the drainage are well vegetated and appear stable. The drainage in this area supports a moderately wide strip of riparian vegetation up to approximately 350 feet wide along the valley bottom. Much of the riparian vegetation along the margins of the valley bottom appears to be supported by inflows of alluvial and colluvial groundwater from the lower canyon walls. This groundwater also provides recharge to the creek.

Approximately 1,800 feet above the confluence with Electric Lake, a small unnamed tributary to Boulger Creek enters from the south side of the canyon (Figure 3.3). This stream appears to be perennial based on the narrow corridor of riparian vegetation that exists along and adjacent to the stream channel. Discharge and field parameters were measured in this drainage by Mayo and Associates during October 1999 and July 2000. On both occasions water was flowing in the stream. The stream was flowing at 32.8 gpm during July 2000. Inspection of aerial photographs suggests that the stream has the appearance of being perennial for a distance of approximately one-half mile above the confluence with Boulger Creek.

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The right (north) fork of Boulger Creek has an average gradient of approximately 4.3%; however, several stream segments have gradients less than 3%. There is a narrow strip of riparian vegetation associated with this reach of the creek. The first approximately 1,800 feet of this drainage, is a B3 stream type. The channel substrate in this reach is made up of material ranging from 2-inch gravels to 12-inch and greater cobble/boulder material. Runs and riffles make up approximately 60% of the stream, with approximately 40% pools. Raleigh Consultants (1992) noted sedimentation in the right fork of Boulger Creek that was attributed potentially to inactive beaver dams. The next approximately 2,000 feet of the right fork consists of a meandering C3 stream type. The channel in this reach is approximately 10 feet wide and 6 inches deep. The stream contains approximately 80% riffles and runs and 20% pools and the substrate in this reach is made up of approximately 50% cobbles, 20% sand and silt, and 35% gravel. The stream banks appear stable. The final approximately 5,000 feet in the uppermost portion of the drainage is a steep, A2 or B2 stream type with riffles comprising about 90% and pools 10%. The width of the stream in this reach is approximately 5 feet, with depths ranging from 4 inches in the riffles to 1 foot in the pools. The substrate in this reach is dominated by large cobbles, boulders, and bedrock.

The left (south) fork of Boulger Creek is a steep drainage with an average gradient of approximately 7.5%. The channel in the lower reach of the left fork is a A3 channel, while the upper, headwaters area is a C5 or E5 type. The channel substrate in the lower part of the south fork is comprised of large cobbles and boulders. In the headwaters region of the left fork, a large wetland is present in a glacial cirque. The stream channel substrate in this region consists primarily of fine-grained alluvial material. Much of the baseflow of the left fork of Boulger Creek originates from springs along the margins of wetland and groundwater from the wetland itself.

The depth of cover separating Boulger Creek from the coal seams that may be mined ranges from 700 feet in the lower reaches near Electric Lake to more than 2,200 feet in the headwaters areas.

Discharge and water quality in Boulger Creek have been monitored at C-4, C-7, and C-8 (Figure 3.4). Discharge has been periodically measured at C-4 (below the confluence with Flat Canyon creek) since 1997. The maximum measured discharge, 3,120 gpm, occurred during July 1999. A minimum flow of 450 gpm was measured during October 1999. Streamwater in Boulger Creek is of the calcium-bicarbonate chemical type. TDS concentrations at C-4 have remained relatively constant during the baseline monitoring period, ranging from 140 to 190 mg/l.

Boulger Reservoir is a man-made water body with a surface area of approximately 4.52 acres with a storage capacity of 45 acre-feet. The reservoir is a popular recreation site for fishing, swimming, and rafting. Boulger Reservoir is separated from the underlying coal seams by approximately 1,200 feet of cover. Comparison of discharge and water quality measurements from C-8 (immediately above the reservoir) and C-7 (immediately below the reservoir) suggests that the water quality of Boulger Creek is not degraded as a result of being in the reservoir.

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Swens Canyon Sub-Basin

The Swens Canyon sub-basin occupies 2.33 square miles or 18.4% of the study area. The stream drains eastward into Upper Huntington Creek, with a gradient averaging 3.1%. Swens Canyon Creek is a third order stream that meanders tightly, particularly in the lower reaches of the drainage. The stream banks and adjacent areas are heavily vegetated with riparian vegetation and appear to be relatively stable. Swens Canyon Creek appears to be a gaining stream over its entire reach.

Along the length of Swens Canyon Creek, there is evidence that the hillsides have periodically encroached into the stream channel resulting in impounding of the stream. These encroachments appear to be the result of mass movement (i.e. hillside slumping) of the Blackhawk Formation sediments that compose the hillsides. The fact that the lowermost canyon slopes are commonly wet from groundwater seepage may be a contributing factor to the frequency of mass movements. It is evident that the drainage has also been periodically dammed in many locations by beavers. As a result of these occurrences, thick sections of sediment have been emplaced by stream deposition in the backwater areas that existed when the stream was dammed, while adjacent areas have not experienced that degree of sedimentation. These conditions, in conjunction with changes in geologic formation or geologic structure underlying the stream bottom, have resulted in a somewhat stair-stepped topography in the canyon bottom.

The lower 5,000 feet of the stream channel in Swens Canyon is comprised of fine-grained material interspersed with gravel, cobbles, and occasional boulders. This reach is a C3 type. This reach of the stream consists of approximately 80-90% runs and riffles, and 10-20% pools. In this reach the stream meanders tightly and the stream channel is well incised in its channel. Groundwater inflows are apparent along much of the extent of this reach of the drainage. These commonly consist of small springs or seepage fronts that emerge near the transition between the valley bottom and the canyon walls.

A small tributary to Swens Canyon Creek enters from the south approximately 1,000 feet above the confluence with Upper Huntington Creek. This tributary, which extends for approximately one-half mile, appears to possibly be perennial based upon the well-established riparian vegetation along the stream banks. No baseline discharge data are available for this tributary. However, it was noted by Mayo and Associates that there was appreciable flow in the drainage during October 1999 and again in July 2000.

The North Fork enters Swens Canyon Creek approximately 3,000 feet above the confluence with Upper Huntington Creek (Figure 3.3). This tributary is approximately 2,500 feet in length and is very steep. The average channel gradient is approximately 13.8%. This stream reach appears to possibly be perennial based upon the well-established riparian vegetation along the stream banks. No baseline discharge data are available for this tributary. However, it was noted by Mayo and Associates that there was appreciable flow in the drainage during October 1999 and again in July 2000. Much of the baseflow discharge to the stream originates from a series of springs discharging from colluvial groundwater systems in its headwaters region.

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In the reach of Swens Canyon Creek extending from the confluence with the North Fork and upstream for approximately 3,500 feet the stream channel narrows considerably. In this reach, the channel substrate is dominated by cobbles and boulders. In some locations, bedrock outcrops are visible in the channel bottom. The channel, which meanders slightly in this reach, contains many active and inactive beaver dams.

In the headwaters reaches of Swens Canyon Creek, the valley broadens into a region of wide meadows and grasslands. The stream channel in this reach is a narrow A2 type. Many springs and groundwater seepages enter the stream channel from the lower hillsides adjacent to the stream.

Swens Canyon Creek is separated from the underlying coal seams by 800 feet of cover at the confluence with Upper Huntington Creek to approximately 2,400 feet of cover in its headwaters area.

Swens Canyon Creek has been monitored by Canyon Fuel at C-3 since 1997 (Figure 3.4). Discharge has ranged from 30 gpm during October 1998 to 300 gpm during both July 1998 and July 1999. The water in Swens Canyon Creek is of the calcium-bicarbonate chemical type. Baseline TDS concentrations in Swens Canyon Creek have ranged from 177 to 213 mg/l.

Little Swens Sub-Basin

Little Swens Creek flows northeast from highland areas toward its confluence with Upper Huntington Creek. The basin encompasses an area of 0.98 square miles, which is 7.7% of the study area. The drainage is steep, with a stream gradient of approximately 5.9%. Little Swens Canyon Creek is a tightly meandering stream with relatively stable, well-vegetated stream banks. Like the adjacent Swens Canyon drainage, there is evidence of a long history of encroachment of hillsides by mass movement onto valley floor. There is also evidence of a long history of beaver dam construction in the drainage. These conditions have resulted in accumulation of sediment in some areas with considerably less sediment in other areas resulting in a somewhat stair-stepped topography on along the canyon bottom.

The stream channel in the lower approximately one-half mile of the drainage is a Rosgen (1996) B3 type. The valley bottom in this reach is approximately 30 feet wide. The channel substrate in this reach consists of gravel, cobbles, and boulders. Generally, the stream channel in Little Swens Canyon is more dominated by rocky material and appears to have less fine-grained material in the substrate than does the adjacent Swens Canyon. The stream banks in this reach are heavily vegetated and appear stable.

In the next 1,000 feet of the drainage, the channel narrows slightly and the channel substrate is dominated by boulders and bedrock. This reach appears to have been impacted considerably by beaver dams and encroachment of the lower canyon walls into the drainage by mass movement. This reach of the drainage is a Rosgen (1996) A2 type.

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A small reservoir has been constructed in the upper reaches of this drainage. This pond has a surface area of approximately 3.15 acres and is used for recreation purposes by a privately owned girl's camp that surrounds the pond.

The Little Swens Canyon drainage is separated from the underlying coal seams by 1,100 feet of overburden near the confluence of the stream with Upper Huntington Creek. In the headwaters regions, the overburden is approximately 2,100 feet. The overburden between the reservoir at the girl's camp and the coal seams ranges from about 1,900 to 2,000 feet

Baseline water quality and discharge measurements have been performed on Little Swens Canyon Creek at C-2 from 1998 to 2000 (Figure 3.4). Discharge at C-2 has varied from 16 gpm during October 1998 to 211 gpm during July 1998. Discharge in the creek is of the calcium-bicarbonate chemical type. TDS concentrations have ranged from 151 to 214 mg/l.

Cunningham Canyon Sub-Basin

The Cunningham Canyon sub-basin, with an area of 0.92 square miles, is a relatively small drainage located near the southern margin of the project area. Cunningham Canyon Creek is an easterly flowing drainage that flows into Electric Lake in the Upper Huntington Creek drainage. The drainage has a steep gradient, averaging 8.0%. The channel substrate in the upper reaches is dominated by cobbles and boulders. In the lower reaches, near the confluence with electric lake, the channel substrate is dominated by fine-grained materials including silt and soil. The stream is entrenched below the land surface by approximately 1 to 2 feet in the lower reaches of the drainage. Riparian vegetation along the stream banks and adjacent flood plain in the lower reaches of the canyon is dense and the stream channel appears stable.

Water quality and discharge have been monitored by CFC at C-5 (Figure 3.4) from 1997 to 2000. Discharge at C-5 has varied from 20 gpm in October 1998 to 162 gpm during October 1997. TDS concentrations at C-5 have varied from 118 to 165 mg/l.

The Cunningham Canyon drainage is separated from the coal seams by 700 feet in its lower reaches near Electric Lake to approximately 1,900 feet in the headwaters area.

Upper Huntington Creek Sub-Basin

Within the project area there are a series of unnamed ephemeral drainages to Upper Huntington Creek (Figure 3.3). These drainages, on the steep western slope of Upper Huntington Creek, range in size from 0.4 to 0.78 square miles. Gradients of the unnamed Upper Huntington Creek sub-basins are all very steep, ranging from approximately 17% to 32%.

None of these drainages are known to support perennial streams. One intermittent stream located immediately south of Little Swens Canyon (Figure 3.3) was monitored for discharge and field parameters by CFC in July 2000. Discharge from this stream was 7 gpm.

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The overburden separating the unnamed Upper Huntington Creek drainages from the coal seams ranges in thickness from approximately 700 feet near Electric Lake to more than 2,000 feet in the highland areas above Huntington Canyon

Upper Gooseberry Creek Sub-Basin

A small portion (0.73 square miles, less than 6%) of the project area drains to the Upper Gooseberry Creek drainage. Gooseberry Creek drains to the north-northwest and flows into Fish Creek which discharges to Scofield Reservoir. While Upper Gooseberry Creek near the project area may possibly be perennial, the stream itself is beyond the project area and would not be undermined. For this reason, this stream has not been investigated.

All of the Upper Gooseberry Creek sub-basin within the project area is separated from the coal seams by more than 1,500 feet of cover.

Electric Lake

Electric Lake lies in Huntington Creek just east and south of the project area. The upper reaches or the reservoir above the dam lie within the Skyline Mine Permit Area. The dam was constructed in 1974 by Utah Power and Light Company (currently PacifiCorp Electric Operations) as a source of water for operation of the Huntington Canyon Power Plant. Construction and operations were authorized under a Forest Service Special-Use Permit issued in 1973. The reservoir covers an area of approximately 425 acres and has a capacity of approximately 44,000 acre-feet of water. PacifiCorp monitors quality of the reservoir at the inflow and outflow of the reservoir. A conservation pool for fish is maintained in the reservoir. The lake and Huntington Creek have been designated as protected by the Utah Division of Drinking Water (UAC R317.2) for 1) secondary contact recreation such as boating, wading, or similar purposes, 2) cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain, and 3) agricultural uses including irrigation of crops and stock watering. Huntington Creek has also been designated as protected for domestic purposes with prior treatment by processes required by the Utah Division of Drinking Water. The water quality is very good (personal communications with Theron Miller, Utah Division of Water Quality, Report on Scofield Reservoir and Electric Lake, 2001). It is considered moderately hard with a hardness concentration value of approximately 111 mg/l ($CaCO_3$). The only parameters that have exceeded State water quality standards for defined beneficial uses are pH and dissolved oxygen during periods of high algal production near the surface during daylight hours. Average values throughout the water column do not exceed criteria. DWQs 1991 data indicates that the reservoir is probably phosphorus limited.

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Existing Skyline Mine Permit Area Drainage Relative to Mine Water Discharge

The Skyline Mine Permit Area lies in both the Huntington Creek and Price River Watersheds. Trough Springs Ridge trends north-south and separates these watersheds. Drainages to the west

of this divide drain into Upper Huntington Creek. Drainages to the east drain into Mud Creek that empties to Scofield Reservoir. Eccles Creek is the largest of the drainages in the Permit Area on the east side of the divide. Burnout Canyon Creek and James Canyon Creek are perennial and are the two largest drainages on the west side of the divide that drain into Huntington Creek.

Water produced in the underground workings of the Skyline Mine has historically been discharged into Eccles Creek just below the Forest Boundary, as authorized by a UPDES (Utah Point Discharge Elimination System) discharge permit issued by the Utah Department of Water Quality. Station CS-12 represents discharge from Mine 3 and CS-14 represents discharge from Mine 1. CS-4 is a monitoring station in Eccles Creek above the discharge point. The general locations of these stations are shown on Figures 3.3 and 3.3a, labeled as UPDES 001 (point of discharge under the UPDES permit).

Eccles Creek drains to Mud Creek, then into Scofield Reservoir. These drainages and the reservoir lie within the Price River Watershed. The discharge locations are shown on Figure 3.3a.

Scofield Reservoir and the Price River and its tributaries have been designated as protected by the Utah Division of Drinking Water (UAC R317.2) for 1) domestic purposes with prior treatment by treatment processes, 2) secondary contact recreation such as boating, wading, or similar purposes, 3) cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain, and 4) agricultural uses including irrigation of crops and stock watering.

Scofield Reservoir occupies an area of approximately 2,800 acres. The capacity is approximately 74,000 acre-feet. It supports a fishery and is used as a culinary and agricultural water source, as well as for recreation as classified above. The water quality is considered fair. It is considered to be hard with a hardness concentration value of approximately 187 mg/l ($CaCO_3$). Scofield Reservoir is listed in the State of Utah's 2000 list of impaired water bodies. The parameters of concern are dissolved oxygen and total phosphorus. The total maximum daily load allocation (TMDL) established by the State and approved by EPA targets a 28% reduction in total phosphorous loading. The TMDL is based on load allocations prepared for Clean Lakes Studies in 1983 and 1990 and additional water quality sampling in 1997 and 1998.

Prior to January 2001, the combined water discharge from Skyline Mine to Eccles Creek was generally less than 1,000 gpm. After January 2001 and until August 2001, the average discharge to Eccles Creek was 2,500 gpm. In August 2001 Canyon Fuel mined through a fault that discharged large amounts of water into the underground workings. The water was pumped to abandoned sections of the mine. In late August, the inflow exceeded capacity and Canyon Fuels pumping capacity. In September, two angled boreholes were drilled from the ground surface in James Canyon above Electric Lake into the Starpoint Sandstone at the fault. The Starpoint Sandstone lies below the coal seams in the overlying Blackhawk Formation. Water pumping started in October and continues to the present in an effort to dewater the underground aquifer

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gaining stream flows. Groundwater discharge from this type of system occurs primarily along the bottoms of canyons. Some groundwater discharge occurs higher on a number of hillsides because of 1) local breaks in slope such as in the head of Swens Canyon where glacial moraine materials create a less steep slope, or 2) groundwater in permeable shallow bedrock, such as a sandstone paleochannel or the Castlegate Sandstone, encounters a less permeable bedrock horizon.

Storage in colluvial/shallow bedrock groundwater systems is small because of the generally limited depth of colluvial and shallow bedrock materials, short flow path lengths, relatively large hydraulic conductivities, and relatively steep hydraulic gradients. Consequently, this type of groundwater system is acutely sensitive to seasonal and climatic variations in precipitation. Seasonal and climatic dependence is demonstrated by variations in spring discharge rates. Discharge from springs is typically greatest in the springtime and declines appreciably during the summer and fall months. A number of springs had lower discharges in springtime 2000 than during previous spring. This reflects sensitivity to climatic changes such as the drought conditions that the region has seen since the beginning of 2000.

Spring and seep survey data also indicate the dependence on seasonal recharge. The total discharge from all of the springs located in the fall 1997 survey was 1,073 gpm. During the following spring the total discharge was 2,895 gpm, a nearly three-fold increase. Although these data were not collected during the same snowmelt recharge cycle, both surveys were conducted during similar moderately wet climatic conditions.

That springs respond quickly to season and climate suggests that time between recharge and discharge in colluvial/shallow bedrock groundwater systems is less than one year. As noted, much of the baseline discharge data for these springs have been collected during a lengthy wet-spell. Because of the heavy climatic dependence of these springs, it is expected that many of the springs in the study area would have much lower discharge rates or dry up in drought years.

CFC has collected unstable isotopic data from five springs in the study area (NorWest 2000a). All spring waters sampled in the study area contain anthropogenic carbon and abundant tritium. These compositions indicate that recharge to the groundwater systems supporting discharge from these springs occurred within the last approximately 50 years.

Boulger Canyon Alluvial Groundwater System

Alluvial sediments deposited in the relatively broad-bottomed portions of Boulger Canyon support groundwater. A distinct groundwater system has been designated for these sediments because of the comparatively larger depth and extent of these deposits relative to other, much steeper canyons in the Project area. The depth of this alluvium is known in one location where exploration drilling (drill hole 99-4-1; Figure 3.4) encountered 40 feet of alluvial sediments.

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Groundwater in these sediments is recharged largely by interflow from colluvial/shallow bedrock groundwater systems. During dry times Boulger Creek could also provide recharge. However,

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visual observations of the creek by the principal authors suggest that Boulger Creek is a gaining creek year round, suggesting that discharge from the alluvial groundwater system is predominately to the creek.

Flat Canyon Groundwater System

Exploration drilling by CFC in the Flat Canyon area has revealed that there is a thick deposit of unconsolidated sediments in the canyon. Drill logs for wells 98-32-1 and 95-33-1 were provided for review by CFC. The locations of these two wells are indicated on Figure 3.4. The drill logs indicate that these sediments are 70 to 90 feet thick on the margins of Flat Canyon. These sediments consist primarily of sand and gravel with only minor fine-grained materials, and thus are expected to be fairly permeable. Inspection of geomorphology in air photos and in the field suggests that these alluvial sediments were likely deposited in an impoundment created by the glacier(s) in Boulger Canyon and the lateral and terminal moraine deposits of the Boulger Canyon glacier(s). Glacial moraine deposits typically have low hydraulic permeability (Freeze and Cherry, 1979). Consequently, water is largely impounded in glacio-lacustrine sediments behind the lateral and end moraines at the confluence of Flat and Boulger Canyons. Because of the thickness, lateral extent, and saturation of these deposits, the Flat Canyon glacio-lacustrine sediments have been designated as a distinct groundwater system.

Discharge from colluvial/shallow bedrock groundwater systems provides the bulk of recharge to the Flat Canyon glacio-lacustrine sediments.

A large portion of the discharge from the Flat Canyon groundwater system occurs directly to Flat Canyon Creek. Flat Canyon Creek does not appear to be fed by perennial creeks in any of the side drainages. Rather, Flat Canyon Creek appears to gradually gain flow throughout the year along its course due to discharge from springs and groundwater discharge directly to the creek.

A limited amount of water is also transmitted from the Flat Canyon alluvium through the glacial moraine deposits. This water supports several small wet areas on the hill slope west of Boulger Reservoir. Groundwater discharge from the Flat Canyon alluvium at this location has not been quantified or monitored. It is believed that this groundwater discharge is largely consumed by transpiration due to the presence of phreatophytes on the hillside. It is expected that because of the large storage volume in the Flat Canyon glacio-lacustrine sediments, that discharge in this location will be essentially constant even during drier climatic cycles.

Discharge from the Flat Canyon groundwater system may also occur via underflow through the basal moraine deposits or bedrock underlying the moraine deposits. Any underflow would recharge the glacial/alluvial sediments below the moraine and would ultimately discharge to either Boulger Creek below the reservoir or via groundwater inflow to Electric Lake. A small amount of water may also migrate downward and recharge underlying bedrock. However, there is no evidence suggesting that discharge occurs via these two mechanisms.

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Deep Blackhawk Formation Groundwater Systems

Deep Blackhawk Formation groundwater systems occur at depths greater than about 150 feet. They have been encountered in underground workings at the Skyline Mine and by exploration drilling in the Project area (CFC, 1999). These systems occur in paleochannel sandstones that are encased in three dimensions by relatively impermeable mudstones and shales. Consequently there is poor hydraulic communication between sandstones both laterally and vertically. Groundwater in these sandstone channels may occur under unconfined or confined conditions. Confined conditions in the underlying Star Point Sandstone attest to the ability of fine-grained units in the Blackhawk Formation to act as substantial barriers to vertical groundwater flow.

Experience at Skyline Mine and other mines in the Wasatch Plateau indicates that coal seams themselves do not bear water; in fact, water must be used to control dust as coal is cut by mining equipment.

The mechanics of deep Blackhawk Formation groundwater systems are not as well understood as the mechanics of near surface groundwater systems described above. Mining encounters groundwater in these systems at a point along the flow path but recharge and discharge locations are not obvious. Groundwater flow direction is estimated to be in the direction of bedrock dip (westward).

Mayo and Associates (1996) have determined that groundwaters in the deep Blackhawk Formation groundwater system have radiocarbon ages of 2,500 to 18,500 years and contain essentially no tritium. This suggests that these systems are hydraulically isolated from the surface and that groundwater flow is likely slow. The stable isotopic ratios of mine inflow waters are considerably more negative than shallow subsurface groundwaters, suggesting that these waters likely recharged anciently under cooler paleoclimatic conditions such as glacial periods.

Mayo and Associates (1996) cite several other lines of evidence to demonstrate that deep Blackhawk Formation groundwater systems are discontinuous and hydraulically isolated from the surface (and recharge sources). First, a 192-foot long upward well was constructed in the roof of the Lower O'Connor A Seam (Hydrometrics, 1987). The well only encountered groundwater at the 40-, 100-, and 120-foot intervals while all other horizons were dry. Similarly, a 128-foot deep well in the floor of the mine intercepted water at 98 feet. From the bottom of the mine to 98 feet the rock was not saturated. Second, discharge rates decline rapidly in newly exposed roof drips. Lastly, the total mine water discharge rate does not increase appreciably with time despite the fact that the total mined area continues to increase. The rate of discharge from mine workings is dependent on the rate of coal production and the timing of the encounter of large water-bearing features.

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Faults do not appear to be important in the conveyance of water in the deep Blackhawk Formation groundwater system. CFC (1999) reports that of the 44 individual fault planes that were encountered prior to 1999, groundwater inflows occurred from only five. Four of the five

appeared to intersect water-saturated sandstone paleochannels in the mine roof. Indeed, experience has indicated that most water-bearing faults encountered in Wasatch Plateau coal mines are associated with sandstone paleochannels. Thus, it is not anticipated that in the project area, large volumes of water would be encountered in faults in the Blackhawk Formation. Recently large groundwater inflows have occurred in the Skyline Mine from two faults; however, these appear to be connected with the Star Point Sandstone and are discussed in the next section.

Potential discharge locations of deep Blackhawk Formation groundwater systems have not been identified. Due to the estimated low flow rates in this type of groundwater system, groundwater discharge at the natural discharge location is not expected to be large in magnitude and thus would be difficult to identify. Nevertheless, because of the westward dip of rocks in the Skyline Mine area and the Project area, groundwater in deep perched bedrock groundwater systems likely discharges, under natural conditions, west of the Project area. However, there are no outcrops of the lower Blackhawk Formation west of the project area. Instead, the lower Blackhawk Formation is dissected by the East Gooseberry Fault west of the study area (Figure 3.1), which likely hinders further westward groundwater flow.

Experience in the Wasatch Plateau suggests that large-offset faults are generally barriers to lateral flow across a fault due to the presence of low-permeability fault gouge. If the East Gooseberry Fault is indeed a barrier to horizontal flow across the fault, then groundwater flow is diverted at the fault in some direction along the fault. The damage zone (rock on either side of the fault that is fractured due to faulting) likely facilitates and supports groundwater flow along the fault. It is doubtful that groundwater from deep Blackhawk Formation groundwater systems discharges to the surface along the surface trace of the East Gooseberry Fault because deep perched systems would not have sufficient hydraulic head.

Starpoint Sandstone Groundwater Systems

As described in the Physiography and Geology sections of this chapter, the Star Point Sandstone is comprised of two sandstone members, the upper Storrs Tongue and the lower Panther Tongue. Mining at the Skyline Mine has encountered water associated with both the Storrs Tongue and the Panther Tongue. Because of the westward dip of the bedrock, there is a high probability that mining in the project area would encounter additional inflows of water from the Star Point Sandstone.

The Storrs Tongue interfingers with the Blackhawk Formation and divides the Lower O'Connor A Seam from the Flat Canyon Seam. However, in the western portion of the project area, the Storrs Tongue pinches out and the Lower O'Connor A Seam and the Flat Canyon Seam merge. The Panther Tongue underlies the Flat Canyon Seam, the lower-most seam where mining would occur in the project area. The Flat Canyon Seam is separated from the Panther Sandstone by 15-30 feet of shale, mudstone, and thin coals.

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The tongues of the Star Point Sandstone are laterally more extensive than individual sandstones in the overlying Blackhawk Formation. It is anticipated that over larger areas, such as the Skyline Mine and project areas, each tongue operates as a single groundwater system. However, it is not believed that the Star Point Sandstone is a regional aquifer in the sense that there is hydraulic continuity throughout the Wasatch Plateau.

The mechanics of Star Point Sandstone groundwater systems are not well understood. The Star Point Sandstone is exposed in Pleasant Valley east of the Skyline Mine area and the project area and dips westward. This suggests that recharge occurs in the east and groundwater flow is to the west. Because of the inclination of the formation and the low hydraulic conductivity of Blackhawk Formation shales and mudstones overlying the Star Point Sandstone members, confined groundwater conditions are created. Similar confined conditions in the Star Point Sandstone have been observed at other coal mines in the Wasatch Plateau such as the Trail Mountain Mine.

Large groundwater inflows from faults have recently been encountered in the workings of the Lower O'Connor Seam in the Skyline Mine. CFC (1999) reports that a fault with approximately 8 feet of offset was encountered during development of the 14L Headgate. The fault initially produced water from the roof and the floor at a rate of 1,200 to 1,400 gpm. Discharge from the roof ceased after a short period but water still continues to be produced from the floor. A second fault along the same trend was encountered in the 16L Headgate. This fault produces 300 gpm of water from the floor. It is believed that this water discharges from the Panther Tongue of the Star Point Sandstone.

Mayo and Associates (1999a) report that groundwater inflows to the Skyline Mine from the Star Point Sandstone have radiocarbon ages greater than 13,000 years and contain no tritium. This suggests that groundwater flow through the Star Point Sandstone is slow and that there is limited hydraulic communication with the surface. Slow flow rates in the Star Point Sandstone are substantiated by the measurement of hydraulic conductivity in other areas of the Wasatch Plateau. At the Crandall Canyon Mine in the Huntington Canyon area, slug testing revealed a hydraulic conductivity of 4.8×10^{-8} to 7.4×10^{-8} ft/s (Mayo and Associates, 1997a). Bills (2000) determined a hydraulic conductivity of 4.06×10^{-6} ft/s for the Star Point Sandstone in the Straight Canyon area. This latter result is higher than the first because of fracturing associated with the Straight Canyon syncline.

The Starpoint Sandstone does not crop out west of Pleasant Valley. Consequently discharge locations for Star Point Sandstone groundwater systems have not been observed in the study area. The Storrs Tongue pinches out in the project area indicating that groundwater is not transmitted westward beyond the study area by the Storrs Tongue. As noted in the previous section, the East Gooseberry Fault truncates the bedrock formations west of the project area. This fault is presumed to be a barrier to lateral flow across the fault. This being the case, groundwater flow is diverted at the fault in some direction along the fault and flow is accommodated in the damage zone of the fault. Potentiometric levels in two monitoring wells, 99-21-1, and 99-28-1 (Figure 3.4), in the project area that are completed in the first sandstone

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below the Flat Canyon Seam (which may be the Panther Tongue) suggest that the hydraulic head in the Panther Sandstone (elevation 8,419 and 8,515 feet, respectively) is not sufficient to cause water to discharge at the surface trace of the East Gooseberry Fault (elevation greater than about 8,800 feet, directly west of the project area).

Although it is not known where groundwater in the Star Point Sandstone in the study area ultimately discharges, it can be surmised with some certainty that groundwater in the Star Point Sandstone in the study area is not in hydraulic communication with the Star Point Sandstone groundwater systems that supply water to the large-discharge culinary water supply springs in Huntington Canyon (Big Bear, Little Bear, or Birch springs). First, as noted above, the radiocarbon ages of Panther tongue water encountered at the Skyline Mine is 13,000 years. The radiocarbon ages of groundwater that discharges from the Huntington Canyon Springs (Mayo and Associates, 1997b; Mayo and Associates, 1999b) are summarized below.

Spring	Radiocarbon Age
Birch Spring	1,700-3,600 years
Big Bear Spring	Mixed; 3,500-4,500 years
Little Bear Spring	Modern

Because water in the Star Point Sandstone in the study area has appreciably greater radiocarbon ages, it is unlikely that this water is hydraulically connected to the Star Point Sandstone in the Huntington Canyon. Second, the East Gooseberry Fault, the surmised location for groundwater discharge from the Panther Tongue, is not structurally connected to fault systems in the vicinity of the Huntington Canyon springs. The Huntington Canyon springs discharge in and near the Pleasant Valley Graben and associated faults whereas the Gooseberry Graben is on the same trend as the Joes Valley Graben.

Water Quality

Groundwater discharge from springs in the study area is low-TDS, calcium-bicarbonate water. For springs that have been monitored for baseline water quality, the average TDS ranges from 60 to 280 mg/l and the average TDS is 180 mg/l (NorWest, 2000a). Concentrations of sodium ion and sulfate are very low. Groundwater quality meets State of Utah drinking water standards for the parameters that have been analyzed. Untreated spring water is used throughout the study area at cabins and campgrounds for culinary uses. Additionally, groundwater discharge supports baseflow to creeks that have been classified as "High Quality Waters – Category 1" by the State of Utah (UAC R317-2).

3.1.7 Vegetation

This summary provides a description of the vegetative resources in the vicinity of the Flat Canyon Tract with the potential to be impacted by the Proposed Action and alternatives as

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described above. Vegetative resources potentially affected include those riparian associated plant communities that are dependent on surface flow and groundwater recharge within the zone of impact of a reasonably foreseeable development scenario. For a more detailed description of vegetative resources and a listing of scientific names of plant species in the area please see Technical Report for Vegetation and Wildlife (Norwest 2000).

Vegetation resources within the Flat Canyon Tract have been described and mapped to five general vegetative community types (Figure 3.5). The approximate area (acres) associated with each vegetative community within the approximately 8,800-acre area are presented in Table 3.1.

Table 3.1. Acres of Vegetative Community Types In The Flat Canyon Tract, Utah

VEGETATIVE COMMUNITY	AREA (acres)
Grasslands	218
Meadows/Wetlands	180
Sagebrush/Grass	2081
Conifer-Timber	2412
Aspen	3868
Total	**8759**

Grassland communities in the area are dominated by slender wheatgrass, mountain brome, and Letterman's needlegrass. Several forb species also occur in the grassland community type.

Primary species found in the dry meadow communities include Kentucky bluegrass, bentgrass (redtop), and Ross sedge. Wet meadow communities are composed primarily of species such as water sedge, Nebraska sedge, beaked sedge, and tufted hairgrass.

The sagebrush/grass communities are dominated by mountain big sage and silver sage. Grass species associated with the sagebrush type include slender wheatgrass, Letterman's needlegrass, and sandberg bluegrass.

Conifer cover types in the area occur primarily on the upper sloping hillsides, typically on northern or eastern exposures. These sites are dominated by Englemann spruce and subalpine fir. Understory vegetation within these conifer stands varies in density and distribution, depending on canopy cover of the overstory. Representative understory species include gooseberry, arnica, butterweed, and lupine.

The aspen community is the most common forested type within the tract and is dominated by mature aspen in the overstory with snowberry, elderberry, Oregon grape, and butterweed making up the primary species in the understory.

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Riparian communities occur within all vegetative types and are associated with stream and spring influence areas. The extent of these riparian communities varies from those areas adjacent to the stream channel to expanses of sub-irrigated acreage covering an entire drainage bottom. Hydrologic contributions to these riparian cover types includes direct stream flow, toe

slope springs at the valley edges, springs and seeps, or a combination of surface and groundwater influences (see Water Resources Technical Report (NorWest 2000)).

Historic beaver activity in all drainages in the project area has had dramatic local influence on the extent and distribution of riparian vegetation. Some residual riparian communities exist that extend the total drainage width (20-60 feet) in the middle reaches of Boulger Creek. Forested riparian cover occurs along the lower ½ mile of the south fork of Boulger Creek in Section 4, in the middle reaches of Swens Canyon, and the upper reaches of Little Swens Canyon. These riparian communities are typically adjacent to the creek banks and vary in width from 2-10 feet on either side of stream channels.

Pothole type riparian communities also occur in otherwise upland cover types below the reservoir in Boulger Canyon. These small wetland areas appear to be dependent on subsurface flows originating on the adjacent upland slopes, and comprise valuable sagebrush/grassland associated riparian areas. The majority of acres of riparian associated communities in the area are found however within the meadow and grassland cover types in Boulger Canyon, Flat Canyon, lower Swens Canyon, and lower Little Swens Canyon drainages. Table 3.2 displays estimated acres of riparian community types within the Flat Canyon Tract.

Table 3.2. Estimated Acres of Riparian Community Types found in Flat Canyon Tract, Utah

DRAINAGE	FORESTED	MEADOW/GRASSLAND
Boulger Canyon	2.0 acres	13.0 acres
Flat Canyon	0 acres	9.0 acres
Swens Canyon	0.5 acres	2.0 acres
Little Swens Canyon	0.4 acres	1.0 acres
TOTAL	2.9 acres	25 acres

To a large extent, current distribution of vegetation has been influenced by historic human-caused disturbance. Grazing (primarily sheep) has occurred throughout the tract since at least the early 1900's and has in the past resulted in degraded streambank and riparian condition (USFS files). Since about the 1960s, reductions in grazing season length and intensity on area allotments has resulted in improved riparian condition (USFS files). Bank stabilization projects (e.g., willow plantings and organic rip rapping) have been implemented in Boulger, Swens, and Little Swens creeks with varying levels of success, though it is evident from field observation that recent bank stabilization has occurred in these drainages.

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Level two (project level field review) riparian inventories conducted in Boulger Creek in 1991, summarized fish habitat and bank conditions in mainstem Boulger Creek (Raleigh Consultants

1992). Field evaluations of riparian condition and fish habitat in Boulger, Flat Canyon, Swens, and Little Swens were also conducted in 2000. Current riparian condition throughout these drainages is generally considered good to excellent. Most reaches of all area streams have fully vegetated banks that are currently stable. Vegetative cover on most streambanks appears to be vigorous, with little evidence of recent perturbances, other than localized sloughing actions. Fish habitat condition assessments are summarized below in the Wildlife and Aquatics Resources sections.

There are two locations in the Boulger Creek sub-basin with larger wetlands: the headwaters of the left fork and a portion of the right fork upstream of the confluence of the two tributaries. These wetlands are maintained by precipitation and their inherent "sponge" effect, by springs along the margins of the wetlands, and by groundwater from upstream alluvium or upwelling. The wetland in the left fork was tested to determine if it is a peatland or fen. This site has been disturbed by human activities and lacks the organic soils and other important fen features to qualify as a peatland or fen (Sanderson, 2001).

Four livestock operators are dependent on the forage produced in this area to meet approximately 25% (3 months) of their forage needs.

Threatened, Endangered, Proposed, and Sensitive Plants

There are no known threatened, endangered, proposed, or sensitive plant species in the project area (personal communication with Bob Thompson, Range Conservationist, Manti-La Sal National Forest, Price, Utah). Therefore, there will not be further discussions of them in this document other than to explain that they were considered.

3.1.8 Wildlife

Terrestrial Wildlife

The tract contains habitat for numerous wildlife species common to southeastern Utah, including amphibians, big game, other mammals, and raptors. Species of particular concern relative to land management in the area are the goshawk, flammulated owl, and three-toed woodpecker, which have been designated as sensitive by the USFS, and for which habitat occurs in the area (Biological Evaluation and Biological Assessment, USFS files).

An evaluation of U.S. Fish and Wildlife Service information indicates that the bald eagle (wintering populations only) is the only federally listed species with the potential to occur in the Upper Huntington drainage.

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Management Indicator Species

Management Indicator Species (MIS) are a select group of species that can indicate change in habitat resulting from activities on the Forest. MIS species for the Manti-La Sal National Forest are elk, Mule deer, macroinvertebrates, Blue grouse, Golden eagle and Abert squirrel (FLRMP). With the exception of Abert Squirrels these species utilize the habitats found within the project area.

Elk and Mule deer are economically important species that are discussed below under big game.

Macroinvertebrates are ecological indicator species in aquatic habitats and the ability of that habitat to support fisheries. Habitat requirements for aquatic macroinvertebrates vary with species. Habitat requirements for any one species are very specific so macroinvertebrate indices are analyzed for general stream health. These indices are Diversity Index, Biotic Condition Index, and Standing Crop (Forest Plan, pg. II-34). There is a macroinvertebrate monitoring site in Upper Huntington Canyon above Burnout Canyon. Monitoring results of this site show that macroinvertebrate indices meet Forest Plan standards and stream health is good. The fishery potential for other streams within the project area is discussed in the following Aquatic Resources Section.

Blue grouse are closely tied to several vegetative types occurring within the project area. Breeding males require areas of escape cover in open timber stands adjacent to open sagebrush/grass/forb habitat types. The edges of such types are heavily used. During the winter Blue grouse require mature conifer stands, preferably Douglas-fir, for foraging. Potential impacts to this species are tied to impacts in vegetation. Vegetation within the project area and potential impacts are found in Sections 3.1.7 and 4.1.6. Implementation of any alternative would have little or no impact on this species, therefore they are not discussed further.

The golden eagle is a State and Federal high interest species found throughout the Forest. During the summer golden eagles can be found foraging within the project area. On the Wasatch Plateau most golden eagles nest along cliffs. There are only a few known tree nests and there are no eagle nests within the project area. Potential impacts to golden eagles are discussed as part of the Unsuitability Criteria Assessment (FEIS, Appendix F). Since there are no effects, they are not discussed in any detail in the FEIS.

Big Game

The project area provides spring, summer, and fall ranges for Mule deer and elk. It also serves as a migration corridor between higher elevation summer ranges and lower elevation winter ranges to the east. The elk herd on the Wasatch Plateau is the largest in the State of Utah. It is at the population objective stated in the Herd Unit Management Plan. The deer herd is also one of the largest in the State. However, the population is currently below the objective. The Mule deer herds throughout the State and much of the West are at low populations. Predation by coyotes and cougar, severe winters, and drought are thought to be the main reasons for declining

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Mule deer populations. The yearlong range of the species includes the entire Wasatch Plateau and the valleys to the east and west.

Bald Eagle

The Bald eagle is a federally listed threatened species that has been proposed for de-listing as of July 4,2000. During the breeding season, Bald eagles are generally associated with edges of water bodies along coastlines, lake shores, or river banks. During winter they tend to concentrate over areas where food is available. This usually means open water where fish and waterfowl can be caught. They may also winter in upland habitats, feeding on small mammals and deer carrion. At wintering areas, Bald Eagles commonly roost in large groups. These communal roosts are located in forested stands that provide protection from harsh weather. They typically construct, large, conspicuous stick nests in sizeable trees. Bald eagles found in Sanpete County are considered to be wintering populations or northern birds that are migrating through in the fall and spring. There are only a few nesting pair in Utah. Until two years ago there was a nesting pair near Castle Dale ,Utah, approximately 35 miles southeast of the project area. It was unoccupied over the last two years. This pair had been observed during the nesting and fledgling period and did not forage on National Forest System lands.

Several Bald eagles can be found foraging in and near the project area during the fall and early winter. They can often be found perched near the reservoirs where they forage mostly on fish and waterfowl. When the reservoirs freeze over the eagles move elsewhere to forage. Some years the reservoirs freeze early, providing little opportunity for forage. (Biological Assessment, Project File).

Goshawk

Goshawks breed in coniferous and mixed deciduous forests throughout much of North America (Reynolds et al. 1991) and have been documented as nesting in the area. Preferred habitat during the spring and summer breeding season is mature forests where the birds can maneuver in and below the canopy while foraging, and where large trees are available in which to build nests. In the Rocky Mountains, goshawks frequently nest in dense stands of mature lodgepole pine or aspen trees and in stands of mixed coniferous species (Jones 1979). Potential goshawk habitat occurs throughout the tract along upper slopes in all drainages. Of particular concern for this sensitive species is the avoidance of human disturbance (e.g., road building, mine vent construction) during the nesting and early post fledging periods (May through September), which could potentially cause nest failure. They are known to move through the entire State of Utah.

Migratory Birds

The project area contains habitat for many species of migratory birds including three species on the priority list of Utah Partners in Flight. These are Broadtail hummingbird, Three-toed woodpecker, and Virginia's warbler (UDWR Publication Number 90-11). These as well as other migratory nest and forage areas lie within the project area.

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Flammulated Owl

This small migratory forest owl is associated primarily with old growth and/or mature open growth stands of ponderosa pine, fir, or aspen. They are somewhat dependant for foraging habitat on a shrubby understory as they feed almost exclusively on small invertebrates (e.g., moths, beetles and grasshoppers) (DeGraaff, et. al. 1991). Nests are usually located in abandoned flicker or other woodpecker cavities in aspens, oaks, or pines. They are known to occur in the western United States and British Columbia.

Though no flammulated owls have been documented in the area, suitable habitat is present and they are suspected to occur in upper slope aspen and mixed forest habitats.

Three-toed Woodpecker

Three-toed woodpeckers primarily inhabit coniferous forests of the West, where they rely on wood boring and bark beetles associated with beetle and fire related ecology. They occur throughout the Rocky Mountains in mixed conifer stands, including Englemann spruce/sub alpine fir and lodgepole pines, similar to those found on north and east slopes in the area. In Colorado, this species consumes spruce beetles for 65 percent of its annual diet and 99 percent of its winter diet (DeGraaff et al. 1991). This species is known to occur in the area and their immediate range includes most of the northern half of the Wasatch Plateau. .

Aquatic Resources

Upper Huntington Creek is the only disease free source of Yellowstone cutthroat trout in Utah (Canyon Fuels Company 1999). Boulger, Swens, and Little Swens Creeks are tributaries to Upper Huntington Creek and as such provide spawning habitat for cutthroat trout (Canyon Fuels Company 1999). Rainbow trout are also present in the system, and are stocked yearly in Boulger reservoir by the Utah Division of Wildlife Resources (UDWR). No other trout species of concern are known to inhabit the Upper Huntington Creek Watershed (Canyon Fuels Company 1999).

Surveys for boreal toad were conducted in the spring of 2001. Habitat for this species and other amphibians was found in floodplain areas along Boulger Creek and other pot-hole-sag-ponds that capture snowmelt along Boulger Creek. Boreal toads were not found in these surveys. Habitat along perennial streams within the project area is excellent and not necessarily dependent on springs.

Boulger Creek

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Boulger Canyon is characterized by open grass and sagebrush meadows and wetlands, a moderately entrenched stream channel, and relatively stable banks. Boulger Creek is a third order stream that flows approximately 4 miles west to east and drains into Electric Lake. Flat

Canyon Creek enters Boulger Creek from the west approximately 1 mile upstream from the lake. Another tributary (South Fork) enters the channel from the south approximately 2.5 miles from the Lake. Boulger Reservoir is located between the two tributaries approximately 1 mile upstream from Electric Lake.

The lower reaches, from Electric Lake to Boulger Reservoir, total approximately 5,000 feet in length and have an average gradient of 2-3 percent. Channel types found in these lower reaches are C3 and B3 (Rosgen 1996). The stream is 8-10 feet wide and is dominated by riffle and run habitat (approximately 90%) with some lateral scour and small plunge pools (10%). Stream depth varies from 6 inches to 2 feet. Substrate in the lower gradient areas (1-2% gradient) is composed of approximately 50% cobble in the 6-24 inch class, is well armored, and appears stable. Gravel (15%) and sand/silt (35%) were also present in the substrate during the 1991 survey, and appear to be distributed slightly differently at present (approximately 30% gravel and 20% sand/silt). Banks are well vegetated and stable, though evidence of previous bank instability does occur. As indicated earlier, historic bank stabilization projects (e.g., willow plantings and organic rip rapping) have been implemented in this drainage. Cutthroat trout and sculpin were observed in these reaches.

While Raleigh Consultants (1992) reported excessive sediment in these reaches during their 1991 surveys, indications from the year 2000 assessment are that instream sedimentation was light to moderate, though obviously, these data are difficult to compare due to variability in season of survey and yearly runoff conditions. Surveys conducted by the Utah Division of Wildlife Resources in 1986 (UDWR 1999) indicated that these reaches contained stable riparian zones, little or no erosion, 90-95% bank stability, good to excellent substrate (10-25% sand/silt), and poor bank shade (10-20%).

Boulger Creek above the reservoir contains four primary reaches for habitat comparison purposes. The first reach is approximately 1 mile long with an average gradient of about 1.5 percent. Riffle and run habitat dominates this reach, with pool habitat making up approximately 5 percent of its length. Stream depth is typically about 6 inches deep, though depth of some pools reaches up to two feet. The Rosgen channel type that typifies this reach is C3 with particle size in the substrate being dominated by 2-4 inch cobbles. Local sections in this stream reach contain varying amounts of cobble ranging from 6 to 12 inches in diameter. Overall stability of the channel is considered good. Undercut banks occur on approximately 90 percent of the reach and appear to provide good cover for fish observed there. Banks are predominately well vegetated with grass/sedge communities and are stable. Willow communities begin to occur along the stream approximately ½ mile up from Boulger Reservoir. Also in this area, evidence of historic bank stabilization activities, as discussed earlier, was found. Sediment was noted by the Raleigh (1992) survey, and was also evident, though not considered excessive, in slack water and pool areas during the 2000 assessment. Fish habitat surveys conducted by the Utah Division of Wildlife Resources in 1999 (UDWR 1999) indicate that from the reservoir to its headwaters, Boulger Creek contained good substrate (50-75% gravel/rubble/boulder, 25% sand/silt) and excellent cover (75-100%). Field observations in July 2000 showed an abundant population of

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cutthroat trout ranging from adult spawning trout to younger age classes (from field observations, R. Davies, pers. commun.).

The second reach above the reservoir begins at the creek's confluence with the southern tributary and is approximately 1,800 feet long. The gradient in this reach averages between 2 and 3 percent, though substrate composition varies considerably from 2-inch gravels to 12 inch and greater cobble/boulder material. Run and riffles make up approximately 60 percent of the habitat, with an increased representation of pools (approximately 40%) over the previous reach, apparently related to those areas with larger substrate (pool forming) material. The channel is typical of a B3 type (Rosgen 1996). Willow cover is prevalent in this reach as is evidence of historic and recent beaver activity. The stream is fed in this reach by several springs and seeps adjacent to the channel in the valley toe slopes. Several cutthroat trout were observed in this reach. Sedimentation was noted by Raleigh Consultants (1992), and was attributed (potentially) to inactive beaver dams. Moderate sedimentation was also noted during 2000 in the pools within the reach, though no obvious sedimentation was observed in riffles or runs. Sediment sources are likely from erosion, including stream fords, gullies in existing roads, and unauthorized ATV use observed in the upper reaches.

The third reach above the reservoir is approximately 2,000 feet long and consists of a meandering C3 (Rosgen 1996) channel, approximately 10 feet wide and 6 inches deep. Riffles and runs comprise approximately 80 percent of the habitat in the reach with pools (primarily lateral scour pools at meander bends) comprising the remaining 20 percent of the reach. The substrate is made up primarily (50%) of 6-12 inch cobble, with approximately 20 percent sand and silt, and 35% gravel. Undercut banks are evident, but not dominant. Banks and substrate appear stable. Sedimentation was noted as minor and appears to be related to bank sloughing at meander bends. Cutthroat trout on spawning redds were observed in this reach.

The stream channel in the fourth and final reach narrows and steepens to an average 6 percent gradient over approximately 5,000 feet. Rosgen channel types most typical of this stream segment are A2 or B2. These riffles make up nearly 90 percent of the habitat, with the remaining habitat comprised of small rock and boulder formed pools. Width is approximately 5 feet and depth ranges from 4 inches in the riffles to one foot deep in the pools. The substrate is dominated by large cobble (6 inches and greater), boulders, and bedrock. Sediment was not noted in this headwaters reach. Fish habitat appears limited due to shallow depth during most of the year, though use by fish during the early season is likely not limited.

Surveys for boreal toad were conducted in the spring of 2001. Habitat for this species and other amphibians was found in floodplain areas along Boulger Creek and other pot-hole-sag-ponds that capture snowmelt along Boulger Creek. Boreal toads were not found in these surveys. The habitat along perennial streams within the project area is excellent and not necessarily dependent on springs.

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South Fork Tributary

The lower reach of the south fork tributary is approximately 3,500 feet long. It is a A3 channel type (Rosgen 1996) with an average width of 3-5 feet and depth of less than one foot. Substrate composition in this reach is primarily large cobble (greater than 6 inches) and boulders. There is also abundant large woody debris present in the channel from the adjacent spruce/fir community. Habitat quality for fish in this reach is poor, due to small stream size and low flow.

The upper reach of this tributary is approximately 500 feet long and originates and flows through a flat, wet, meadow. The stream in this area is approximately 1 foot wide and less than a foot deep. The substrate is composed of fine sand and silt and fish habitat is rated as poor. The Rosgen classification for this reach is C5 or E5.

Flat Canyon Creek

Flat Canyon Creek is a small tributary flowing from west to east into Boulger Creek approximately ¼ mile downstream of Boulger Reservoir (Figure 3.3). The creek originates from springs near the western edge of the Tract and flows approximately 1 1/4miles before its confluence with Boulger Creek. In its upper reach (approximately ¾ mile long) it has a gradient of less than one percent as it meanders through a flat valley bottom (Rosgen E5). Average width of the stream is about ten feet, though the wetted width of the floodplain in the upper reach is approximately 100 feet or more. Substrate is dominated by silt and sand, and fisheries habitat value is considered low due to slow moving water and siltation in the stream. Fish habitat in this reach is dominated by run features.

The lower reach of Flat Canyon Creek is a relatively incised channel (Rosgen B3) (approximately three feet wide and 1,200 feet long) that is constrained by highway 264 on its northern bank. The average gradient in this reach is three percent, and habitat is primarily riffle dominated, with occasional pools (<5%) formed as a result of rock and boulder substrate. The substrate is composed of 4-12 inch cobble and boulders and appears well armored and stable. Several cutthroat trout were observed in this reach. Vegetation associated with this reach is primarily sedge communities, though willow clumps do occur. Banks are well vegetated and stable.

Swens Canyon

Swens Creek is a small third order tributary to Upper Huntington Creek that flows from west to east in the north central portion of the Tract. Reach one, beginning at the Highway 264 crossing, is a narrow (five feet wide) meandering channel with 75 percent undercut banks and multiple lateral scour pools at the meander bends. Habitat distribution in this stream is made up of approximately 80-90 percent runs and riffles and 10-20 percent pools. These pools range in depth from one to two feet. The reach length is approximately 4,000 feet.

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The stream in this reach is incised approximately two feet below ground surface, and evidence of historic riparian degradation, perhaps due to grazing, and stream stabilization projects also occurs. The floodplain in this reach ranges up to 60 feet in width. Substrate consists primarily of 2-4 inch gravel and cobble with occasional areas of large (greater than 12 inch) boulders. The Rosgen channel type is C3 (Rosgen 1996).

A perennial tributary enters the main drainage from the south approximately 1,000 feet from the beginning of reach one. The tributary extends approximately ½ mile to the south and west and appears to lack any suitable fish habitat value due to its small size.

Immediately upstream of its confluence with this small tributary in reach two, historic beaver activity (dams, lodges) is evident. Fish habitat in this reach is similar to that described for reach one in that meanders are still prevalent in the channel, but willow vegetation on the banks is more dominant than below in reach 1. Substrate is dominated by slightly larger cobbles in the 4-6 inch diameter range. Reach two extends for approximately 3,000 feet to its confluence with a second tributary, which enters the drainage from the north. Tributary two is a perennial A type channel (Rosgen 1996), and it appears to be too small to support quality fish habitat.

Upstream from its confluence with tributary two, the channel in reach three (approximately 1,000 feet long) narrows and willow vegetation along the channel becomes dominant. Channel dimensions in reach three are approximately six feet wide and six inches deep. Substrate is dominated by boulder and bedrock in places, which has prevented the downcutting that has been observed in other streams in the area. Beaver activity is prevalent in reach three, as are cutthroat trout.

Reach four begins at a small, willow/conifer lined, perennial stream that enters the main channel from the south and extends approximately 2,500 feet. Reach four is a low gradient (two percent), slightly meandering channel. Average depth is approximately six inches, and substrate material is predominately small (2-4 inch) cobble. One large beaver pond occurs in the middle of the reach and adult cutthroat trout were observed in the pond.

Reach five begins approximately 1 ¼ mile up the stream in the northeast portion of Section 10 (Figure 3.3). This reach is a narrow A2 channel type (Rosgen 1996) that does not appear to support fish habitat as its substrate is composed of large glacial till material (three feet diameter). The gradient is between 4 and 6 percent and bank vegetation is dominated by grasses and sedges. Several springs and seeps occur on the adjacent slopes in this reach.

Little Swens Canyon

Three reaches, approximately one mile in total length, were surveyed in Little Swens Creek. Evidence of historic beaver activity is common throughout this drainage. Reach one begins at the highway crossing and extends nearly ½ mile. It is a moderately incised channel (two feet), B3 channel type (Rosgen 1996) with a floodplain width of approximately 30 feet. Substrate consists of 2-4 inch gravel and cobble with 12 inch boulders commonly occurring. Fish habitat

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consists primarily of shallow (6 inches or less) riffle habitat; though boulder associated plunge pools were also observed. Bank vegetation is dense and overhanging banks are common. Cutthroat trout are present in this reach.

Reach two narrows slightly and becomes a boulder and bedrock dominated channel (B2 channel type). Willows are prevalent and historic beavers dams appear to have influenced the channel to a large degree. This reach extends approximately 1,000 feet. A four-foot high waterfall currently exists in the middle of the reach. The waterfall appears to have been formed by recent channel migration in the reach. No fish were observed above the waterfall.

Reach three is a very narrow A2 channel type that is dominated by large 6-24 inch boulders in the substrate, though bedrock substrate was also found in local areas within the reach. The average gradient is nearly 6 percent. Evidence of historic beaver dams also occurs in this reach. No fish were observed.

Threatened, Endangered, and Sensitive Species

No species other than those discussed above are of concern in the project area. All species known or suspected to occur in the Wasatch Plateau are addressed in the Biological Assessment and Biological Evaluation (Project File).

3.1.9 Recreation

The Upper Huntington Creek/Flat Canyon area contains several stream fisheries, reservoirs, roads, and trails, developed recreation sites, cabins, a girl's camp, and boat ramp facilities at Electric Lake. The area is one of the highest recreation use areas on the Forest for both developed and dispersed recreation activities, including camping, hiking, boating, fishing, motorized sightseeing, hunting, snowmobiling, and cross-country skiing. The Recreation Opportunity Spectrum (ROS) classification for the tract area includes both Roaded Natural areas and Semi-Primitive Motorized areas. State Highway 264 has been designated as part of the Huntington and Eccles Canyons National Scenic Byway and is managed to provide motorized access and interpretation of natural resources and land management activities, including development of energy resources.

Recreation demand is increasing each year for the State of Utah and the project area. The State of Utah has projected that the State's population could grow to 3 million people by the year 2015. This translates to increased demand for recreation opportunities.

Developed recreation facilities on National Forest System lands include the Boulger Reservoir and Dam complex that supports dispersed camping and fishing opportunities. A spillway/fish ladder was constructed in 1997 to allow passage of Yellowstone cutthroat trout upstream from Upper Huntington Creek to the reservoir and perennial reaches of Boulger Creek above the reservoir. A hardened (gravel or aggregate surface) access road and parking area and a toilet

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have been constructed just east of the reservoir to support these activities. Use is 5,000 Recreation Visitor Days (RVDs) per year. Dispersed campsites are located just south of the reservoir and parking area. The Forest has made a decision to do additional improvement work and to add the area to the Fee Demo profile currently in place.

Flat Canyon Campground is open to public use during the summer season and it closed during the winter months. It consists of an asphalt road with two loops. One loop accesses a group camping area and a second loop provides access to 12 individual campsites with parking spurs. The PAOT (People At One Time) capacity at the site is 110. The occupancy rate is the highest on the Manti Division of the Forest at about 30%. The use season is about 93 days, equating to about 3,000 RVDs per year. The water system is fed by a spring located on the west slope of Boulger Canyon. A retaining wall has been constructed to stabilize the unstable slope at the spring. Water is transmitted to a holding tank on a bench just above the campground by a buried pipeline. The water is then piped to seven individual pressurized faucets. The primary use is reserved group camping by organizations and families. The campground is concessionaire managed. Annual revenue to the concession permittee averages $4,000 per year. There is a host pad site with septic system at the campground from which the concessionaire operates the campground along with Gooseberry Campground and Gooseberry Reservoir Campground.

Private cabins in and adjacent to the project area are generally used for recreation throughout the year for all-season recreation opportunities, including hiking, fishing, hunting, recreational vehicle use, snowmobiling, x-country skiing. The four private cabins within the project area in Flat Canyon and the one in Swens Canyon are relatively modest log or timber frame structures supported on concrete strip or pad foundations. There are some other properties further along Flat Canyon and up Little Swens Canyon, but these are outside the area under consideration. The State Highway, Forest roads, and private roads used for access to these facilities are discussed in the Transportation Section.

3.1.10 Visual Quality

The project area is located in a sparsely populated portion of Sanpete and Emery County. The topography is characterized by the broad U-shaped glacial canyons of Upper Huntington Canyon and it's tributaries. The valleys are bounded by rounded high vegetated ridges and slopes. The valley perimeters are typical of glaciated terrain, consisting of low rounded mounds and ridges (moraines) consisting of earth materials left behind by the retreating glaciers.

The area is more developed than most other areas of the Forest due to the recreational popularity of the area and private inholdings. Developments consist of State Highway 264, Forest and private roads in the tributaries, Electric Lake and Dam, Boulger Reservoir and associated dispersed recreation area, Flat Canyon Campground, as well as privately owned summer cabins and access roads. State Highway 264 has been designated as a Scenic Byway as part of the Huntington and Eccles Canyon Scenic Byway loop. Interpretation of land management activities and energy developments, including coal mining, is emphasized.

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The portal facilities for the Skyline Mine lie approximately two miles to the east and northeast of the project area in Eccles Canyon. Even though underground mining has taken place under the east slope of Upper Huntington Canyon, there is no visible evidence of mining.

Landscapes within the project area are classified by the Forest Service by their scenic quality, sensitivity level, and the distance from which they are seen. Scenic quality is measured by describing landscapes as distinctive, common, or minimal. Sensitivity is categorized as low, moderate, or high. The sensitivity level of a particular view is determined by the viewing point, the number of viewers, and the duration of viewing. The viewing distances are further defined as foreground, middleground, and background. This classification system has been used to determine visual quality objectives (VQO) for landscapes within the project area. VQOs provide a standard for scenery management. Each VQO describes a different amount of acceptable change or alteration of the scenery.

The canyon bottom along Upper Huntington Creek and Flat Canyon, including State Highway 264, is classified as fg1A: foreground viewed, high sensitivity level, distinctive variety class. The western slopes of Upper Huntington Canyon in the northern portion of the coal lease tract are classified as mg1A: middleground viewed, high sensitivity level, distinctive variety class. The remaining areas are foreground and middleground viewed with lower sensitivity levels and variety classifications due to developments that dominate the landscape.

The visual quality within the majority of the tract and directly adjacent to the tract is designated in the Forest Plan as "Partial Retention". Upper Huntington Creek, the highway, Flat Canyon Campground, and Boulger Reservoir lie within the area classified as "Partial Retention". This VQO provides for management activities that are "visually subordinate" to the characteristic landscape.

The southwestern portion of the tract has areas designated as "modification". This VQO provides for management of activities that are "visually dominant" within the characteristic landscape.

The upper end of Electric Lake, east of the Flat Canyon Tract in the Skyline Mine Permit area, is designated as "Retention". This VQO provides for management activities that are not evident and must remain subordinate to the characteristic landscape.

No specific visual quality objectives have been designated for management of the Huntington and Eccles Canyons Scenic Byway (State Highway 264). The areas visible from scenic byways are managed for visual quality as designated in the Forest Plan. The Forest Service has not classified the adjacent private lands.

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3.1.11 Transportation

The transportation study area affected by the project is bounded by State Route (SR) 264 on the south, Electric Lake and SR 264 on the east, Forest System Road 50225 to the north, and a combination of Forest System Road 50173 and a segment of SR 264 on the west. There are approximately 63 miles of road on the Forest and Private lands in the transportation study area; 7.3 miles of road are within the planimetric project area boundary. Road segments that are within 800 feet of the outer boundary are included in the study as having potential to be affected by the project from subsidence, based on an angle-of-draw of 22 degrees from vertical. There are approximately 9.6 miles of road that could be potentially affected by mining, considering those within the project boundary and those segments within 800 feet of the boundary.

The paved segments potentially affected are: SR 264 and Forest Road 50057; approximately 2.0 miles. The Forest Service aggregate-surfaced roads are 50056 (partial), 50057, 50230, 50222; approximately 1.0 mile, and 0.3 miles on private lands (continuation of roads 50222 and 50230. The remaining miles are native-surfaced roads including 50228, 53068, 53065, 53069, 50056 (partial), 53084 (5 miles), and 1.3 miles of private roads. The paved segments and those with aggregate (gravel) surfacing are double-lane roads. The native-surfaced roads are single-lane with turnouts.

State Highways

SR 264, a bituminous-surfaced double-lane highway, traverses the tract in a west-to-east direction, providing the main transportation access to the project area. It trends southeast through the project area to Electric Lake, then north to SR 96. It is part of the Huntington and Eccles Canyons Scenic Byway. Both highways are maintained by the Utah Department of Transportation. They are paved and are plowed in the winter, providing year-long access to Skyline Mine, private lands within the Forest, and general recreation areas from Sanpete Valley and Castle Valley. It is used extensively for mine related, private lands access, and recreation purposes. In 1998 average daily traffic was 440 vehicles per day, increasing by approximately 20 vehicles per day over each of the previous two years.

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Forest System Roads

In general, these roads are maintained for Traffic Service Level D at operational and objective maintenance level 2 for existing forest uses. Roads in this maintenance level are typically low speed, single-lane with some spot surfacing. These roads provide for access by high clearance vehicles during the normal season of use. User comfort and convenience are not considered priorities for these roads (USDA-FS 1992). Some of the roads in the project area have been further improved as described below due to high use levels and are maintained for Traffic Level C and Objective Maintenance Level 3 where improved surfacing exists, such as at Boulger Reservoir, Flat Canyon Campground, and Camp Shalom. The major Forest Roads are described below. There are additional small segments that lie in the project area or within 800 feet of the outer project boundary.

Forest Road 50230 provides access to private lands in Little Swens Canyon from SR-264. It is an aggregate-surfaced road that provides access to the Camp Shalom. Numerous private roads provide access to buildings and structures at the camp.

Forest Road 50228 is a single-lane aggregate-surfaced road that provides access to private lands in Swens Canyon. Numerous private roads provide access to cabins.

Forest Road 50056 provides access to Boulger Reservoir and beyond to upper Boulger Canyon. It is gravel surfaced to the parking area and native surface from the parking area beyond Boulger Reservoir in Boulger Canyon. It is primarily used for recreation, including sightseeing, hunting, camping, and fishing.

Forest Road 50057 is a single-lane, paved, bituminous-surfaced road that provides access to Flat Canyon Campground and individual camping sites.

Forest Road 53084 is a single-lane native surface road from Skyline Drive (west of the project area) that provides access to the east along the ridge between Flat Canyon and Boulger Canyon.

Private Roads

There are numerous private roads on the adjacent private lands that provide access to privately owned cabins and facilities. Private roads that cross National Forest System lands are permitted under a special-use permit or easement.

At least two single-lane native surface private roads lead north and south from SR-264 in the Flat Canyon area, approximately 1 mile west of Flat Canyon Campground, that provide access to private cabins. The roads that lead south traverse Flat Canyon Creek and the associated riparian and wetlands in the floodplain. They lie entirely on private lands.

Forest Road 50230 that provides access into Little Swens Canyon and Camp Shalom becomes private at the boundary of the private lands. The road loops through the camp area with spurs that provide access to individual camp areas and facilities.

Forest Road 50222 is a single-lane aggregate-surfaced road that leads from SR-264 to the Electric Lake boat ramp. A portion of this road lies within 800 feet of the eastern boundary of the Tract.

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3.1.12 Cultural and Historic Resources

Archaeological surveys for ten previous projects have been conducted within the project area and a Class I inventory has been completed for the leasing analysis (Hauck, 2000). Approximately 16% of the project area has been field inventoried, and additional reconnaissance (Elkins and

Montgomery, 2001) has been conducted for this analysis. This inventory provides sufficient cultural resource data to assess the effects of the proposed leasing.

Inventories indicate that there are few prehistoric archaeological resources in the project area. Temporary camps, tool manufacturing evidence and occasional isolated artifacts such as projectile points or stone flakes have been recorded, suggesting that the area was used mainly for upper elevation hunting activities, from Paleo-Indian (10,000 B.C.) times through the Formative culture period (AD 1200) and probably on into the historical period by ethnographic Native American groups. Rock shelter formations that could have been used by prehistoric people are not expected in the project area.

Six historic sites (sawmill, wagon road, log fence, homestead, cabin, and Johnson Sawmill) were inventoried. Only the homestead site (42Sp445) was recommended by Elkins and Montgomery (2001) as eligible to the NRHP (National Register of Historic Places) since the site consists of standing in-period habitation structures that embody the characteristics of a type, period, or method of construction. The Utah State Historic Preservation Officer also recommends that the wagon road site (42Sp443) as eligible for the NRHP. These sites are located on the private lands in the project area.

3.1.13 Paleontological Resources

Paleontological resources of concern in the project area are limited to vertebrate animal species. Even though plant fossils and invertebrate animal species are present, they are not specifically identified for protection or as a concern.

In the Federal Regulations contained in 36 CFR 261.2 pertaining to prohibitions on uses of National Forest System lands, paleontological resources are defined as "any evidence of fossilized remains of multicellular invertebrate and vertebrate animals and multicellular plants, including imprints thereof. Organic remains primarily collected for use as fuel such as coal and oil are Paleontological Resources,, but are excluded from prohibitions under the rule". Therefore, fossils contained in coal seams and mined in the recovery of coal reserves are not protected under the rule.

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Fossil Sites and Footprints

The potential for significant fossilized paleontological resources in the project area is generally limited to the Cretaceous Blackhawk and Price River Formations, and the Cretaceous-Tertiary North Horn Formation.

The coal seams in the Blackhawk Formation contain compressed vegetation with remnant imprints of the plant tissues, such as leaves and stems, and dinosaur footprints. Dinosaur footprints occur in the discontinuous lenticular sandstone and mudstone units that separate the coal seams. These lithologic units were deposited as paleostream channels flowed through the

peat bogs and swamps where vegetation suitable for coal production accumulated. Footprints and tail drags were left in the swamps/bogs by passing dinosaurs, then the imprints were filled in by the sand, silt, and clay deposited by streams, forming casts or imprints. Rarely fossils of bone material are found in the coal. They have little scientific value since only bone fragments are found and much of their structure was destroyed by the coal formation process and high-energy paleostream channel environments.

The upper Price River Formation and lower North Horn Formations contain extensive fossils of late Cretaceous vegetation and animals, including dinosaurs. The upper North Horn Formation contains early Tertiary mammal fossils. The Price River Formation crops out on the upper slopes of the canyons and ridge tops in the project area covered by thick deposits of soil and talus materials. The North Horn Formation forms isolated caps on the ridges in the project area. No significant sites have been identified in the project area to date.

Pleistocene Mammals

Deep glacial deposits in the form of moraines are extensive in the canyons in the project area. In other similar areas of the Forest, skeletons and individual bones of Pleistocene mammals have been found buried in the lowland depressions in the canyon bottoms buried by glacial deposits. A Colombian mammoth skeleton and short-faced bear skull were discovered beneath glacial materials in Spring Creek, a glaciated tributary of Huntington Creek in 1988. It is probable that Pleistocene mammal remains occur within the canyon bottoms and floodplains in the project area adjacent to the stream channels below the glacial materials. No discoveries have been made in the project area to date.

Pleistocene mastodon, horse, camel, and bison fossils/bones have also been found on the Forest and could occur within the project area.

3.1.14 Socio-Economics

The proposed action involves potential leasing of the Flat Canyon Coal Lease Tract on National Forest System lands with Federal coal. It also involves the potential for mining of the adjacent non-Federal coal reserves on non-Federal lands in private ownership.

The area of analysis for socio-economics and coal recoverability encompasses the immediate vicinity of the project area, portions of Carbon, Emery, Salt Lake, Sanpete, Sevier, and Utah Counties considering the locations of direct employment, production, and support services such as materials supply, trucking, and maintenance.

Canyon Fuel Company, LLC employs 220 people at the Skyline Mine. These employees reside in the following Counties by percent:

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Sanpete County	51.36%

Carbon County	31.36%
Utah County	12.73%
Emery County	3.18%
Salt Lake County	0.91%
Sevier County	0.45%

In 1999 approximately 26.5 million tons of coal were produced from Utah coal mines. Mining from Federal coal leases on the Wasatch Plateau Coal field within the Manti-La Sal National Forest totaled approximately 21.7 million tons. This accounts for approximately 82 percent of the State's total production. In 1999 1,843 people were employed at Utah coal mines. The Utah Office of Energy and Resource Planning projected direct employment in the year 2000 at 1,748. The Skyline Mine accounts for approximately 12 percent of the total direct employment of Utah coal mines. These figures do not account for employment by Utah coal mine support services such as supply, repair/maintenance, and trucking.

Coal mining and related support services are the largest employers and the largest industry in Carbon and Emery Counties. Coal mining is of less economic importance in the other counties but still provides important jobs and employment opportunities.

At a mine-mouth value (does not include shipping) of approximately $17.00 per ton, the value of the estimated 36 million tons of recoverable reserves in the project area would be $612 million. At a mining rate of approximately 4 million tons per year, the annual value of the coal produced is $68 million.

Under current State and Federal laws, 50 percent of the mining royalties go to the Federal government. The other 50 percent goes into the State Mineral Lease Account and is allocated to State agencies.

Royalties, energy production, employment, and taxes related to development of Federal coal reserves benefit the Federal, State, and local economies.

Royalties paid to the private coal estate owners on adjacent lands would be subject to negotiations between the coal owners and the mine operator. The amount paid to surface land owners for remediation of potential effects to surface resources is also subject to negotiations between the surface estate owners and the coal operator. Compensation for damages to surface resources and structures is required under Utah State law. It is not possible to estimate the amounts at this time. The coal mined from the non-Federal lands would also contribute to the life of the mine and associated benefits of extended employment. The coal would be made available for energy production and royalties would be considered taxable income, further benefiting the Federal, State, and local economies.

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Total direct coal mine employment has been on a downward trend since 1997, decreasing from 2,091 to 1,843 in 1999 (Utah Office of Energy & Resource Planning, July 2000). Two local mines closed during 2000 and 2001 and 4 additional mines are projected to close by 2003. It is

also possible that one new mine could open and for an existing mine to reopen. Approximately 300 direct mining jobs and an unknown number of mine support jobs could be lost. This is having a significant economic impact to the Carbon and Emery County areas and to a lesser degree to Sanpete, Utah, Salt Lake, and Sevier Counties.

Due to the mine closures discussed above, Utah coal production and royalties received are on a downward trend and will decrease markedly over the next 5 years, decreasing revenue to the Federal, State, and local governments.

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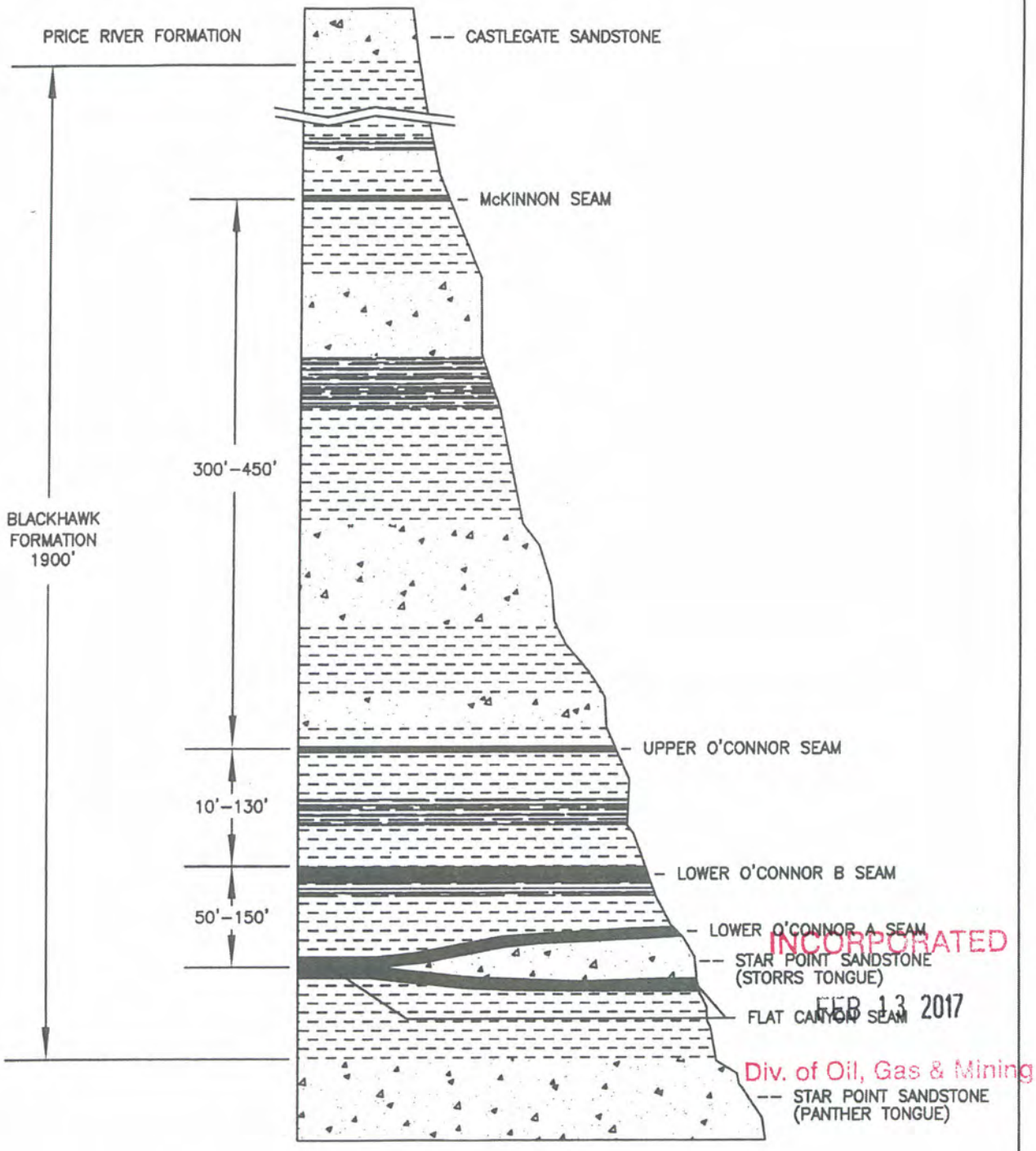

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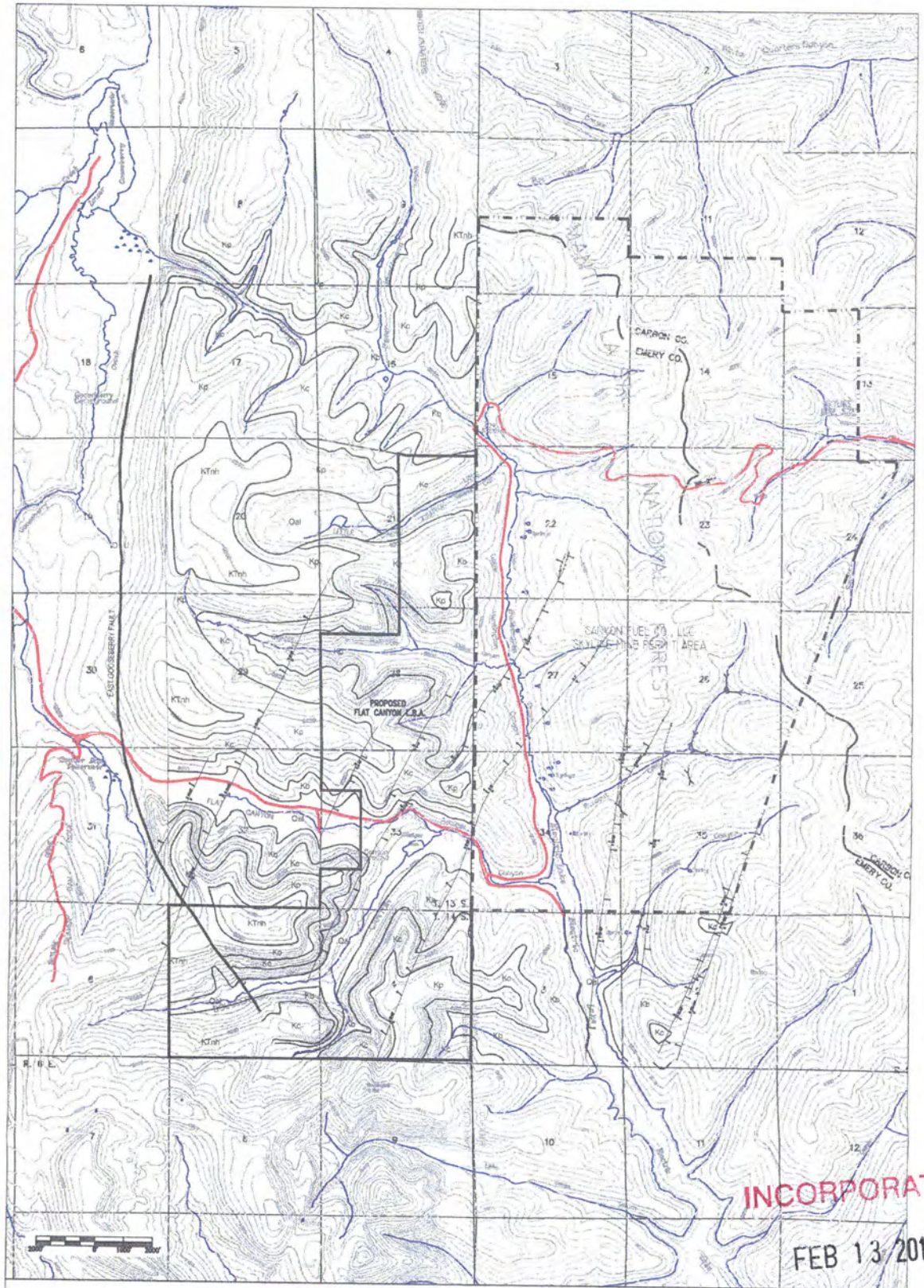
FIGURE 3.2
GENERALIZED COLUMNAR SECTION
FLAT CANYON TRACT AREA

DATE: 8/30/2000
DWG: HYDRO3-4.DWG



LEGEND

- FLAT CANYON COAL LEASE TRACT
- RFDS AREA
- SKYLINE MINE PERMIT AREA
- GEOLOGIC UNITS
- FAULTS
- Qa QUATERNARY ALLUVIUM
- KTn NORTH HORN FORMATION
- Kp PRICE RIVER FORMATION
- Kc CASTLEGATE SANDSTONE
- Kb BLACKHAWK FORMATION

FIGURE 3.1
GEOLOGY MAP

FILE: HYDRO1-2.DWG	SCALE 1" = 3200'
DATE: 9/11/2000	

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

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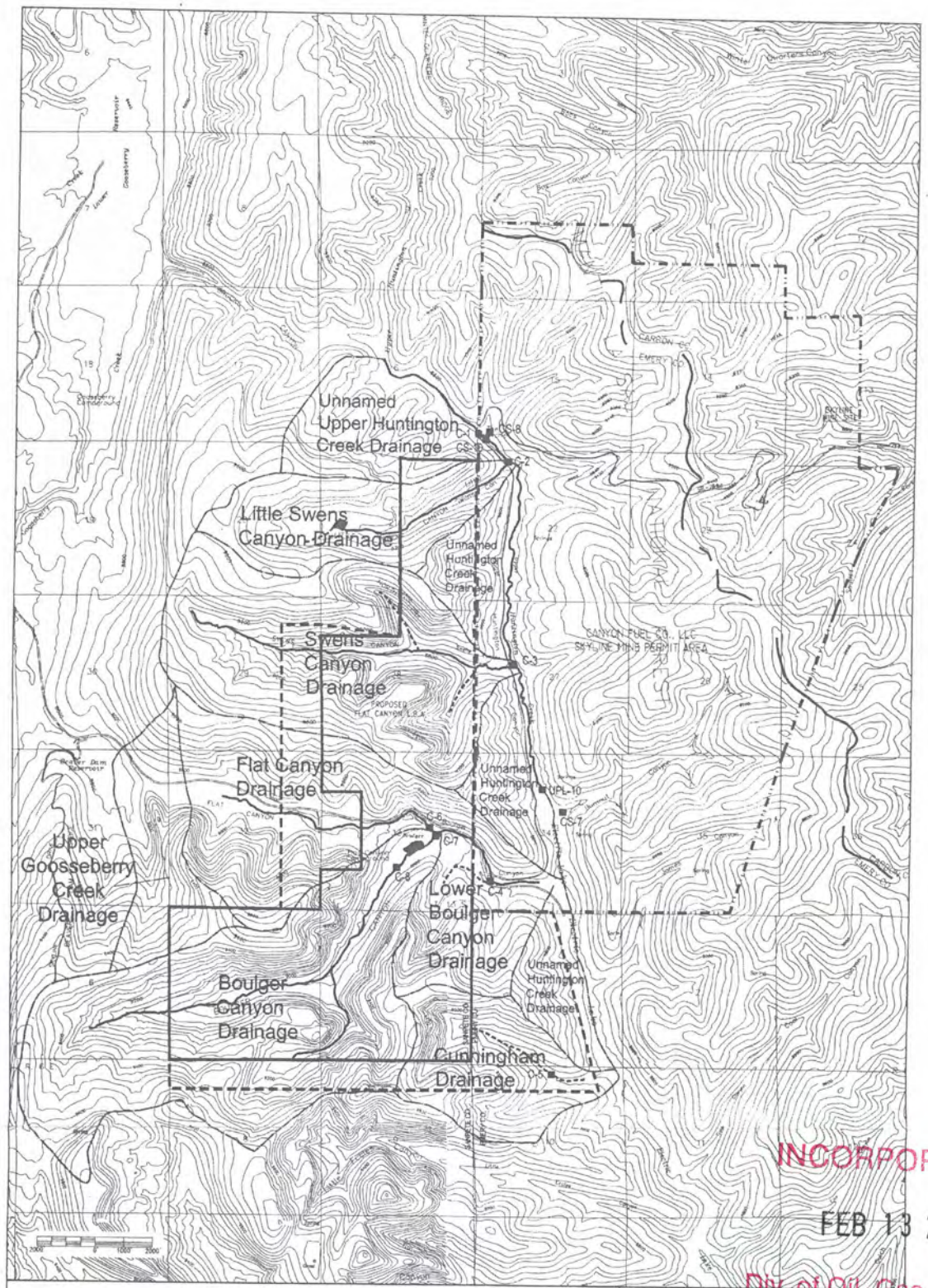

FIGURE 3.3
WATERSHED BOUNDARIES AND PERENNIAL STREAM REACHES

FILE: HYDRO1-2.DWG
DATE: 8/30/2000
SCALE: 1" = 3200'

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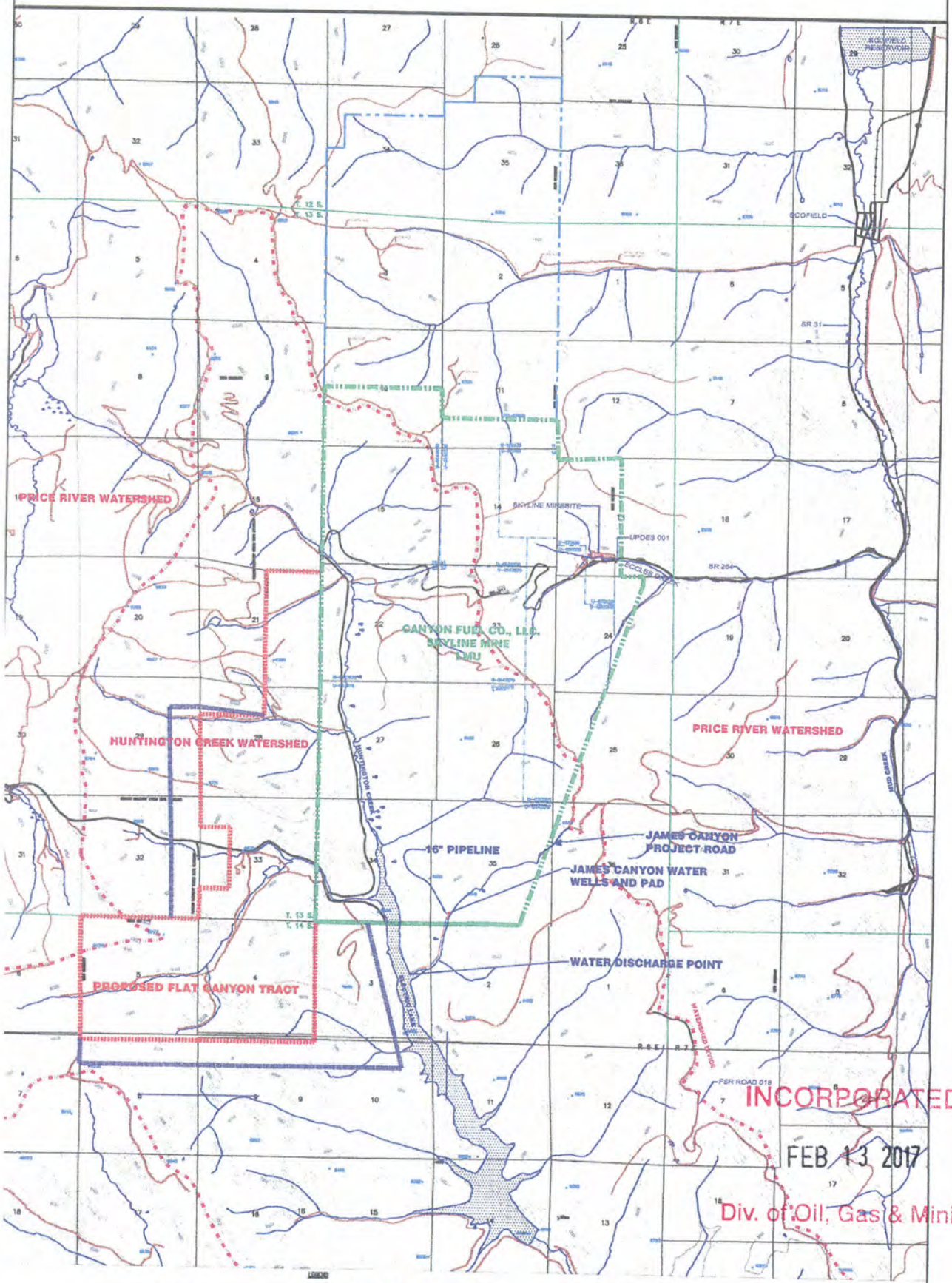

LEGEND

- FLAT CANYON COAL LEASE TRACT
- LEASED W/ PERMIT
- PROJECT AREA
- WINTER QUARTERS LEASE AREA (NOT PERMITTED)
- ELEVATION CONTOUR
- IMPROVED ROAD
- UNIMPROVED ROAD
- PROJECT AREA
- STREAM
- SPRING
- MAJOR WATERSHED DIVIDE

FLAT CANYON COAL LEASE TRACT
FINAL ENVIROMENTAL IMPACT STATEMENT

FIGURE 3.3a
WATERSHED AND WATER
DISCHARGE POINTS

FILE: FIGURE 3.3a.DWG
DATE: 11-07-01
SCALE 1"=4000'

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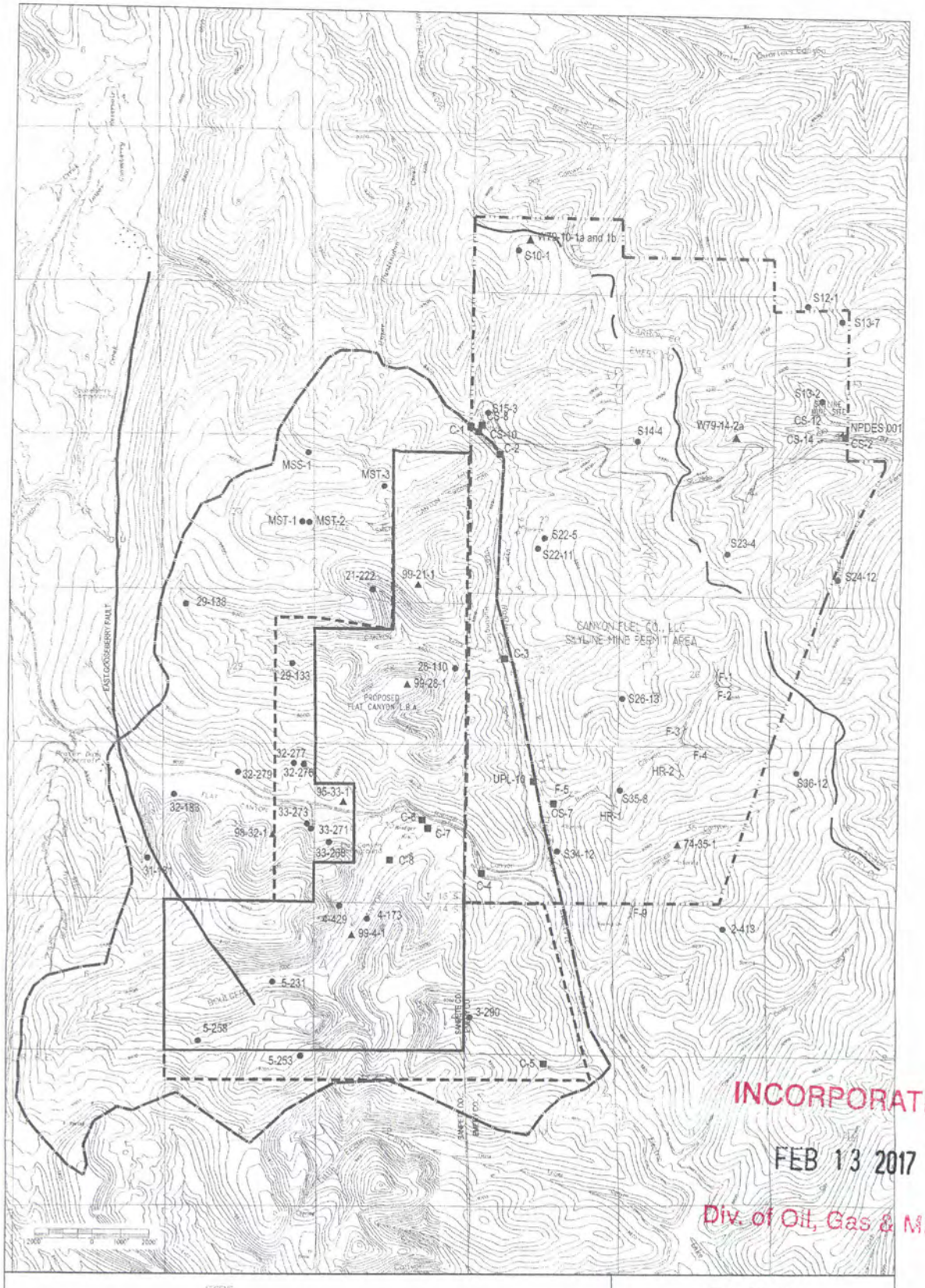

FIGURE 3.4

LOCATION MAP AND HYDROLOGIC MONITORING POINTS

FILE: HYDRO1-2.DWG | SCALE: 1" = 2000'

DATE: 10/13/2000

FLAT CANYON COAL LEASE TRACT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

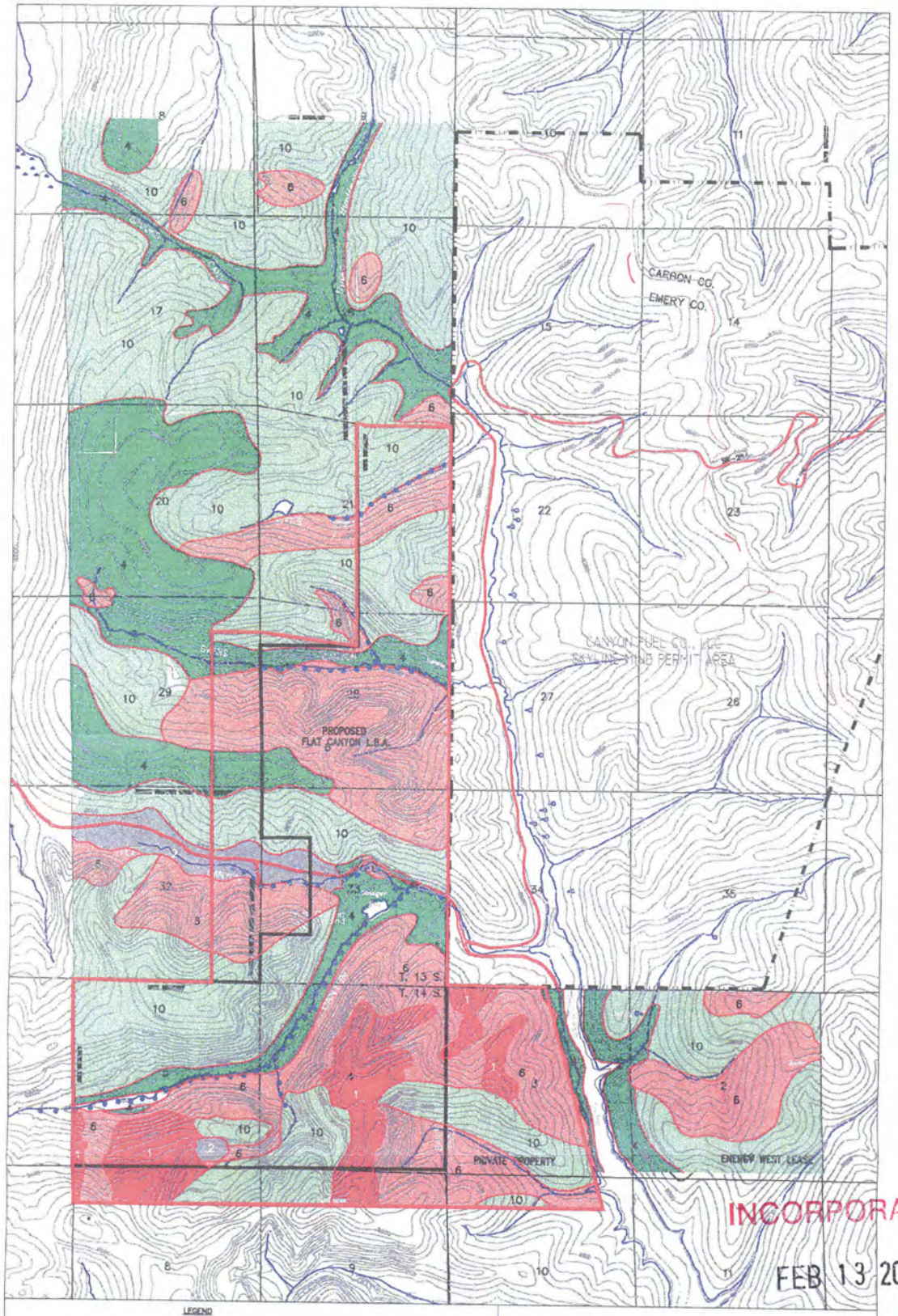

FIGURE 3-5
VEGETATIVE TYPES

DWG: VW3-1.DWG
DATE: 10/18/2000
SCALE 1" = 2640'

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4.0 EFFECTS OF IMPLEMENTATION

This chapter presents a description of the effects of implementing the No Action, Proposed Action, and other identified alternatives on the current human and natural environment likely to be affected. The effects are discussed by issue under functional areas or resource categories for each alternative as compared to current conditions. The subheadings are the same as those presented for the affected environment in Chapters 2 and 3. Direct, indirect, and cumulative effects are included.

The issues are evaluated by the evaluation criteria identified in the individual issue statements found in Chapter 2.

4.1 EFFECTS OF IMPLEMENTATION

The effects of mining would involve surface disturbance related to the construction and operation of exploration drill holes, two ventilation holes, the associated access roads, and surface subsidence caused by extraction of the underground coal seams. If leased, the life of the Skyline Mine would be increased by as much as 12 years, extending the direct effects of the existing mining operation by approximately the same length of time.

4.1.1 Mining/Coal Reserves

Under each alternative a different amount of the in-place mineable coal could be recovered by underground mining. The amount of coal that could actually be mined is called "recoverable coal", measured in million tons. The amount of recoverable coal is dependant on the mine layout, type of mining conducted, and local geology/structure. Faults are known to occur within the project area but it is not known if there is sufficient offset to prevent mining through them. For the purposes of this analysis, it is assumed that they would not inhibit mining. The differences in coal recoverability for the action alternatives discussed below are therefore caused by differences in the mine layout/method needed to prevent subsidence of specific surface resources.

4.1.1.1 Alternative A (No Action)

Under this alternative the Flat Canyon Tract would not be leased, therefore no coal would be recovered from the delineated tract area or the private lands with non-Federal coal reserves directly along the western and southern boundaries of the tract. If the tract were not leased, access to these reserves would not be provided. Even if an underground right-of-way were granted through the tract area solely for the purpose of accessing the private reserves, it would probably not be economical to drive access tunnels or mains through the tract (a distance of approximately one mile) to mine the small amount of recoverable private coal reserves by the room-and-pillar method. It could be possible to mine the private lands in the project area, but this would be a relatively small amount of coal.

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Without the addition of the Flat Canyon Tract, Canyon Fuel projects closure of the mine around the year 2003. If other available reserves in Federal Coal Lease (U-67939) that lie along the northern boundary of the existing permit area are mined, the mine life could be extended 6 to 8 years. It could however take 2 to 3 years to develop underground access to this lease from the existing permit area for mining.

Cumulative Effects

If the Tract is not leased and mined, mining would not occur on the adjacent private lands. In addition, it is possible that Canyon Fuel would close the mine in 2003. It is also possible that coal reserves in Federal Coal Lease U-67939 would be mined, extending the mine life an additional 6-8 years.

Irreversible/Irretrievable Commitment of Resources

The recoverable coal reserves in the Flat Canyon Tract and adjacent private lands could be irreversibly and irretrievably lost.

Short-Term Use vs. Long-Term Productivity

If the recoverable coal reserves in the project area are not mined in conjunction with the Skyline Mine as proposed, the long-term coal productivity related to the estimated additional years of mine production discussed under Alternatives B and C would not occur.

4.1.1.2 Alternatives B and B'

Under these alternatives underground mining would occur to maximize coal recovery and mining efficiency without specific measures for the protection of surface resources from the effects of subsidence. The project area would be accessed from the Skyline Mine Permit Area by driving full-support (no subsidence) mains westward under Upper Huntington Creek (near perpendicular crossing) and then southward paralleling Upper Huntington Creek under west flank of the drainage. Figures 1.2, 4.1, and 4.2 show the general locations of the mains. The mains would provide access for setting up development workings in preparation of longwall and room-and-pillar recovery areas (See Section 1.8 Reasonably Foreseeable Development Scenario). The majority of the coal would be mined by the longwall method with some fringe areas being mined by room-and-pillar recovery methods. Mining could take place in two overlapping seams in the majority of the tract, but there are some areas where only one of the seams could be mined. The Lower O'Connor Seam (upper seam) would be mined first. The Flat Canyon Seam (lower seam) would be mined after the upper seam is mostly mined out. Figure 4.1 (Upper Seam Mining Scenario, Alternative B) shows the probable longwall and room-and-pillar mining areas in the Lower O'Connor Seam. Figure 4.2 (Lower Seam Mining Scenario, Alternative B) show probable longwall and room-and-pillar mining areas in the underlying Flat Canyon Seam. Longwall panels would most likely be oriented in a general east-west direction, but could possibly be oriented in a north-south direction. The recoverable coal reserves are estimated to be

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approximately 36 million tons. It is estimated that the life of the Skyline Mine could be increased by 9 to 12 years at a production rate of 3 to 4 million tons per year.

Cumulative Effects

Production of coal from the project area is estimated at 36 million tons.

Irreversible/Irretrievable Commitment of Resources

The energy fuels and materials expended in the mine process would be irreversibly and irretrievably consumed. Since coal is a nonrenewable resource, the coal reserves mined and consumed would represent an irreversible commitment of this resource. Coal left in place for roof support and safety reasons would be irreversibly lost under the current capabilities of mining. BLM estimates that 50% of the estimated 72 million tons in-place mineable coal could be recovered. This is based on a conservative estimate of the capabilities of longwall mining with current technology. This means that 36 million tons could be mined and an equal amount would be unmined and lost to future production, under current technology.

Short-Term Use vs. Long-Term Productivity

Long-term productivity of available coal resources would be 9 to 12 years for the Flat Canyon Tract project area.

4.1.1.3 Alternative C

Under this alternative, the mine plan presented under Alternative B would be modified to prevent subsidence of specific surface resources. The perennial drainages, Boulger Dam, Flat Canyon Campground, and SR-264, would be protected from subsidence using a 23 to 30 degree angle-of-draw to determine the protection areas. Generally, this would separate the project area into three distinct zones of full-extraction mining. Full-support mains could cross under the perennial drainages providing access to the full-extraction blocks. Figure 4.3 shows the mining scenario for the upper Lower O'Connor Seam (Upper Mining Scenario, Alternative C). Figure 4.4 shows the mining scenario for the lower Flat Canyon Seam (Lower Seam Mining Scenario, Alternative C).

This would reduce the mineable area and recoverable reserves about 50%. The recoverable reserves would be reduced to approximately 18 to 20 million tons. The life of the Skyline Mine would be extended by 5 to 7 years.

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Cumulative Effects

The mining of underground coal reserves depends on the geologic, geotechnical, and economic factors associated with the extraction of the coal. If extensive acreage is blocked from full-extraction due to surface resource protection, the operating cost associated with the extensive

development required to extract each longwall panel could lower overall mine efficiency and coal recovery (BLM, 1999). This decreased ratio of coal mined during longwall mining to that coal mined for development (LDR-Longwall Development Ratio) could make the overall productivity marginal.

Not allowing full-extraction under surface features considered in these alternatives divides the mining blocks into essentially three irregular areas or regions (Figures 4.3 and 4.4). If the longwall panels were to be set up perpendicular, or near perpendicular, to the main-entry corridor, much of the coal in the smaller areas may not contain enough extractable coal to be considered a reserve. The northernmost area is probably too small by itself at the present time for longwall extraction. The middle or second block is less than the average panel length in the United States of 8,907 feet (Coal Age Magazine, 2001) for viable longwall coal extraction and most of the panels would be less than the average panel lengths in Utah mines of 6,140 feet (Coal Age Magazine, 2001). There could be many tons of coal lost due to the short panel lengths. Longer longwall panels that would intersect protected areas to the south cannot be considered because the non-mining areas are too large to consider moving around. The third (southern) block could probably be developed through longwall mining. However, if the northern and middle blocks are not viable for longwall mining, the distance necessary to access this block could be too great for it to be considered a reserve. Other longwall panel orientations or additional development from the main corridor needed to access the coal may require considerable development for panels and could affect the minability.

Canyon Fuel has detected several faults in the area through geophysical exploration. Existence of these faults has not been confirmed. The panels in the middle block are less than the average panel length and any other features, such as faults, could negate the potential minability. This is because the longwall panels may be too short to be viable. Because of the complexity of operational, economic, and geotechnical issues influencing coal recovery, the smaller irregular, nonperpendicular structural conditions and boundaries imposed by not allowing full-extraction, in addition to geologic and geotechnical factors, may affect minability of the coal. If the company feels that the risk is too high, the coal may not be mined and could be bypassed

Irreversible/Irretrievable Commitment of Resources

The energy fuels and materials expended in the mine process would be irreversibly and irretrievably consumed. Since coal is a nonrenewable resource, the coal reserves mined and consumed would represent an irreversible commitment of this resource. The total amount of coal that could be mined from the project area could be reduced from 36 million tons to 18-20 tons. This means that an additional 16 to 18 million tons would be left underground as compared to Alternative B.

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Short-Term Use vs. Long-Term Productivity

Long-term productivity of available coal resources would be 5 to 7 years for the Flat Canyon Tract project area.

4.1.2 Topography/Physiography, Geology (Includes Direct Surface Disturbance, Subsidence, and Seismicity)

This section describes the effects of disturbance for surface facilities, subsidence, and seismicity on the geology and topography of the project area. It is separated by subheadings for each of these categories.

4.1.2.1 Alternative A (No Action)

Disturbance from Surface Facilities

Under this alternative the lease would not be issued and there would be no surface disturbance associated with surface facilities that could cause effects to other resources.

Subsidence

Under this alternative the lease would not be offered or issued and no underground mining would occur. There would be no subsidence or related effects.

Seismicity

Under this alternative, the lease would not be issued and there would be no mining that would cause mining-induced seismic events. The project area would continue to experience seismic events from mining currently being conducted in the Skyline Mine permit area to the east. The University of Utah earthquake catalog has been used to evaluate the seismic activity in the area, with emphasis on mining-induced seismicity. A total of 1,013 events with magnitudes greater than 2 (Richter) were recorded within a range of several miles from the Skyline Mine workings. The frequency of events is much greater at the lower magnitude levels and decreases as magnitude increases. The fifty events with the highest magnitudes have been plotted in the cumulative frequency plot against magnitude presented in Figure 4.5. All of the events were recorded from 1993 to 1996 when Canyon Fuel was extracting coal from the deeper sections of Mine No. 3.

Events of magnitude 2 or greater can be felt by humans for a distance of 3400 feet from the location of location of origin (epicenter). Except for a 3.45 magnitude event that occurred in 1996, neither the Forest Service nor Canyon Fuel has received inquiries or complaints from the public or private landowners regarding these events. It is assumed that, even though these events could have been felt by people in the area, they were not noticed or did not cause concern from those within the area.

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4.1.2.2 Alternatives B and B'

Disturbance from Surface Facilities

It is estimated that about ten exploration drill holes would be required. The drill pads and temporary access roads would be short-term. Construction of the pads and access roads and drilling would take place for each hole in a single summer season, then would be reclaimed the same year in the fall. It would take approximately 3-5 years to meet revegetation standards. The temporary disturbance for access roads would be about 4.6 acres and about 4.6 acres for the drill pads. The total disturbance would be about 9.2 acres.

Ventilation shafts would not be constructed until underground mining progressed to each location and additional ventilation was required for safe operations. The general area proposed for location of these shafts is shown in Figure 4.1. The construction footprint for each ventilation shaft would be approximately one acre and about 1,000 feet of access road would be required, giving a total of about 2.9 acres. Crossing of Swens Canyon Creek would be required using a bridge to prevent disturbance of the stream channel. The roads would be reclaimed after one season of use. Most of the pad area would also be reclaimed, leaving just the vent shaft and fenced area 6-8 foot high chain link) for the life of the mine. These areas would be disturbed for the majority of the mine life and then they would be plugged and reclaimed.

The total new surface disturbance for the Tract would be about 12 acres with this divided into about 5.5 acres for access roads and 6.6 acres for drill pads and ventilation shafts. This disturbance is related to predicted surface facilities only and does not include subsidence resulting from underground mining.

The effects to other resources are discussed based on the issues identified in Chapter 2 and the evaluation criteria identified for each issue.

Subsidence

As underground mining occurs the coal is removed leaving a void. Due to the weight of the overlying rock and the resulting downward pressures, the rock immediately above the void is rubbleized and caves into the void. The rock strata above the caved and rubbleized zone also reacts to the loss of support and the weight of the overlying rock until equilibrium is reached. This results in downward and lateral movement of the rock and fracturing in three distinct zones above the mine void. If an area of coal removed is sufficient in size to cause the entire column of rock above to move downward before equilibrium is reached, subsidence of the ground surface will occur. Rock strata failure/subsidence is a complicated process. The amount of subsidence and disruption of the ground surface is dependent upon rock strength, discontinuities, stress, thickness of the overburden (depth of the coal seam), topography of the ground surface, mining method and orientation of mine workings, as well as the area, thickness, and number of overlying seams extracted. A detailed description of the subsidence process based on longwall mining is included in Appendix D.

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The amount and location of subsidence and the amount and type of associated surface disturbance expected is based on subsidence models that were locally adjusted using subsidence monitoring information from the adjacent Skyline Mine Permit area. Since the topography and geological conditions in the project area are generally the same and the mining method and general configurations of mine workings are similar, the subsidence predictions should be very accurate. There could however be variations based on differences between the mine layouts used in the Reasonably Foreseeable Development Scenario and actual mining as conducted by a future lessee/operator. For this reason, the mine layout used for the analysis presents a maximum reasonable subsidence/surface disturbance type scenario for predictions and effects analyses. The subsidence predictions were conducted by NorWest Mine Services, Inc. under the direction of the Bureau of Land Management and Forest Service. The shallowest overburden above the upper seam is 700 feet in Huntington Canyon at the southernmost portion of the project area.

Maximum subsidence (S_{max}) of 10 to 13 feet would occur at the center of longwall panels or blocks of panels where both mineable seams are extracted. From the edge of the panels, the amount of subsidence decreases laterally away from the center of the subsidence profile to a point of no subsidence, defining the edge of the profile. The subsided ground surface area extends beyond the vertical projection of the underground panel edge location to the ground surface, a horizontal distance determined by geological conditions and overburden thickness. The angle-of-draw defined as the angle between the vertical projection of the panel edge to the surface and the inclined projection from the panel edge to the point on the surface where subsidence decreases to zero. The angle-of-draw, determined from monitoring of subsidence at the Skyline Mine to the east, was determined to be approximately 22 degrees. The angle-of-draw is relatively constant over large mining areas with consistent geologic conditions, unless disrupted by major faults. This angle was used to predict the subsidence area for the analysis or project area.

Horizontal compression and tension zones occur at the ground surface due to the vertical ground movement from subsidence. It is these forces that tend to cause lateral ground movement and fractures in addition to the elevation changes. Tension zones form at the ground surface in the area between the vertical projection of the panel edges and the flanks of the subsidence troughs in the area defined by the angle-of-draw. This is caused by the subsiding land surface pulling away from the adjacent unaffected ground as vertical movement takes place. It is here that tension cracks on the ground surface are most common. Compressional forces occur at the ground surface in the area at the center of the subsidence troughs where the land is squeezed together as it moves downward during subsidence. As mining in individual rectangular longwall panels progresses, the subsidence trough develops within days behind advance of the mine face. This results in transient (moving) tensional strain that becomes a compression zone after the panel is completed. In other words, the surface is temporarily pulled apart as mining progresses then is squeezed back together after mining is completed. These forces occur in each panel and only become permanent after mining of a panel block, consisting of several parallel panels, is completed. The majority of the final subsidence movement occurs rapidly as mining advances

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then tapers off to smaller amounts of movement that can occur for up to two-years following completion of mining. Room-and-pillar recovery mining sections experience subsidence in a similar manner but the subsidence can take a longer time to be complete and there can be more surface disruption and cracking because of the effect of differential settlement above individual pillars.

Where mains (see Appendix D for a description of mains) are driven for access to the mining areas, entry widths and pillars are designed to provide sufficient support of the overlying rock to prevent subsidence in the short or long-term (200 years) with a safety factor of 1.74. Even though pillar failure over centuries is unlikely, the effects of pillar failure have been analyzed. In the unlikely event that pillars fail over time, failure of the pillars would occur over a long time span, resulting in very slow, gradual subsidence. Within the outer edge of the mains, only 40% of the coal would be mined. The maximum amount of subsidence that could occur over one seam is less than 2 feet and less than 5 feet for two overlapping seams.

Under this alternative, no special lease stipulations would be added to the lease to protect sensitive resource areas from subsidence. The lease would be offered by BLM with the standard terms and conditions included on Lease Form 3400-1 only. It represents a scenario where the mine plan would be developed to maximize recovery of the coal resource. The majority of the Tract and project area would be subsided from longwall mining with a high proportion of the area subjected to multiple-seam mining. This mining scenario is depicted on Figures 4.1(upper seam) and 4.2 (lower seam). The related subsidence zones are depicted in Figure 4.6.

The exact amount of subsidence and disruption of the ground surface at any particular location would be dependent on a specific detailed mine plan and extraction sequence. However, the degree of subsidence expected from different aspects of the mine layout is discussed below in relation to the mining layout features below:

- panels (above the center of panels);
- single abutment pillar (above the edge of solid coal pillars);
- stacked abutment pillars (above the edge of coal pillars aligned in two seams);
- single fire barrier pillar (a fire barrier pillar is in one seam only);
- stacked fire barrier pillars (fire barrier pillars are aligned in two seams);
- gate roads (where gate road pillars are left between panels); and
- longwall face (dynamic effect at center of panels during retreat).

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The manner in which subsidence occurs and the location of pillars left underground defines the range of temporary and permanent subsidence impacts to be expected. Particular zones where permanent subsidence might lead to a higher impact are related to areas of higher differential subsidence above fire barrier pillars and abutment pillar zones. Where these pillars are stacked above each other in multiple seam cases the degree of differential subsidence is much greater. The location of fire barriers cannot be reliably predicted without a specific mine plan, but the

location of the major abutment zones can be reasonably estimated from the mining scenarios evaluated. The variation of subsidence and the relative degree of effect in relation to the Skyline subsidence is presented for different mining layout features are discussed below in relative terms and shown on Figure 4.6.

The qualitative descriptors used to define the degree of differential subsidence are defined below in relation to typical conditions experienced at Skyline. They should not be regarded as quantitative and have been developed based upon relating observations at Skyline to expected subsidence from the mine layout.

Very Low: This generally applies to most of the areas between panels (above gate roads) and dynamic subsidence as the longwall face retreats at greater depth. A gentle flexure of the strata is expected with no major tension cracking and induced surface gradient changes less than about 0.4%.

Low: This generally applies to some single abutment and fire barrier pillars at greater depth and above some gate roads and dynamic subsidence areas at shallower depth. Flexure of the strata is expected with a low potential for tension fractures to occur and induced surface gradient changes of about 0.4 to 0.8%.

Moderate: This generally applies to single abutment pillars at shallower depth, single fire barrier pillars at depth and stacked abutment pillars at depth. Generally flexure of the strata is expected with a low to moderate potential for some minor tension fractures to occur at ridges with low lateral constraint. Induced surface gradient changes of about 0.8 to 1.5% are expected.

High: This generally applies to stacked abutment pillars at shallower depths and stacked fire barriers at depth. Flexure of the strata has a moderate potential for tension fractures to form at ridges or steeper slopes with reduced lateral constraint. Induced surface gradient changes of about 1.5 to 2.5% are expected.

Very High: This only applies to stacked fire barrier pillars at shallow depths. Major flexure of the strata has a high potential to create major zones of tension fractures in areas with reduced lateral constraint. Induced surface gradient changes of over 2.5% would be expected.

For the purpose of analysis, a total of nine representative subsidence prediction points have been used for the evaluation of impacts to the most sensitive (most vulnerable to effects of subsidence) locations of the project area that includes structures, facilities and resources and their locations are presented in Figure 4.7. The main resources, structures and facilities that have been evaluated for impact from mining induced subsidence are listed below together with their description and reference to the numbered prediction points used to characterize the degree of subsidence.

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Boulger Dam & Reservoir

This is an earthen dam and associated reservoir located at the mouth of Boulger Canyon near its confluence with Flat Canyon. The reservoir is below and adjoining the Flat Canyon Campground and provides recreational amenities. Characterization for this structure is covered by Subsidence Point No. 6.

State Highway 264

This is a paved, all-weather highway passing through the project area following the valley floors of the Upper Huntington Creek, Boulger Canyon, and Flat Canyon. Characterization of this structure in Flat Canyon is covered by Subsidence Point No.5 and in Boulger Canyon by Point No.6. Where it runs alongside the west side of the Upper Huntington Creek valley floor it is protected from subsidence by restrictions on longwall mining below this important drainage.

Flat Canyon Campground & Facilities

The Flat Canyon Campground facility consists of camping areas with associated freshwater and toilet facilities. Freshwater is provided by a spring collection system located on the west side of Boulger Canyon with the water fed to the campground through a buried pipeline and storage tank near the campground. Characterization of these facilities is covered by Subsidence Point No.8 for the spring collection system and No.5 and No.6 for the Campground.

Private Cabins & Buildings

Within the area influenced by mining there are a number of privately owned cabins in Flat Canyon and Swens Canyon. Characterization of the four cabins in Flat Canyon is covered by Subsidence Point No. 5 and the one cabin in Swens Canyon is covered by Point No. 3.

Upper Huntington Creek Perennial Drainage

This drainage system is defined as the perimeter of the Upper Huntington Creek valley alluvium. No longwall mining that would subside this area is planned for the Tract area, but it is likely that a main development corridor would be required running parallel and under the creek at depths from 700 to 1000 feet.

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Flat Canyon Perennial Drainage

This drainage system is defined as the perimeter of the Flat Canyon valley alluvium. Characterization of this canyon is covered by Subsidence Points No. 5 and No. 6.

Boulger Canyon Perennial Drainage

This drainage system is defined as the perimeter of the Boulger Canyon valley alluvium. Characterization of this Canyon is covered by Subsidence Points Nos. 1, 6, 7, and 8.

Swens Canyon Perennial Drainage

This drainage system is defined as the perimeter of the Swens Canyon alluvium. Characterization of subsidence in this canyon is addressed by Subsidence Points 3 and 4.

Little Swens Canyon Perennial Drainage

This drainage system is defined as the perimeter of the Little Swens Canyon alluvium. Characterization of this Canyon is covered by Subsidence Point No. 2.

Cunningham Possible Perennial Drainage

This drainage system is not projected as perennial within the Tract, but has been designated as possibly perennial on adjacent private land. Characterization of this area is covered by a single Subsidence Point No.9.

Table 4.1 displays the number of seams to be mined, overburden thickness, amount of maximum subsidence, and relative degree of differential subsidence for each of the above described locations.

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Table 4.1. Predicted Subsidence and Relative Degree of Effect in Comparison to Skyline

Parameter	Subsidence Prediction Point								
	1 Boulger South	2 Little Swens	3 Swens West	4 Swens East	5 Flat West	6 Boulger Dam	7 Boulger West	8 Boulger Central	9 Cunn-ingham
Overburden Thickness above Lower Seam (feet)	1850	1600	1700	1100	1500	1200	1750	1500	1600
Number of Seams Mined	2	1	2	2	1	2	1	2	2
Maximum Subsidence (feet)									
Panels	10	5	10	12	4	13	4	13	12
Single Fire Barrier Pillar	7	2	6.5	7	2	9	2	8	7
Stacked Fire Barrier Pillars	4.5	-	4.5	5.4	2	6	3.5	5.9	5.4
Gate Roads	9.5	4.5	9.5	11.5	3.5	12.5	3.5	12.5	11.5
Maximum Slope Change (%)									
Single Abutment	0.6	0.8	0.6	1.4	0.6	1.2	0.6	1.0	0.8
Stacked Abutment	1.4	-	1.4	3.0	-	2.8	-	2.2	1.8
Single Fire Barrier	0.6	0.7	0.6	1.4	0.6	1.2	0.6	1.0	0.8
Stacked Fire Barrier	1.4	-	1.4	3.0	-	2.8	-	2.2	1.8
Gate Roads	0.2	0.1	0.2	0.4	0.2	0.4	0.1	0.2	0.2
Longwall Face (Dynamic)	0.3	0.4	0.3	0.7	0.3	0.6	0.3	0.5	0.4
Degree of Differential Subsidence (Relative to Skyline)									
Single Abutment Pillar	VL	L	VL	M	L	M	VL	L	L
Stacked Abutment Pillars	M	-	M	H	-	H	-	H	H
Single Fire Barrier Pillar	L	M	L	H	M	M	L	M	M
Stacked Fire Barrier Pillars	H	-	H	VH	-	VH	-	H	H
Gate Roads	VL	VL	VL	L	VL	L	VL	VL	VL
Longwall Face (Dynamic)	VL	VL	VL	L	VL	L	VL	L	VL

VL = Very Low, L = Low, M = Moderate, H = High, VH = Very High (relative to experience at Skyline)

Seismicity

Subsidence causes ground shaking or seismic events as the rock strata above the extracted coal fractures and bends. Prediction of seismic events and the resulting ground vibrations at a given point from mining activity requires evaluation of the following parameters:

- Magnitude of the Maximum Credible Event (MCE) that is historically reported as local magnitude on the Richter scale. This is based on recording vibrations within a frequency range that is important for evaluation of the impact on typical structures.
- Source location, type, and period of vibrations generated.
- The mechanism involved in transmitting the vibrations through rock and soil to the ground surface, typically defined by an attenuation equation based on the distance from the source.

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- The site-specific reaction of the surficial materials with the bedrock interface and the degree to which particular structures respond to ground vibrations. This may involve separate evaluation of the different vibration parameters for displacement, velocity, and acceleration in three orthogonal planes and their variation with frequency.

The effects would be the same for both action alternatives, but they would occur for a longer period of time under Alternative B so there would be more total events. It is expected that up to 12 years of mining could occur for Alternative B. They would occur for a shorter period of time (5 to 7 years) with fewer total events for Alternative C because of the decreased recoverability associated with protection of resources and structures from subsidence. Since the geologic and mining conditions in the project area are generally the same as the conditions in the Skyline Mine permit area to the east, the frequency and magnitude of events experienced at Skyline Mine would continue as has occurred in the past.

Evaluation of historic mining induced seismicity at the Skyline Mine has been used to predict the MCE level to be used in calculations. Only 12 events exceeded 3 in magnitude. Of these, only 4 exceeded 3.2. Only one event in 1996 exceeded 3.4 at a magnitude of 3.45.

A magnitude of 3.45 was selected for the MCE based on evaluation of the results from monitoring. Even though it is highly unlikely that an event of the magnitude would occur again, it is possible therefore this MCE was used for evaluations of potential effects. A source location about 500 feet above mine workings was selected to be conservative. A conservative attenuation relationship, known as the McGarr Equation, was selected for estimation of ground vibrations variation with distance from the MCE. It is known, from monitoring of seismic events and ground shaking at the Joes Valley Dam, that the McGarr equation projects that more energy would reach structures on the Wasatch Plateau than would actually occur. However, no data are available at this time to adjust the equation to local conditions. No site-specific data were available concerning the effect of vibrational coupling between bedrock, superficial materials and structures, consequently it was assumed that there was no magnification. Ground vibrations at structures are measured as peak particle velocity (PPV) or peak particle acceleration (PPA). Peak particle acceleration is used to determine how much vibration would be experienced at structures based on the MCE at distance. Perception of vibrations by humans is generally measured as peak particle velocity.

The issues of importance related to mining-induced seismicity involve potential damages to reservoirs and dams and the response by humans to these events. These effects are evaluated in the related sections of this chapter.

The potential for damage to structures is a function of the amount of energy or shaking that would occur at the specific location, determined by the magnitude of the seismic event, distance between the location of the event and structure, and how much energy is transferred to the location through rock (attenuation).

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Human response to mining induced seismicity has the potential to be noticeable by campers, forest visitors, and cabin residents within a range of about 3,400 feet from full-extraction mining areas. With a possible frequency of one event that can be distinctly felt every 5 days on average, this is not considered to result in adverse impact. It should be possible to minimize any adverse impact by adequate warning, education, and the implementation of a suitable public relations program.

The range of seismicity predictions have been summarized in relation to their effects on the dams and presented in Table 4.2.

4.1.2.3 Alternative C

Disturbance from Surface Facilities

The effects would be the same as Alternative B.

Subsidence

Under this alternative the perennial drainages, Boulger Dam, Flat Canyon Campground, and SR-264 would be protected from subsidence by using a 23 to 30 degree angle-of-draw. As discussed Section 4.1.1, this would separate the mining and subsidence areas into three blocks separated by the protection zones for perennial streams. The maximum subsidence would be similar to that under Alternative B, at around 13 feet that could occur somewhere in the center area of each of the three subsidence blocks. The differential subsidence where maximum tensile strain is experienced would be basically the same in magnitude as discussed under Alternative B but the area affected would be larger, essentially surrounding each of the three subsidence blocks. Figures 4.3, 4.4, and 4.8 display the subsidence blocks and maximum differential areas for this alternative. The subsidence points shown on Figure 4.7 and discussed in Table 4.1 would not be subsided due to the required protection zones.

Seismicity

Subsidence-induced seismicity would be essentially the same as discussed for Alternatives B and B', but fewer would occur because of the shorter mine life and there would be no subsidence directly below the protection zones. Since the subsidence protection zones are relatively small relative to the distances of concern regarding attenuation of the seismic wave energy, the differences would be negligible.

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4.1.3 Facilities

4.1.3.1 Alternative A (No Action)

No mining would occur within the project area, but the mains in the existing permit area under or adjacent to Huntington Creek could still be driven to access existing lease areas. It is unlikely

that the mains would cause subsidence of State Route 264 or the gas pipeline buried beneath the highway. If subsidence did occur, it would occur very slowly over hundreds of years. It is remotely possible that minor repairs of the highway would be required at isolated locations. The pipeline is no longer in service and is not likely to be reactivated. It could, however, be used as a water pipeline to discharge water from the underground mine workings to Electric Lake if this is approved at some time in the future. Because of the low potential of subsidence and the slow rate that it might occur, damage to the pipeline is not a concern, especially considering the relatively short mine life as compared to centuries for subsidence.

Since no subsidence would occur within the project area, no mining-induced seismic events would be triggered in the project area. The project area could, however, experience seismic-induced seismic events from mining in the existing Skyline Mine Permit Area to the east. Some of the larger seismic events could be perceived by humans in the project area but because of the distances involved, it is not likely that there would be any damage to structures.

4.1.3.2 Alternatives B and B'

Potential Subsidence/Seismicity Effects to Boulger Dam & Reservoir

The results for subsidence Prediction Point 6 indicate that cumulative vertical subsidence of up to about 13 feet could be expected from mining two seams below the dam. The dam is estimated to be marginally stable and would not withstand major subsidence without failure. Due to the sensitivity of this structure, it is prudent to assume that stacked abutment or fire barrier pillars would not be located within the angle of draw from the dam, as they would result in High to Very High differential subsidence. Hence, the degree of differential subsidence is expected to vary from Low to Moderate and there is reasonable expectation that the dam could fail. The rate and extent of failure would depend upon the degree of differential subsidence imposed on the structure and whether or not the reservoir is drained. Since there is potential for the dam to fail, mitigative measures would be required of the lessee/operator under Alternative B' based on SCLSs #7, #9, and #13 prior to and/or during mining.

The main options for mitigation are listed below:

- Drain the reservoir prior to subsidence and repair/replace the dam afterwards. This would logically include replacing the dam to current requirements for construction and operations and dredging of the reservoir. This is estimated to cost about $390,000.

- Make any necessary upgrades to the dam as determined by a detailed subsidence/stability analysis for protection of the facility. Options might include reinforcing the structure by adding a buttress to the downstream face with the reservoir drawn down for short periods of active subsidence. This is estimated to cost about $150,000. This option would only be acceptable if the lessee/operator could demonstrate that the dam could withstand planned subsidence and

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seismicity without sustaining damage. Close monitoring of the dam would be required at additional cost to the lessee/operator.

The public safety risks will need to be addressed and other mitigative measures taken to limit the potential safety hazards if the dam were to fail. Under Alternative B', the dam would be taken out of service for the life of operations or potentially reconstructed or reinforced to prevent downstream hazards. This is a relatively small dam, with a limited ability to damage infrastructure or injure personnel downstream should it fail. With the ability to carry out full or partial draining of the dam and minimize downstream damage, it is likely that acceptable mitigation safety measures can be identified.

A Parametric Stability Analysis was carried out on the dam by NorWest Mine Services, Inc. (Appendix F, Technical Report on Geology, Mining, Subsidence, and Seismicity, October 19, 2000 maintained in the FS project file). The analysis indicates that the dam could withstand a seismic event with an equivalent horizontal ground acceleration of up to 0.1g. Any acceleration greater than this could induce failure of the downstream slope and a potential breach. A review of historical events included in the United States Geologic Survey and University of Utah databases, confirms that to date the structure has probably not experienced any seismic events, either natural or mining-induced, with an equivalent ground acceleration greater than about 0.08g. Based on an MCE of 3.3 or 3.45 the McGarr equation indicates that the dam could withstand this event at a distance of over 5,500 feet but not closer. Therefore, under this alternative the dam could experience damage from mining-induced seismicity and potentially breach. It is known that the McGarr equation overestimates that attenuation of seismic energy for sedimentary strata found in the project area. It is anticipated that current monitoring in the Trail Mountain area intended to refine the McGarr equation for areas in the Wasatch Plateau will result in lower transmission of energy over distance relative to Table 4.2.

Under Alternative B' the mitigations described above would occur due to potential damage to the dam from seismicity.

The variation of peak particle acceleration with distance from events of magnitude 3.33 and a deeper event of 3.45 are presented in Table 4.2 and shown on Figure 4.9.

Table 4.2. Attenuation of Mining Induced Seismic Vibration with Distance for Magnitude 3.33 and 3.45 Events (after McGarr, 1981)

Horizontal Distance from a 3.33 Magnitude Event at Shallow Depth of 500 ft. (Ft)	Horizontal Distance from a 3.45 Magnitude Event at 3000 ft Depth (Ft)	Peak Particle Acceleration (g)
1,000	-	0.4
1,600	-	0.3
2,600	0	0.2
5,500	5,500	0.1
6,900	7,200	0.08

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It is estimated that the dam and reservoir would be out of service for up to 12 years if the dam is taken out of service or if it is damaged, considering two seams of mining and the length of time that mining-induced seismic events could occur.

Potential Subsidence/Seismicity Effects to State Highway 264

The section of the highway that passes alongside Upper Huntington Creek is protected by the requirement for protection of this perennial drainage. The results for Subsidence Prediction Points 5 and 6 in Flat and Boulger Canyons indicate that cumulative vertical subsidence from about 5 ft. in the west up to about 13 feet in the central and eastern section could be expected. The degree of differential subsidence is expected to range from Very Low to Moderate over the majority of the length of the road, with the possibility that it will be High at the east end where stacked barrier pillars will be located (NorWest, 2000).

Skyline has undermined SR 264 in the past without major problems. The road follows the valley floor with thick surficial soils, predominantly of glacial origin, and lateral constraint. The effect of subsidence is expected to result in flexure of the surface with induced gradient changes up to 3% for the majority of the area and some minor surficial cracking at the east end. Damage to drainage ditches and culverts could also occur.

Under Alternative B' (SCLS #13) and possible under Alternative B (conditions for permit approval) close monitoring of the highway during active subsidence and repairs would be required. Resurfacing of the road at the east end with re-grading of drainage ditches and the possibility of replacement of one culvert may be required. The total costs to the lessee/operator for this work are estimated to be in the order of $52,000 (NorWest, 2000). Additional costs would be incurred for monitoring.

No major safety concerns are anticipated based on the experience of the Skyline Mine, although safety is an important issue so warning signs and regular inspections of the road surface would be required during the periods of active subsidence and immediate repair of hazards would be required.

It is not anticipated that mining-induced seismicity would affect the highway or public safety.

Potential Subsidence/Seismicity Effects to Mainline #41 and Mainline #104 Gas Transmission Pipelines

A decommissioned segment of the gas transmission pipeline runs along the Upper Huntington Creek valley floor alongside State Highway SR 264. This structure will be protected due to the pillars left in the Main Development Corridor to protect this perennial drainage. In addition, the pipeline was taken out of service in 2000. Consequently, no subsidence is expected for this structure.

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That portion of Mainline #41 that is currently in service, including the new Mainline #104 constructed in 2001, lies within the Skyline Mine Permit area along Trough Springs Ridge and Granger Ridge more than a mile to the east of the project area. In addition, an additional refined fuels pipeline could be constructed in the same corridor no earlier than the 2002 field season. Considering this distance, subsidence and mining induced seismicity have no potential to damage to the pipelines. The current approved Mining and Reclamation Plan for the Skyline Mine provides for protection of the pipelines from subsidence. Extensive areas of the current pipeline corridor were mined and subsided while the temporary reroute under SR 264 was in service. Subsidence has stabilized under the ridge top segments (Skyline Mine Annual Subsidence Monitoring Reports). Other segments are protected by full-support mining zones where subsidence will not occur. Even with the close proximity of past and current mining, no damage to the pipelines has occurred or is anticipated from either subsidence or mining-induced seismicity. The magnitudes of past and anticipated mining-induced mining events are not great enough to cause damage to the gas pipelines, as demonstrated by past mining in the area.

No effects of mining-induced seismicity are anticipated.

Potential Subsidence/Seismicity Effects to Flat Canyon Campground & Facilities

The results for subsidence prediction points 5 and 6 show that from 5 to 13 feet of subsidence may be observed at the main facilities and up to 13 feet may be observed at the spring collection system. The degree of differential subsidence is likely to range from Very Low to Moderate.

Damage to the restroom structure may be observed with cosmetic damage to the structure expected. It is also possible that damage to the toilet vault, septic tank, and drain field could occur. There is a minor potential for damage to the water supply pipeline, tank, and hydrant system. The spring collection system and pipeline have a very low driving head that might be eliminated under some subsidence conditions.

Hazards to campground users would not be high but would still be a major concern during periods of active subsidence. It is likely that the campground would be taken out of service for two seasons or more coinciding with the periods of active subsidence for each seam of mining and continue until damaged facilities are repaired.

Under Alternative B' the lessee/operator would be required to monitor damages and repair them as soon as possible. The total estimated cost of mitigation is in the order of $150,000.

Minor cosmetic damage could occur to structures from seismicity. The potential is relatively low. Under Alternative B' repairs would be required of the lessee/operator.

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Potential Subsidence/Seismicity Effects to Private Cabins & Buildings

The results for subsidence prediction points 5 for Flat Canyon and 3 for Swens Canyon indicate that subsidence will range from 4 to 10 feet in these areas. The degree of differential subsidence in both areas is expected to be from Very Low to Low.

Subsidence is likely to result in minor distress and cosmetic damage to structures and the rupture of underground service connections. Where the cabins in Flat Canyon are located close to the limit of single seam mining there is the possibility that they may be exposed to permanent subsidence requiring major reconstruction. Occupancy during active subsidence should not be permitted. Repairs would probably be required under the Utah Coal Rules. The estimated costs for mitigation are estimated to be $360,000 for Flat Canyon and $360,000 for Swens Canyon. While there are safety concerns, these can be mitigated to acceptable levels.

A 3.3 or 3.45 seismic event within 5,500 feet would be perceived by occupants of these buildings. Unanchored items could be knocked over and minor cracking to rigid masonry or concrete foundations or chimneys could occur. Less than 1% of expected events are expected to be above 3.0. Reports differ regarding the potential for people to feel events in the range of 2.0 to 3.0 and would be dependant on the distance from the epicenter or origin location of the event.

Potential Subsidence/Seismicity Effects to Electric Lake Dam

No mining will take place within 2 miles of this structure, consequently no subsidence could occur.

Should the MCE occur at the closest location of mining to the dam, the dam would experience less than 0.1g of acceleration. If the largest known mining-induced seismic event (3.8 on Gentry Mountain caused by room-and-pillar mining in 1981) were to occur at the closest point, the dam would experience less than 0.1g. There are no anticipated effects to Electric Lake Dam.

Potential Subsidence/Seismicity Effects to Hunt Reservoir Dam

No mining would take place within approximately 0.5 mile of this structure, consequently no subsidence could occur.

The nearest mining could occur at a distance of approximately 0.5 mile or 2,600 feet. Mining-induced seismicity could cause damage and breach of this structure if the MCE of 3.33 or 3.45 would occur within 5,500 feet. Since there is potential for the dam to fail, the lessee/operator would be required under Alternatives B and B' to work with the landowners and develop mitigative measures prior to and/or during mining.

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The main options for mitigation are listed below:

- Drain the reservoir prior to subsidence and repair/replace the dam afterwards. This would logically include replacing the dam to current requirements for construction and operations and dredging of the reservoir in cooperation with the landowner and State of Utah. This is estimated to cost about $390,000, including about 2–3 years of lost use.

The public safety risks will need to be addressed and other mitigative measures taken to limit the potential safety hazards if the dam were to fail. This is a relatively small dam, with a limited ability to damage infrastructure or injure personnel downstream should it fail. With the ability to carry out full or partial draining of the dam and minimize downstream damage, it is likely that acceptable mitigation safety measures can be identified.

Cumulative Effects

The project area is developed considering the density and number of roads, highways, reservoirs, campgrounds, and privately owned camps and cabins/structures. The effects to existing structures/facilities are discussed in the previous section. Due to projected increased recreation use for the area, the Forest Service has plans to further develop the Boulger Reservoir area by reclaiming recreation disturbances directly adjacent to the reservoir and developing additional camp locations with gravel surfacing adjacent to the parking area. In addition, some minor expansion of the Flat Canyon Campground may be needed to accommodate use projections. Past, Present, and Reasonably Foreseeable Future Actions are displayed in Appendix A. These improvements would probably be delayed until an opportune time relative to the mining, subsidence, and repairs needed to repair any damages. Reconstruction of Boulger Dam and dredging of the reservoir area following mining would probably result in a more stable dam constructed to current safety requirements.

It is likely that private landowners in the area would improve their existing facilities and construct new ones. It is also reasonably foreseeable that new roads on the private lands would be needed to access these facilities. The private landowners should work with the mining company to construct these facilities to avoid subsidence damage.

The anticipated mining could delay new developments in the project area for as much as 12 years because development during the active subsidence periods would be subjected to potential damages as discussed in previous sections. Human use of the area will probably continue to increase but the projected increased use of developments could be delayed up to 12 years until mining is completed and subsidence is substantially complete.

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Lost use of the structures/facilities and delayed development could displace use to other facilities. It is projected that use of Benches Reservoir, Electric Lake, and Gooseberry Campground would increase because people would use these facilities instead of the closed facilities. This could require additional maintenance of these facilities due to the increased use.

Irreversible/Irretrievable Commitment of Resources

Any lost use of structures and facilities due to mining-caused damages would be irretrievable but not irreversible. The structures can be repaired and replaced.

Short-Term Use vs. Long Term Productivity

If new developments were delayed due to mining, the associated human activity and disturbance to natural resources would also be delayed. The decreased rate of development would decrease the rate that productivity of natural resources in the area would be affected until mining and subsidence are complete.

4.1.3.3 Alternative C

Underground mining would be restricted to methods that would not cause subsidence and/or to areas where subsidence would not occur at perennial streams or structures such as dams, pipelines, highways, and campgrounds, specifically discussed under Alternative B. However, subsidence of cabins and structures on non-federal lands with non-federal coal could occur, if allowed by the surface and mineral estate owners. The mining scenario is depicted on Figures 4.6 (upper seam) and 4.7 (lower seam).

Subsidence would occur only in the areas between perennial drainages as depicted on Figure 4.8. The drainages, paved highways, campground, and Boulger Reservoir would be protected by preventing full-extraction mining within the area determined by projecting a line from the edge of the channel alluvium in the drainage downward to the coal seam using the angle-of-draw. This would split the mining area into major northern and southern blocks of recoverable coal in both mineable seams and a third smaller northernmost block of coal that could be mined only in the lower seam. Figure 4.8 depicts the relative differential subsidence and degree of effect for this mining scenario.

Two private cabins on the south side of Flat Canyon lie within the subsidence protection zone for Flat Canyon Creek. However, two private cabins on the north side of Flat Canyon and one private cabin in Swens Canyon could be subjected to subsidence. They would be subsided as described in Alternatives B and B' and shown on Table 4.1. The cabins north of Flat Canyon is located in a single seam abutment zone and the cabin in Swens Canyon is located in a double abutment zone.

The structures would be protected by preventing full-extraction mining in an area defined by projecting a 23-degree angle-of-draw from the structure down to the coal seam. No full-extraction mining would be allowed within the resulting protection zone. Where the structures lie within a protection zone for perennial drainages, the structures would already be protected. The cabins on the south side of Flat Canyon and the cabin in Swens Canyon would be affected as described under Alternative B.

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Even though some of the structures would be protected from subsidence, full-extraction mining would occur within distances where the structures would be subjected to mining-induced seismicity. The effects would be the same as described in Alternative B'.

Cumulative Effects

The project area is heavily developed considering the density and number of roads, highways, reservoirs, campgrounds, and privately owned camps and cabins/structures. The effects to existing structures/facilities are discussed in the previous section. Due to projected increased recreation use for the area, the Forest Service has plans to further develop the Boulger Reservoir area by reclaiming recreation disturbances directly adjacent to the reservoir and developing additional camp locations with gravel surfacing adjacent to the parking area. In addition, some minor expansion of the Flat Canyon Campground may be needed to accommodate use projections. Past, Present, and Reasonably Foreseeable Future Actions are displayed in Appendix A. These improvements would occur unimpeded by mining and subsidence.

It is likely that private landowners in the area would improve their existing facilities and construct new ones. It is also reasonably foreseeable that new roads on the private lands would be needed to access these facilities. For the structures in Flat Canyon, development would probably continue as projected. Any new construction in the Swens Canyon area could be delayed because subsidence could affect them. Most likely, the private landowners would work with the mining company to delay construction/improvement of facilities at a later time to avoid subsidence damage.

The projected rates of new development would continue unaffected by mining, with the possible exception of the private lands in Swens Canyon since this are would not be specifically protected from subsidence.

Irreversible/Irretrievable Commitment of Resources

Any lost use of structures and facilities due to mining-caused damages would be irretrievable but not irreversible. The structures can be repaired and replaced.

Short-Term Use vs. Long Term Productivity

If new developments in Swens Canyon were delayed due to mining, the associated human activity and disturbance to natural resources would also be delayed. The decreased rate of development would decrease the rate that productivity of natural resources in the area would be affected until mining and subsidence are complete.

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4.1.4 Surface Water

This section discusses the effects to surface water from surface developments, underground mining, subsidence, and mine water discharge. Since there are multiple complex issues discussed in this section, the issues are specifically listed as subheadings identified as an issue (***Issue.***) followed by the issue statement presented in ***bold italic print***. Only the specific issues appropriate for each alternative are listed. This is a departure in the format for other sections in this chapter.

4.1.4.1 Alternative A (No Action)

The lease would not be issued and no mining would occur within the project area. There would be no new effects from mining-induced subsidence, seismicity, or mine water discharge

The effects discussed below would occur regardless of the pending decision regarding leasing of the Flat Canyon Tract. The effects discussed below are presented here to provide a thorough understanding of the recent events at the Skyline Mine and associated effects to surface water that have occurred since analysis of the Flat Canyon Tract started approximately two years ago and since the DEIS was released for public review.

The effects of mining in the Skyline Mine Permit Area would continue for several years. The discharge of mine water to Eccles Creek from the Skyline Mine portals has steadily increased from less than 1,000 gpm prior to January 2001 and could continue to increase. The effects relative to this issue are discussed in this section. The other issues regarding water resources are not specifically listed and discussed in this section because the Flat Canyon Tract would not be leased and no associated mining-induced changes would occur.

Issue. Prolonged and increased discharge of mine water into Eccles Creek could change water quality in Eccles Creek, other downstream drainages, and Scofield Reservoir.

The Skyline Mine currently discharges mine water into Eccles Creek just below the Forest boundary under a Utah Point Discharge Elimination System Permit (UPDES 001). Currently, Skyline Mine is permitted to discharge 7.1 tons per day of dissolved solids. Discharge increased from approximately 1,000 gpm prior to January 2001 to the current discharge rate (November 2001) of between approximately 10,000 gpm and 15,000 gpm. Canyon Fuel anticipates that total discharge of mine water could stabilize at around 15,000 gpm. Reference Chapter 3, Section 3.1.5 for a detailed description.

Mine water discharge has affected stream morphology in Eccles Creek and Mud Creek since the mine started operations in 1979. The water quality in the creeks and in Scofield Reservoir has been affected by the introduction of mine water discharge.

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As of September 2001, Canyon Fuel is also discharging ground water from two wells in James Canyon in an effort to decrease ground water flow to the mine. The water is being pumped from

a fracture system in the Star Point Sandstone prior to it entering the mine workings. The ground water is currently being discharged to Electric Lake from the James Canyon wells at a rate of approximately 2,000 to 4,000 gpm. Discharge at this location could continue through 2003.

Chemical Water Quality

With the exceptions discussed below, the parameters monitored by Canyon Fuel at the discharge in Eccles Creek have generally met the water quality standards established for the designated beneficial uses. Prior to the recent increases in discharge, concentrations of total boron, cyanide, dissolved lead, total phosphorous, and TDS have on at least one occasion exceeded the concentration limits specified by one or more of the standards. Concentrations of cyanide from CS-12 on one occasion exceeded the standard for aquatic wildlife. On each of the other 12 monitoring events, no cyanide was detected. During the single cyanide-monitoring event from the UPDES outfall, the concentration of cyanide also slightly exceeded the standard. The concentration of total mercury also exceeded the standards during the single time it was sampled at the UPDES outfall. Concentrations of phenol, an organic compound, have exceeded the standards for recreation and aquatic wildlife on a few occasions at both CS-12 and CS-14, while on all other occasions, no phenol was detected in the discharge water. When detected in mine water discharge, phenol was also detected at similar concentrations in Eccles Creek above the mine water discharge points. The causes of the occasional elevated phenol concentrations in Eccles Creek and mine discharge water are not known. It is important to note that CS-12 and CS-14 are mixed at the discharge point representing a single discharge (UPDES outfall at UPDES 001). The average concentrations for each of the chemical parameters discussed above, (with the exception of phenol) are generally suitable for each of the beneficial uses.

Water discharged from the James Canyon wells is good quality water that generally meets the beneficial use standards for Electric Lake. Based on a mixing model prepared by EarthFax (2001) the TDS concentration of water entering the reservoir could raise by less than 1%. The other solute parameters show changes ranging from -17 to 56 percent (EarthFax, 2001). None of the parameters that could increase are of concern and are included in the less than 1% increase in TDS. Phosphorous, phenols, mercury, cyanide discussed for mine water discharges to Electric Lake were not detected in concentrations that would cause concern.

Scofield Reservoir is listed in the State of Utah's 2000 list of impaired water bodies. The parameters of concern are dissolved oxygen and total phosphorus. The total maximum daily load allocation (TMDL) established by the Sate and approved by EPA targets a 28% reduction in total phosphorus loading. The TMDL is based on load allocations prepared for Clean Lakes Studies in 1983 and 1990 plus additional water quality data collected in 1997 and 1998. It is predicated on the hydrologic conditions as of 1983; at the time the mine discharge was less than 500 gpm (DEQ_DWQ, 2000; Denton, 1983). The recent change in hydrologic regime would require a review, and perhaps, a revision of the TMDL and UPDES permit by the State (DWQ, C. Adams, 2001 personal communication). Total phosphorous has occasionally exceeded standards at all sites monitored for this parameter, including the site upstream of the mine (CS-4) and the UPDES outfall. Based on data available through the coal mine data base maintained by

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the Utah Division of Oil, Gas, and Minerals, 29 of 49 samples taken at the UPDES outfall exceeded the total phosphorus standard of 0.05 mg/l; as did 9 of 38 taken at CS-12 (Mine 1), 10 of 19 taken at CS-14 (Mine 3), and 8 of 30 taken at CS-4 upstream of the mine. Recent testing of the mine water discharge has shown that phosphorous levels are below detection limits or when detected is at approximately the same as water at CS-4 upstream. This is however based on relatively short-term and limited tests.

Due to the current high flows of ground water to the mine workings that is directly pumped to the surface discharge point in Eccles Creek, the water quality has improved for almost all parameters, including phosphorous. Less water is being pumped to abandoned gob areas of the mine where the water tends to decrease in quality due to prolonged exposure to the underground mine environment.

Automated continuous monitoring equipment has recently been installed in the Skyline Mine discharge system that ensures that water that is excessively elevated in TDS, ph, turbidity, or oil and grease concentrations would not be discharged. If these parameters exceed a threshold determined by the company, water is automatically rerouted to underground storage areas within the Skyline Mine.

Sediment and Stream Morphology

Below the point of discharge, Eccles Creek has a well defined, gravel and cobble channel with a steep gradient, moderate sinuosity, and dense riparian vegetation. Mud Creek from Eccles Creek to Scofield Reservoir has a gentle gradient and high sinuosity. The lower portion of Mud Creek is entrenched in the valley bottom with little to no floodplain and little riparian vegetation stabilizing the stream channel.

To evaluate possible effects of the increased mine discharge, both the magnitude and duration of the increased flow should be compared to unaugmented stream flow patterns. Data from the USGS stream gage for Mud Creek (Station 09310700, 8/22/1978-9/30/1998) and Eccles Creek (Station 09310600, 10/01/1979-9/30/1984) was used to develop flow duration curves. The period of record for Eccles Creek is short and includes the usually high runoff of 1983 and 1984. Because the derived flow duration curve is somewhat skewed toward higher flows of longer duration, the effects of the increased mine discharge may be understated.

The discharge rates after January 2001 and before August 2001 (approximately 2000 gpm, 4.5 cfs) had little effect on the average number of days capable of transporting sediment per year. For Eccles Creek the change would be from 7 to 9 days; for Mud Creek, from 13 to 14 days. However, the current discharge rate of 10,000 gpm (22 cfs) could increase the number of sediment-transporting days from 7 to 31 in Eccles Creek and from 13 to 20 in Mud Creek. The projected stabilized discharge of 15,000 gpm (33 cfs) could result in an increase from 7 to 182 days for Eccles Creek and from 13 to 26 days in Mud Creek.

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Recent assessment of the stability of Eccles Creek after approximately ten weeks of mine discharge averaging 22 cfs revealed few obvious changes in channel conditions (EarthFax, 2001). Based on an analysis of stream gage records, regional predictive equations for peak flows, and research about sediment transport, sediment transport should begin at approximately 35 cfs in Eccles Creek and 85 cfs in Mud Creek (EarthFax, 2001; Whiting, et.al., 1999). Therefore, the flow ranges likely to cause channel adjustment have not yet occurred.

Using the classification system and interpretations developed by Rosgen (1996), the stream segments downstream of the mine should vary in their response to the current and projected increases in mine water discharge as displayed in the following table.

Table 4.3. Stream Channel Responses to Current and Projected Increases in Mine Water Discharge.

Stream Segment	Stream Type	Sensitivity To Disturbance Including Changes In Flow Magnitude And Timing	Stream Bank Erosion Potential	Influence Of Vegetation In Controlling Channel Stability
Eccles Creek – 0.3 miles downstream from Skyline Mine surface facilities	B3a	Low	Low	Moderate
Eccles Creek – 0.3 miles downstream from the mine to 0.6 miles upstream from Mud Creek	B4a	Moderate	Low	Moderate
Eccles Creek – from confluence with Mud Creek upstream 0.6 miles	E6b	Very high	Moderate	Very high
Mud Creek – from Eccles Creek downstream 0.8 miles	E3b	High	Moderate	Very high
Mud Creek – from 0.8 miles downstream of Eccles Creek to Town of Scofield	G6c	Very high	High	High

If the current discharge level (10,000 gpm) is sustained, stream bank collapse and erosion at outside bends is likely to occur in the lower portions of Mud Creek during and following spring runoff. Meander cutoffs and headcutting may also occur in the very sinuous part of Mud Creek. Although the sections of Eccles and Mud Creeks classified as E stream types have a high or very high sensitivity to disturbance, that sensitivity may be offset by the stability provided by the existing streamside vegetation. Sediment generated by these adjustments would be deposited in Scofield Reservoir.

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At the expected, stabilized discharge level (15,000 gpm), Eccles Creek could be subjected to flows capable of transporting sediment approximately 50% of the year and perhaps year-long. Probable channel adjustments include stream bank erosion, undercutting of valley side-slopes

and sloughing, channel widening, and some headcutting. Adjustments in Mud Creek would be as described above but likely over a greater portion of the stream. Sediment generated in Eccles Creek may be temporarily stored behind beaver dams in the upper portions of Mud Creek; that generated in Mud Creek would be deposited in Scofield Reservoir.

Cumulative Effects

Construction of the Skyline Mine began in 1979. Concurrently SR 264 was constructed by the Utah Department of Transportation to provide all-season access to the mine from Utah, Sanpete, Carbon, and Emery Counties. Construction of the mine and highway caused morphological changes to the channel. The Main Fork and North Fork of Eccles Creek were diverted into 72 inch culverts and Eccles Canyon was filled to construct the portal facilities area. Surface water flow from the disturbed mine area is collected in the portal facilities sediment pond. Treated water from the sediment pond and mine water are discharged to Eccles Creek just below the Forest boundary. The increased flow to Eccles Creek has affected stream morphology and quality in Eccles Creek, Mud Creek, and Scofield Reservoir as discussed in the previous section. Cumulatively the mine and highway have caused changes to stream morphology and downstream waters. A major source of sediment introduced to Eccles Creek below the culvert outlet is from traction materials (sand and slag mixed with salt) used on SR 264 by UDOT during the winter months to keep the road open. The raw, steep road cut through the mine area also contributes sediment. In addition, grazing along the floodplain of Mud Creek has decreased riparian vegetation. The stream bank has been substantially altered due to these effects.

Future actions discussed in Appendix A could increase sediment yields on a temporary basis, but Best Management Practices would be used to minimize effects to water flow and quality. Additional long-term effects should be negligible and in some cases existing effects can be mitigated with improved management practices.

Irreversible/Irretrievable Commitment or Resources

The effects described above are irretrievable lasting through the life of the mine and highway. Once the mine is closed and reclaimed the stream channel will be reclaimed and mine water discharge would cease. Flows and quality would return to near premining conditions but changes from the natural, undisturbed conditions are irreversible.

Short-Term Use vs. Long-Term Productivity

The mining activity and other uses and the associated benefits would continue for at least another 2 years and potentially beyond if the mine is extended to the north into the unmined lease area. Once the mining stops, mine water discharge would be discontinued, decreasing flow to Scofield Reservoir to pre-mine levels

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4.1.4.2 Alternatives B and B'

Under Alternatives B and B, the lease would be issued and mining would occur. Under Alternative B, the Special Coal Lease Stipulations (SCLS) would not be applied to the lease and no specific measures would be taken to protect surface waters from subsidence. Under either alternative monitoring sufficient to detect effects to water flow and quality would be required under provisions the Federal regulations and Utah Coal Rules. Alternative B' differs only in that monitoring could be more comprehensive and detailed sufficient to detect more subtle effects under SCLS #7 and mitigations may be required under SCLS #9, #13, and #17. Specific monitoring and mitigation plans would be made provisions for permit approval. Monitoring would include flow and quality measurements on selected sections of streams and on springs selected to be representative of ground water sources. Monitoring sufficient to detect stream morphology changes would also be required under Alternative B' (discussed in more detail in Section 4.1.7 (Wildlife).

Issue. Prolonged and increased discharge of mine water into Eccles Creek could change water quality in Eccles Creek, other downstream drainages, and Scofield Reservoir.

If the Flat Canyon Lease is issued, the anticipated discharge rates of 15,000 gpm discussed above could be prolonged by 9-12 years and it is anticipated that the total discharge could increase by another 7,000 gpm by intercepting additional ground water, for a total of 22,000 gpm. On the other hand, discharge to Eccles Creek could decrease to an estimated 10,000 gpm if discharge to Electric Lake is authorized by the Utah Division of Water Quality under a new UPDES discharge permit.

Canyon Fuel requested that the Utah Department of Environmental Quality, Division of Water Quality change the designation of Electric Lake from High Quality Water - Category 1 (no new point source discharges allowed) to High Quality Water - Category 2 (new discharge allowed if there is no degradation of water quality). This is in anticipation of obtaining the Flat Canyon Tract and their proposal to discharge a portion of water entering the mine to Electric Lake. If the request were denied, it would be necessary to discharge all water to Eccles Creek for a total of 22,000 gpm. If reclassification is completed, as requested, and a new UPDES permit is issued for discharge to Electric Lake, as much as 12,000 gpm could be discharged to Electric Lake. This would leave approximately 10,000 gpm to discharge to Eccles Creek.

If Canyon Fuel does not obtain a UPDES discharge permit for Electric Lake and all mine water is discharged to Eccles Creek, discharge could increase to as much as 22,000 gpm. This could cause greater effects to water quantity and quality in Eccles Creek and downstream watercourses.

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Chemical Water Quality

It is anticipated that the chemical quality of groundwater encountered during mining in the project area would be similar to that encountered in the Skyline Mine (NorWest, 2000a). However, the quality of the water discharged should improve compared to historic conditions

due to the increased quantity of groundwater and changes in Skyline Mine's management of water in the mine. These changes include increased pumping capacity, less storage time for water pumped to abandoned areas of the mine, and better mixing of groundwater and stored water. The concentration of TDS at CS-14 has decreased from a historic average of 1,104 mg/l to the current average of 241 mg/l.

A flow-weighted linear mixing model was used to estimate the changes in some water quality parameters for water discharged to either Eccles Creek or Electric Lake (EarthFax, 2001). The following table summarizes the results of this modeling for the two discharge scenarios (discharge entirely to Eccles Creek and discharge to both Eccles Creek and Electric Lake). The table includes both the historic and current discharges, which are part of Alternative A, for comparison purposes. It also includes the historic and current concentrations and the modeled historic and current concentrations to display the "goodness" or accuracy of the model in predicting values. These estimates assume a continuous mine discharge. It is likely the quantity of water discharged will fluctuate; therefore, the quality of water may vary within the range displayed.

Table 4.4. Eccles Creek - Water Quality Combining Eccles Creek Upstream of Skyline Mine and Mine Discharges

Parameter (all values in mg/l)	Historic	Historic (modeled)	Current	Current (modeled)	Project area contribution with portion of discharge going to Electric Lake (modeled)	Project area contribution with all discharge going to Eccles Creek (modeled)
Alkalinity	321	283	264	265	455	472
Calcium	88	92	55	55	93	92
Chloride	14	12	6	6	10	11
Magnesium	35	47	27	27	46	43
Potassium	6	7	5	5	7	7
Sodium	52	40	15	15	24	21
TDS	554	705	333	328	549	513
TOC	0.7	0.9	0.7	0.4	0.7	1
TSS	27	9	27	22	40	46
Sulfate	193	291	49	74	130	149

The modeled parameters indicate that the water discharged in either scenario would meet the State water quality standards.

In order to receive a new or modify an existing UPDES permit, it must be demonstrated that beneficial use standards would not be exceeded in the receiving water. When a UPDES discharge permit is issued or modified, the water quality of the proposed discharge water is evaluated by the Utah Division of Water Quality (DWQ - Mike Herkimer, personal communication, 2000). WET testing (testing of effects to selected aquatic species) is performed

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to ensure that the water is not toxic (either chronic or acute) to aquatic organisms. If harmful constituents are identified in the proposed discharge water, then an approved water treatment plan must be implemented before any water may be discharged. If constituents are found in the water that are regulated under TMDL, such as phosphorus, or which may cause the receiving water to not meet the quality standards for the designated beneficial uses, specific discharge limits are placed on these constituents. Routine water quality monitoring of the discharge water by the company is required for all parameters requested by the Division of Water Quality to demonstrate compliance with the UPDES permit.

Sediment and Stream Morphology

A sustained mine discharge of 22,000 (49 cfs) could have significant effects on both Eccles and Mud Creeks. A discharge of this magnitude exceeds the flow level at which sediment transport is expected to begin in Eccles Creek and could make sediment transport and stream bank erosion a year-round event. In Mud Creek it could result in an increase in sediment-transport flows from 13 to 38 days. All portions of Eccles and Mud Creeks would likely be affected with more damage sustained in those segments with high and very high sensitivity to disturbance. Probable effects have been described above.

Peak flows of a given magnitude would occur more frequently if augmented by sustained mine discharges. The 5-year "natural" peak for Eccles Creek is estimated to be 107 cfs; this plus 49 cfs equals the 10-year "natural" peak. Therefore, flood damages may occur more frequently. If a portion of the mine discharge is routed to Electric Lake or stored in the mine, augmented flood damages may be reduced or avoided.

Issue. A new mine water discharge point at the north end of Electric Lake would involve changing all or some of the discharge from Eccles Creek in the Price River Watershed to Upper Huntington Creek in the Huntington Canyon Watershed. This could decrease flow in the Price River Watershed and increase flow in the Huntington Canyon Watershed.

If the proposed lease is issued, current discharge rates could be extended by 9-12 years and the amount of discharge could increase for this length of time as discussed below.

The mine is currently discharging approximately 10,000 gpm (22.3 cubic feet per second or cfs) to 15,000 (33.4 cfs) into the Price River Watershed and is anticipated to stabilize at 10,000 gpm. Prior to January 2001, Canyon Fuel was discharging less than 1,000 gpm. This is an increase of 10 to 15 times that amount. The increase of 9,000 gpm (anticipated stabilized discharge) is an annual increase of nearly 4.7 billion gallons or 14,500 acre-feet to Scofield Reservoir, which is approximately 20% of the current capacity of 73,600 acre-feet.

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If a UPDES permit is not obtained for discharge to Electric Lake, the discharge to Scofield Reservoir could increase to 22,000 gpm (49.0 cfs), an increase of 12,000 gpm (26.7 cfs) over the anticipated stabilized discharge of 10,000 gpm. A sustained discharge of 10,000 gpm is approximately 16,125 acre-feet per year, which is approximately 22% of the reservoir capacity.

The potential increase of 12,000 gpm would be 6.3 billion gallons or 19,350 acre-feet, approximately 26% of the reservoir capacity. The average water yield for the Price River near Helper is 80,570 acre-feet per year. The potential increase is 24% of this amount.

If the 12,000 gpm is discharged to Electric Lake, the annual water discharge of 19,350 acre-feet represents 54% of the capacity of Electric Lake that is 35,500 acre-feet. The average yield for Huntington Creek near Huntington is 59,190 acre-feet per year. The potential discharge is approximately 33% of this amount.

The mine water discharge is not affected by climate, as are surface drainages. However, it is unknown how long the discharge might persist or what quantities might be produced. During dry years the addition to either reservoir would likely be considered a benefit by water users. During extremely wet years, when water is spilling from the reservoirs, the addition of this amount of water would be small relative to the 6,200 cfs capacity of the Scofield Reservoir spillway or the 2,300 cfs capacity of the Electric Lake spillway. Operators of the dams would need to adjust water management accordingly.

Discharge of water from the mine workings will be discontinued upon mine closure. The portals and discharge points are more than 700 feet in elevation above the mine workings. The mine workings will most likely flood, but none of this water would reach the ground surface and discharge to surface drainages.

Issue. Changing some or all of the mine water discharge from Eccles Creek to Electric Lake could change water quality in the receiving streams/water bodies.

It is proposed in the Reasonably Foreseeable Development Scenario that mine water might be discharged to Electric Lake at a location selected to minimize erosion or sediment disturbance in the lake. Mine water discharge at this location could last 9-12 years. This would depend on Canyon Fuel's ability to obtain a UPDES discharge permit from the Utah Division of Water Quality. Discharge would not continue after mine closure, since the discharge points at the ground surface are sufficiently above the flooded mine workings to prevent continued flow to the surface.

Huntington Creek and Electric Lake are protected for secondary contact recreation such as boating, wading, or similar uses. These waters are also protected for cold-water species of game fish and other cold-water aquatic life, including the necessary aquatic organisms in their food chain. The waters are also protected for agricultural uses including irrigation of crops and stock watering. Huntington Creek has been designated as protected for domestic purposes with prior treatment as required by the Utah Division of Water Quality.

The chemical quality of Electric Lake could be affected by the proposed discharge. The magnitude of this impact is directly related to the volume of mine water discharged into the receiving water.

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Groundwater from the James Canyon wells is currently being discharged into Electric Lake. Mining in the Flat Canyon Tract is expected to generate additional mine discharge. The following table summarizes the results of modeling for selected parameters (EarthFax, 2001). The table includes both the historic and current discharges, which are part of Alternative A, for comparison purposes.

Table 4.5. Electric Lake - Water Quality Combining Inflow from Upper Huntington Creek and the James Canyon Wells

Parameter (all values in mg/l)	Historic	Current	Stabilized (modeled)	Project area contribution with portion of discharge going to Eccles Creek (modeled)
Alkalinity	183	199	218	229
Calcium	53	50	51	50
Chloride	7	6	5	5
Magnesium	10	13	15	16
Potassium	1	2	2	2
Sodium	4	4	4	4
TDS	182	183	192	196
Sulfate	15	13	11	10

The modeled parameters indicate that the water discharged would meet State water quality standards.

Based on historic water quality of discharge waters to Eccles Creek, mine water discharge may be a source of phosphorus and other pollutants not currently found in the watershed. Phosphorus is of particular concern. In natural systems, available phosphorus is a limiting factor in the growth of phytoplankton. The human-caused addition of phosphorus to lake systems is widely accepted as a principle cause of accelerated eutrophication (Goldman, 1983). At this time there is no evidence of accelerated eutrophication in Electric Lake, unlike in Scofield Reservoir.

Recent limited testing of the mine discharge waters by Canyon Fuel indicates that the quality has improved such that parameters of concern such as phosphorous are similar to the receiving waters.

Before any mine water could be discharged into these waters, a UPDES discharge permit would be required. In order to receive this permit, it would need to be demonstrated that the quality of the receiving waters would not be decreased and the beneficial use standards for these waters would not be exceeded. Water quality analyses for the Skyline Mine discharge for parameters monitored prior to January 2001 are included in Appendix E. As discussed above, all important water quality parameters would be controlled through the UPDES permitting process and are regulated by several Utah State regulatory agencies.

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The temperature of groundwater from the Skyline Mine has averaged between about 11°C and 16°C (Mayo and Associates, 1994). If this water is discharged directly into Electric Lake during the winter months when temperatures of the lake water are near 0°C, there would be an alteration of the thermal regime of the lake. This may locally result in the melting or thinning of the surface ice in the vicinity of the discharge point and affect lake thermodynamics and stratification.

Under Alternative B, no specific measures are likely to be required of the operator to monitor and mitigate any effects to the reservoir. Under Alternative B' monitoring and mitigations may be required in the mine permit, based on SCLS #7, #13, and #17.

Issue. Subsidence of perennial streams and Boulger Dam/Reservoir could intercept flowing/impounded water and divert it underground, changing the hydrology.

Direct Effects

Perennial streamflow could be affected if subsidence-related tension fractures caused diversion of surface water into the underlying bedrock. However, this is very unlikely. Based on area geology, low-permeability bedrock formations underlie all of the perennial streams in the project area. This is the case regardless of the surface geomorphology. For instance, although Boulger Canyon is wide with a low stream gradient whereas Swens Canyon is narrow and steep, the Blackhawk Formation underlies the unconsolidated sediments in each canyon. Canyon geomorphology in the study area is a function of erosional process (fluvial and glacial) not the underlying bedrock.

In order for water to be diverted from the stream channel and surrounding alluvium, the integrity of the perching layer(s) would need to be compromised such that downward migration of surface waters into deeper unsaturated rock horizons could occur. In the short-term, subsidence fractures through the Blackhawk Formation could divert surface or alluvial groundwater. However, subsidence fractures in this formation would heal rapidly as the fractures are wetted due to the expansion of hydrophilic clays. Thus, if subsidence fractures were to damage the perching layer beneath the stream and alluvium, these fractures would likely remain open for only a short period of time. In the long-term, the subsidence fractures must be extensive and interconnected to convey water from the surface system. It is expected that the integrity of the low-permeability bedrock horizons that support both streams and shallow groundwater systems in the project area would not be compromised (NorWest, 2000a). For these reasons, the potential for the direct interception and translocation of surface waters by subsidence fractures is considered remote.

The experience of Canyon Fuel performing longwall extraction beneath Burnout Creek (NorWest, 2000a) provides support for the idea that obvious detrimental effects to perennial streamflow are unlikely if these drainages were undermined. As reported by NorWest (2000a), there were no quantifiable effects on baseflow discharge attributable to mining under Burnout Creek. The geologic conditions in the project area (geologic formation, overburden thickness, and degree of fracturing and faulting) are sufficiently similar to those at Burnout Canyon (less

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than 1 mile from the project area) to justify extrapolation of the observed effects of undermining Burnout Creek to the project area. Thus, it is probable that no obvious losses of surface water would occur if surface water drainages in the project area are undermined.

Effects to stream morphology caused by subsidence of perennial stream channels are discussed in Sections 4.1.6 (Vegetation) and 4.1.7 (Wildlife).

Indirect Effects

There is potential for localized shifting of groundwater discharge locations as a result of mining-related subsidence. This could result from minor alterations in the attitude of bedrock horizons (i.e. a change in the groundwater flow direction) or changes to fracture networks that may support groundwater discharge. This was observed in only one spring in the Skyline Permit area where overburden thickness was less than 200 feet. It is very unlikely that this would occur in the project area where the overburden thickness ranges from 700 to over 2,000 feet.

Numerous water rights for creeks are held in the project area by both private landowners and government agencies. Perceptible or quantifiable impacts to spring flow and creek discharge rates, other than increased flow from mine water discharge, are not anticipated. If there are no decreased flows in springs and creeks, there should be no impairment of water rights. In the event that there is a mining-related flow diminution of an appropriated surface water source, Utah Code 40-10-18 requires the mine operator to "promptly replace any state appropriated water in existence prior to the application for a surface coal mining and reclamation permit." Lease stipulations would also require replacement of other water sources affected by mining.

Under Alternative B, the mining regulations would require the lessee/operator to replace domestic water sources or State Appropriated Waters (Water Rights) that can be demonstrated to have been affected by mining. By not applying specific lease stipulations for replacement of non-domestic or unappropriated waters, there would not be a specific requirement for replacement of waters needed for ecosystems.

Under Alternative B', SCLS #17 would require replacement of water or appropriate mitigations if water that supports ecosystems is affected, as well as State Appropriated Water.

Cumulative Effects

The affected area contains numerous developments including Boulger Reservoir, Flat Canyon Campground, Camp Shalom, SR 264, several private cabins, roads and trails, and encompasses several sheep allotments. Since Euro-American settlement, intense grazing and timber cutting, along with the developments described above, have altered vegetation types and densities. Due to these changes and loss of soil to erosion, runoff has increased. Stream morphology has changed due to the changed flows and changes in vegetation. Quality has undoubtedly been decreased relative to pre-settlement conditions by these changes. As displayed in the table of past, present, and reasonably foreseeable future actions in Appendix A, additional development

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of private lands is anticipated that would most likely result in similar effects. The planned improvements to the Boulger Reservoir area should be beneficial to water quality since the disturbed areas directly adjacent to the reservoir would be revegetated, traffic would be restrained to Forest System Roads, and dispersed campsites would be graveled to decrease erosion and sediment production. Improvement of sanitary facilities should decrease the potential for degradation of water quality. Potential improvements at Flat Canyon Campground would have similar effects.

Due to Best Management Practices that include sediment control and reclamation/revegetation used in construction of the Questar Mainline #104 and the gas wells on Trough Springs Ridge, and other projects shown in Appendix A, sediment contributions to the cumulative impact area are expected to be short-term and negligible.

Other future actions discussed in Appendix A could increase sediment yields on a temporary basis, but Best Management Practices would be used to minimize effects to water flow and quality. Long-term effects should be minimal, and in some cases, existing effects would be mitigated with improved management practices. The future activities projected to occur would employ sediment control measures during construction, operations, and reclamation. Regarding the two wells drilled on Trough Springs Ridge in 2001, Forest requirements for pad design use impermeable pits and berms to prevent fluids and precipitation from leaving the disturbed area. Operators are also required to prepare spill prevention and recovery plans to mitigate effects. Drill holes are cased to prevent escape of drilling and production fluids and are plugged on abandonment to prevent contamination and mixing of ground water aquifers. -

Effects to water quality from surface disturbing activities and subsidence of perennial stream channels are discussed in Sections 4.1.6 (Vegetation) and 4.1.7 (Wildlife).

The cumulative effects in regard to the identified issues for the proposed action associated with future activities, other than the proposed leasing/mining, would not be measurable and considered negligible relative to those discussed for the proposed project.

Irreversible/Irretrievable Commitment of Resources

The effects described above would be irretrievable during the period of mining. Once the mine closes and reclamation is completed the surface water flow and quality could return to near premining condition over the long-term.

Short-Term Use vs. Long-Term Productivity

The effects of mining would continue for approximately an additional 9-12 years. Once the mine is closed and reclamation is completed the surface water flow and quality would return to near premining condition.

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4.1.4.3 Alternative C

Under this alternative monitoring sufficient to detect effects to water flow and quality would be required under provisions the Federal regulations and Utah Coal Rules. Special Coal Lease Stipulations (SCLSs) would also be applied. Under the stipulations monitoring could be more comprehensive and detailed sufficient to detect more subtle effects under SCLS #7 and mitigations may be required under SCLS #9, #13, and #17. Specific monitoring and mitigation plans would be made provisions for permit approval. Monitoring would include flow and quality measurements on selected sections of streams and on springs selected to be representative of ground water sources. Monitoring sufficient to detect stream morphology changes would also be required under Alternative B' (discussed in more detail in Section 4.1.7 (Wildlife).

Issue. Prolonged and increased discharge of mine water into Eccles Creek could change water quality in Eccles Creek, other downstream drainages, and Scofield Reservoir.

The effects would be the same as Alternative B and B'.

Issue. A new mine water discharge point at the north end of Electric Lake would involve changing all or some of the discharge from Eccles Creek in the Price River Watershed to Upper Huntington Creek in the Huntington Canyon Watershed. This could decrease flow in the Price River Watershed and increase flow in the Huntington Canyon Watershed.

The effects would be the same as those described for Alternative B', except that discharge of mine water would be extended for a shorter period of time 5-7 years.

Issue. Changing some or all of the mine water discharge from Eccles Creek to Electric Lake could change water quality in the receiving streams/water bodies.

The effects would be the same as those described for Alternative B' but would be extended for a shorter time period (5-7 years).

Issue. Subsidence of perennial streams and Boulger Dam/Reservoir could intercept flowing/impounded water and divert it underground, changing the hydrology.

Direct Effects

There would be no direct effects to perennial streams with the possible exception of the Cunningham Drainage. This drainage has steep gradients and the effects would be similar to those encountered in Burnout Canyon; negligible effects to overall function of the ecosystem.

Effects to stream morphology caused by subsidence of perennial stream channels are discussed in Sections 4.1.6 (Vegetation) and 4.1.7 (Wildlife).

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Indirect Effects

Creek discharge could be indirectly affected if there were a diminution of discharge from springs that contribute to baseflow. As discussed below in the groundwater section, the potential for diminution of discharge from shallow groundwater systems is considered negligible.

If there were a perceptible or quantifiable decrease in streamflow as an indirect result of subsidence, SCLS #17 would require that the operator replace, at his expense, any surface water identified for protection that may be lost or adversely affected with water from an alternate source in sufficient quality and quantity to maintain existing riparian habitat, fishery habitat, livestock and wildlife use, or other land uses.

Effects to stream morphology caused by subsidence of perennial stream channels are discussed in Sections 4.1.6 (Vegetation) and 4.1.7 (Wildlife).

Numerous water rights for creeks are held in the project area by both private landowners and government agencies. Perceptible or quantifiable impacts to spring flow and creek discharge rates, other than increased flow from mine water discharge, are not anticipated. If there are no decreased flows in springs and creeks, there should be no impairment of water rights. In the event that there is a mining-related flow diminution of an appropriated surface water source, Utah Code 40-10-18 requires the mine operator to "promptly replace any state appropriated water in existence prior to the application for a surface coal mining and reclamation permit." Lease stipulations would also require replacement of other water sources affected by mining.

Cumulative Effects

The effects would generally be the same as discussed under Alternative B' except that the additional effects of mining would occur for a shorter time. The life expectancy of the mining operation in the project area under this alternative is 5 to 7 years rather than 9 to 12 years for Alternatives B and B'.

Effects to water quality from surface disturbing activities and subsidence of perennial stream channels are discussed in Sections 4.1.6 (Vegetation) and 4.1.7 (Wildlife).

Irreversible/Irretrievable Commitment of Resources

The effects described above would be irretrievable during the period of mining. Once the mine closes and reclamation is completed the surface water flow and quality would return to near premining condition.

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Short-Term Use vs. Long-Term Productivity

The benefits of mining would continue approximately an additional 5 to 7 years. Once the mine is closed and reclamation is completed the surface water flow and quality would return to near premining condition.

4.1.5 Ground Water

This section discusses the effects of underground mining, subsidence, and mine water discharge to ground water resources. Since there are multiple complex issues discussed in this section, the issues are specifically stated as subheadings identified as an issue (***Issue.)*** followed by the issue statement presented in ***bold italic print.*** Only the specific issues appropriate for each alternative are listed. This is a departure in the format for other sections in this chapter.

4.1.5.1 Alternative A (No Action)

There would be no effects to the project area.

4.1.5.2 Alternatives B and B'

Issue. Subsidence could change the flow of springs and seeps, affecting the flow of springs and their receiving streams. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems.

The mechanisms whereby mining-related subsidence could affect near-surface groundwater systems are, for the most part, analogous to the potential impacts to perennial creeks, described in the previous section. As with perennial creeks, the operation of near surface groundwater systems is fundamentally dependent on the presence of low-permeability bedrock horizons that create perched groundwater conditions.

The reaction of rock strata above longwall-mined areas is a function of overburden thickness. There are four zones of movement above subsided areas. These include the cave zone, fracture zone, flexure zone, and soil zone. In the project area the fracture zone is estimated to extend above the Lower O'Connor B seam up to 375 feet for single seam extraction and up to 675 feet above the Flat Canyon Seam for double seam extraction. The minimum overburden thickness in the project area where longwall mining could occur is about 900 feet for the Lower O'Connor B seam. Most of the surface is more than 1,200 feet above the Lower O'Connor B seam. Thus, both colluvial/shallow bedrock groundwater systems operate entirely with the flexure zone and soil zone.

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The expected response in the flexure zone would be movement along existing joints and bedding planes, which could open up in zones of tension. Vertical movement along fractures typically remains within individual beds and is not vertically extensive unless massive strong beds are in the zone. Weaker rocks in the upper part of the zone may flex without causing failure along

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joints or tension cracks to form. In the soil zone materials are weak and generally do not fail due to the ability to flex. Tension crack formation does occur in the active tension zone but cracks close again when the compression zone reaches that point.

Based on the previous discussion, it is expected that the integrity of the low permeability bedrock horizons that are fundamental to the operation of colluvial/shallow bedrock groundwater systems generally would not be compromised. The exception would be the creation of tension cracks in high-strain zones as discussed below.

In zones of permanent tension that form above such features as panel ends, fire barrier pillars, and the outer edge of a block of panels, tension cracks are possible in shallow subsurface strata and may persist for a time. The degree to which these tension cracks impact shallow groundwater systems would be dependant on the degree of interconnectedness of fractures with other fractures or permeable horizons that are capable of receiving water. However, it is anticipated that because of lithologic heterogeneity and the abundance of swelling clays in the Blackhawk Formation, that tension fractures which do form would heal quickly.

Subsidence also has the potential to locally alter groundwater flow directions. This is caused by slightly altering the attitude of shallow bedrock or by subtle disturbances in unconsolidated material. While this could affect the discharge rate from an individual spring, the total discharge from the groundwater system would remain the same as groundwater is diverted to other nearby discharge locations.

Experience in the Skyline Mine area suggests that shallow bedrock horizons are not compromised to the degree that there is perceptible or quantifiable dewatering of springs. The response of springs and wells (NorWest, 2000a) to undermining and subsidence suggests that subsidence does not result in dewatering of groundwater systems. Lastly, exploration drill holes in the Blackhawk are very unstable, and when left open for a few days, slough badly (Vaughn Hansen Associates, 1982) suggesting that any subsurface openings created by subsidence would heal quickly.

It is estimated that there is a negligible probability of perceptibly or quantifiably dewatering near surface groundwater systems as a result of mining-related subsidence and fracturing. There is a possibility that there may be some local alterations in groundwater flow direction, which might affect the discharge from an individual spring but not diminish the total discharge from a groundwater system.

Under Alternative B, only State Appropriated Water would be required to be replaced if it is adversely affected by mining. Under Alternative B', SCLS # 17 would require replacement/mitigation of ecosystem waters as well as State Appropriated Waters if adversely affected by mining.

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Numerous water rights for springs are held in the project area by both private landowners and the U.S. Forest Service. A water right has a specified point of diversion. It is possible that if a

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spring discharge location shifted as a result of subsidence, this could affect a water right because water could no longer be diverted at the specified point. If such a situation were to occur, the water right holder would need to consult with the State Engineer to determine what response would be appropriate. Perceptible or quantifiable impacts to spring discharge rates are not anticipated. Under Alternative B, in the event that there was a mining-related flow diminution of an appropriated spring, Utah Code 40-10-18 requires the mine operator to "promptly replace any state appropriated water in existence prior to the application for a surface coal mining and reclamation permit." Under Alternative B' the lessee/operator would be required to replace/mitigate any loss of water needed for ecosystems as well as State Appropriated Waters.

Issue. Interception of ground water in underground mine workings and subsequent discharge to Eccles Creek could cause diversions of surface and ground water from the Huntington Canyon Drainage to the Price River Drainage. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems.

Direct interception of groundwater by mine workings results in the local dewatering of deep groundwater systems. Groundwater that is encountered in underground workings at the Skyline Mine and groundwater that may be encountered in the project area issues from either deep Blackhawk Formation groundwater systems or Star Point Sandstone groundwater systems (NorWest, 2000a). Neither the lower coal/water bearing portion of the Blackhawk Formation nor the Star Point Sandstone crop out within many miles down dip of the project area. It is unlikely that water from these zones contributes to surface water flow in the Huntington Canyon Watershed.

The potential for diversions between watersheds exists if water encountered underground is discharged to a drainage other than the one where the water would naturally discharge. The Skyline Mine area and mine workings straddle the surface water divide between two major watersheds, the Price River and the San Rafael River. Most of the surface area in the Project area is within the San Rafael River Basin. The southwest corner of the Project area is within the Gooseberry Creek drainage, which is tributary to the Price River Basin.

As described above, mining at the Skyline Mine does not appear to have created pathways for the downward migration of water from the surface or near surface to the mine. Mining in the project area also would not divert surface flows or near-surface groundwater into deeper formations.

Deep Blackhawk Formation groundwater systems do not have good hydraulic communication with the surface as indicated by radiocarbon ages that are many thousands of years old, the lack of tritium, and the rapid decline of inflow rates after a water-bearing feature is encountered. What this suggests is that the dewatering of these horizons should not induce renewed recharge to these systems and therefore there should be no impact to the hydrologic balance in the recharge areas. Because deep Blackhawk Formation groundwater systems drain quickly when encountered, it is doubtful that these systems support perceptible or quantifiable discharge to the surface.

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Star Point Sandstone groundwater systems also discharge water to mine workings that is many thousands of years old. Because of the lateral continuity of the Star Point Sandstone, it is possible that there may be hydraulic continuity from the recharge zone to where water is encountered in mine workings. However, pump test analysis (Mayo and Associates, 1997a; Bills, 2000) indicates that the hydraulic conductivity of unfractured Star Point Sandstone is low, and thus recharge to the Star Point Sandstone is largely constrained by the low permeability of the unit. Thus it is unlikely that dewatering of the sandstone would perceptibly or quantifiably impact the hydrologic balance in the recharge area. Due to the antiquity of water in the Star Point Sandstone, it is unlikely that discharge from the Star Point Sandstone, wherever that may occur, is important to the hydrologic balance of that area.

The probability of impacting developed groundwater systems that exist above the mined horizon decreases with increasing overburden thickness. As noted by NorWest (2000a), subsidence causes water level perturbations in deeper groundwater systems but there is no indication that the groundwater systems monitored by wells have been dewatered. If a saturated horizon in the deeper bedrock were dewatered, it is unlikely that there would be a perceptible or quantifiable impact to the surface hydrologic balance because of the limited recharge and discharge of these systems.

In summary, although mine workings could encounter large amounts of groundwater, more than 1,000 gpm, this water is derived from storage in the groundwater system. Where groundwater naturally discharges to the surface from deep bedrock groundwater systems, it is surmised that the discharge rate is several orders of magnitude less than the rate that water inflows to mine workings. It is estimated that there is a remote probability that direct interception of groundwater by mine workings would cause perceptible or quantifiable impacts to the hydrologic balance at either the recharge or discharge areas of deep groundwater systems.

Issue. Equipment and materials spilled, used, and/or abandoned in underground mine workings could change ground water quality and any connected surface water sources. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems

The quality of water that passes through the mine environment may be degraded by chemical interactions with naturally occurring minerals or materials and equipment introduced into the mine. Potential environmental effects can occur if degraded water discharges from the mine workings either during active mining or after mining activities cease. These potential effects are discussed below.

Some materials used in mining operations, when brought into contact with groundwater, have the potential to adversely impact the quality of water discharged from the mine. Mayo and Associates (1994) report that in the late 1980s gypsum rock dust was used in the Skyline Mine. This practice resulted in exceeding TDS limits for mine discharge water because of the high solubility of gypsum. In March 1991, Skyline Mine began using carbonate rock dust, which is considerably less soluble in water. As a result of this change water quality of mine discharge

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water eventually improved. Mayo and Associates (1994) also note that part of the increase in TDS of mine discharge waters relative to mine inflow waters is a result of the oxidation of longwall emulsion fluid. When fugitive longwall emulsion fluid comes in contact with mine waters, the organic molecules in the fluid are readily oxidized by bacterial action resulting in the production of carbon dioxide gas. Carbon dioxide gas reacts with water to form carbonic acid (H_2CO_3), which dissociates into hydrogen ions and bicarbonate. The liberated hydrogen ions are rapidly consumed in reactions with naturally occurring carbonate minerals, resulting in increased calcium ion, magnesium ion, and bicarbonate concentrations in mine water.

During the course of mining operations, many tons of ferrous metals are utilized. Some of the metal objects are removed after mining ceases and, as a necessity, others are left in place. The largest permanent use of metal in mining operations is in roof-support. Thousands of metal roof-bolts are installed at regular spacing in the mine roof to prevent roof collapse. In some locations, wire mesh is also installed. For safety reasons, it is not possible to remove the roof-bolts or wire mesh after mining in an area has ceased. Additionally, metal is used in stoppings and man-doors, overcasts, cribbing, well casings, pipes, and miscellaneous items such as hangers and signs. There is the potential for the metal in these objects to oxidize (rust) as it comes in contact with water in the mine environment.

Oxidation of ferrous materials results in the release of iron into the water. The magnitude and rate of the potential oxidation is constrained by a complex variety of factors, including the temperature, Eh (reduction-oxidation potential), and pH of the water, the pressure on the system, the presence or absence of bacteria, and the solute chemistry of the mine water. As a result, this potential impact is difficult to quantify. However, discharge water from Wasatch Plateau coal mines has not been degraded by elevated iron concentrations. To what extent the iron concentration in mine discharge water may change after mining operations cease is difficult to determine. However, the concentration would likely remain low because dissolved iron is rapidly precipitated as iron hydroxides as noted previously.

Under Alternatives B and B', the operator would not be specifically required to remove equipment that is not incorporated into the mine. However, Section 7 of the BLM lease form requires lessees to remove equipment and materials "as required by the authorized officer." Equipment could be left underground only upon obtaining approval through an approved mine permit or permit amendment. Under Alternative B', the effects would probably be the same but the requirement would be reinforced by SCLS #19.

If equipment were left underground, it is unlikely that corrosion of abandoned equipment would degrade the quality of water in the mine environment. Mining equipment, such as longwall mining machines, roof bolters, and continuous miners, is made of high quality steel alloy containing chromium. The metal is highly resistant to corrosion. Calculations of the corrosion potential of the steel used in longwall mining machines have been performed by the University of Utah Metallurgy Department (BLM, 1998). They determined that it would take thousands of years for the metal to corrode away, and that the metal would need to be ground to a fine particulate for chromium to be dissolved. The University of Utah (BLM, 1998) report indicates

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that the general conditions required to hasten the corrosion of this metal do not exist in the Utah coal mining environment.

Minor water quality impacts could occur if lubricants were not drained from the equipment prior to abandonment. The magnitude of this impact would depend on the amount of organic materials, the volume of water in a flooded section, and the rate of bioremediation. Computerized controls on equipment may contain lead, cadmium, mercury, and chromium and could cause water quality impacts if located in a flooded section. However, the magnitude of this impact is estimated to be minimal because of the small amount of controls relative the volume of water likely to be impounded and the slow oxidation rates of these materials in the mine environment.

Petroleum, oils, and lubricants are regularly used in mining operations. These materials may degrade discharge water quality if they are mishandled or abandoned underground and exposed to water passing through the mine. There have been several spills or leaks at the mine, which resulted in contamination of Eccles and Mud Creeks. The probability of additional releases to surface water systems has not been assessed. Any toxic or hazardous materials which are used underground would have to be removed from the mine prior to closure.

Cumulative Effects

Past, Present, and Reasonably Foreseeable Future Actions are displayed in Appendix A.

Cumulatively, expansion of facilities and construction of new facilities in the area and increased human use/activity has the potential to decrease the quality of shallow alluvial ground water systems in the area. Any spills of petroleum products, sewage, or other materials due to subsidence, vehicle use, pipeline leaks, and other uses could reach the shallow aquifer systems. If more springs are developed on private lands for use at private facilities, water usage would increase and available water to the shallow ground water systems could decrease. The potential for effects to deep, perched ground water systems is negligible due to the low permeability of the rock layers exposed in the project area.

Flow in surface drainages and shallow alluvial ground water systems has probably increased due to human-caused changes to vegetation densities and types since Euro-American settlement. Conversion of grass/forb vegetation to mountain brush types and soil loss from resulting erosion has decreased the ability of the land to absorb and hold water. Historic timber cutting has decreased the forested area, thereby decreasing transpiration and increasing runoff. Observation of current vegetation types and environments in the project area indicates that conifer invasion of aspen stands, generally causing increased transpiration, is probably not an important factor in the project area (personal communication, Robert Thompson, Forest Botanist).

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Historic effects to ground water systems cannot be quantified because there is no baseline data on subsurface water to serve as the basis for comparison with current conditions determined through project baseline monitoring conducted by NorWest, 2000.

Deep perched water aquifers (sandstone channels) will be dewatered during the mining process and water will continue to be discharged to surface drainages for the life of the mining operations. Since this stored mine water has been aged at 10,000 years and greater and hydrologic connection to surface waters is through low permeability rock layers, it would take thousands of years to replenish this water. Dewatering of these deep aquifers would not cause direct effects to other resources, but discharge of ground water to surface drainages would cause effects (see Surface Water).

The oil and gas exploration wells projected in Appendix A would employ sediment control measures during construction, operations, and reclamation. Forest requirements for pad design use impermeable pits and berms to prevent fluids used during drilling and precipitation from leaving the disturbed area. Operators are also required to prepare spill prevention and recovery plans to mitigate effects. Drill holes are cased to prevent escape of drilling and production fluids and are plugged on abandonment to prevent contamination and mixing of ground water aquifers.

The current ground water conditions are not expected to change measurably due to actions not associated with mining displayed in Appendix A. The direct and indirect effects of the proposed action discussed in the previous section would however occur.

Irreversible/Irretrievable Commitment of Resources

No effects to the overall amount and quality of ground water available to surface water systems are anticipated, but changes in the location of ground water emergence at springs could occur due to subsidence. No irreversible or irretrievable commitments to the resource are anticipated.

Cumulatively the changes in surface and ground water and flow and quality since Euro-American settlement are irretrievable. The current trends could be reversed with intensive management.

Short-Term Use vs. Long-Term Productivity

Anticipated mining activities are not expected to cause changes to overall ground water flow. No long-term changes to productivity from mining are anticipated. Current activities and trends discussed under cumulative effects would most likely continue.

4.1.5.3 Alternative C

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The effects would be generally the same as discussed for Alternative B' even though perennial drainages would not be subsided. The only difference is that a smaller area would be subject to subsidence and the resulting effects.

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In the event that there was a perceptible or quantifiable mining-related diminution of groundwater discharge at a developed spring location in the area, the application of the coal mining regulations would require replacement of State Appropriated Waters. Special Coal Lease Stipulation #17 (Appendix C) would require the lessee to replace any water lost from developed groundwater sources with water of similar quality.

Although the impacts to water quality are expected to minimal, the application of SCLS #19 would require that the operator remove mine equipment and materials that are not needed for continued operations, roof support, and mine safety from underground workings prior to abandonment of mine sections, unless specifically approved by the authorized officer in consultation with the Surface Management Agency.

Cumulative Effects

Same as Alternatives B and B'.

Irreversible/Irretrievable Commitment of Resources

Same as Alternatives B and B'

Short-Term Use vs. Long Term Productivity

Same as Alternative B and B'.

4.1.6 Vegetation

The effects to vegetation would generally be caused by the construction of surface facilities, changes in stream morphology due to subsidence, and changes in mine water discharge to surface drainages.

Forest Plan direction and EO 11990 provide the basis for evaluating whether projected changes in riparian areas and wetlands are acceptable or unacceptable. The Forest Plan direction includes the following, "Give preferential consideration to riparian area dependent resources in cases of irresolvable resource conflicts". EO 11990 requires Federal agencies to minimize the destruction, loss, or degradation of wetlands; to preserve or enhance the natural and beneficial values of wetlands; and to consider maintenance of natural systems, including conservation and long term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources.

4.1.6.1 Alternative A (No Action)

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Under this alternative, no underground coal mining or associated facilities construction would occur in the Flat Canyon Tract. Mining related impacts to vegetative resources in the area would not occur.

4.1.6.2 Alternatives B and B'

Potential effects to vegetation under these alternatives include those associated with changes in stream and spring morphology caused by subsidence, changes in stream morphology due to increased mine water discharge, and those associated with the construction of surface facilities.

Disturbance from Surface Facilities

Exploratory drilling would temporarily disturb an estimated 9.2 acres of vegetation. Disturbance of riparian vegetation for road crossings would be minimized by requiring a bridge or bottomless arch. Disturbance for any individual drill hole would be for one season. The disturbance would be recontoured and planted after completion of the hole. It is estimated that revegetation standards would be met within 3 to 5 years after reclamation and seeding.

Construction of the two ventilation shafts, access roads, and the water pipeline would temporarily disturb approximately 2.9 acres of grass and shrub vegetation. The temporary roads to the vent shafts and most of the vent shaft pads would be reclaimed during the same season as constructed. The unreclaimed portions of the vent hole pads (less than 1 acre) would remain for the life of operations; approximately 12 years. When no longer needed for operations, the reclaimed access roads would be opened again to plug the holes and reclaim the remaining disturbance. Again it would take approximately 3 to 5 years to meet reclamation vegetation standards. It would take additional time, estimated at 5-10 years for the disturbed area to blend with adjacent vegetation and no longer be apparent to the casual visitor.

Revegetation with native species is stressed. Non-natives can be used in some cases if needed to establish vegetative cover as soon as possible to control erosion or to meet management objectives for the area.

These ground disturbing activities could increase the potential for noxious weed infestation in the Swens Canyon and Upper Huntington drainages. Mitigation activities including revegetation of disturbed areas and monitoring/eradication of noxious weeds prior to bond release would reduce the potential for erosion and weed related impacts.

Subsidence

Subsidence induced changes are described in Sections 4.1.1, 4.1.3, 4.1.4 and 4.1.7. They include sequential lowering of surface features by up to 14 feet in affected drainages. These surface changes would likely influence stream morphology; however, water volume in the stream/alluvial groundwater system is not expected to change.

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As the stream channel reacts to changes in longitudinal profile, lateral adjustments, such as stream channel widening and bank erosion, and vertical adjustments (entrenching) are likely. Established streamside riparian vegetation could be lost due to these channel adjustments and to the dewatering associated with channel entrenchment. Since there are two seams of mining, there could be two separate episodes of subsidence and stream channel morphology changes resulting in two separate episodes in loss of riparian vegetation. Depending of the timing, recovery from the mining of the first seam may not occur before the second seam is mined. Streamside riparian vegetation is primarily two species of willows, and several species of sedges and rushes. This variety in species improves the probability that the riparian community contains species suited for immediate occupancy of disturbed sites and species adapted to more stable conditions. With Alternative B, reestablishment of vegetation along eroded stream banks would be relatively rapid (5 to 8 years) if the channel does not meander into the valley toe slopes and if channel entrenchment does not occur. If the channel does meander into the valley toe slopes, reestablishment of riparian vegetation may not occur. With Alternative B', stream channel stabilization and revegetation would be required; therefore, most adverse effects associated with lateral channel adjustments would be mitigated.

Vertical channel adjustments may result in straightening of the stream channel, increased runoff rates, and lowering of the alluvial water table. While established vegetation might survive the change in water table, new seedlings from natural reproduction or planted stock would have a reduced likelihood of survival. The effects of dewatering may extend beyond the immediate streamside zone into the valley floor. Therefore, with both Alternatives B and B', streamside vegetation would likely be lost in areas of vertical adjustment.

Subsidence may cause some local alterations in groundwater flow direction, which may cause spring discharge locations to shift. The existing wetland communities surrounding these springs would be lost. Reestablishment of similar wetland communities at new spring locations would likely take 10 to 20 years as existing vegetation is replaced by hydrophilic species. The actual location of springs and/or seeps, which may be impacted, is not known. Commercially available planting stock is not generally available for the species characterizing these wetlands; therefore, the possible effects of Alternatives B and B' are similar.

There are two locations in the Boulger Creek sub-basin with larger wetlands: the headwaters of the left fork and a portion of the right fork upstream of the confluence of the two tributaries. These wetlands are maintained by precipitation and their inherent "sponge" effect, by springs along the margins of the wetlands, and by groundwater from upstream alluvium or upwelling. The wetland in the left fork was tested to determine if it is a peatland or fen. This site has been disturbed by human activities and lacks the organic soils and other important fen features to qualify as a peatland or fen (Sanderson, 2001). Possible effects from subsidence would be similar to those described above due to relocation of springs and vertical adjustments in the stream channels and dewatering through the wetlands.

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Increased Mine Water Discharge

If all mine water is discharged to Eccles Creek increases from the existing 10,000 -15,000 gpm to 22,000 gpm, effects to stream morphology would be as discussed in the Surface Water Section 4.1.4. Headcutting and increases in sediment could result in loss of riparian habitat along both Eccles and Mud Creeks. It could take as much as 10 to 20 years for the stream channels to stabilize based on the changing flows and for riparian vegetation to become re-established. It can be assumed that Canyon Fuel would initiate action to stabilize and reclaim the altered stream channels to mitigate effects. If this takes place, the duration of adverse effects could be shortened.

Cumulative Effects

The affected area is heavily developed considering the density and number of roads, highways, reservoirs, campgrounds, and privately owned camps and cabins/structures. Continued development of private lands in the project area and the coal drilling activities are expected to affect vegetation. Loss of vegetation for coal drilling activities and drilling of the vent holes is short-term. Vegetation removal for expanded or new development of private lands would be long-term. Past, Present, and Reasonably Foreseeable Future Actions are displayed in Appendix A.

Cumulatively, livestock grazing, expansion of facilities and construction of new facilities in the area and increased human use/activity has the potential to affect vegetation. Human-caused changes to vegetation densities and types since Euro-American settlement have occurred. Conversion of grass/forb vegetation to mountain brush types and soil loss from resulting erosion has decreased the ability of the land to absorb and hold water. Historic timber cutting has decreased the forested area, thereby decreasing transpiration and increasing runoff. Observation of current vegetation types and environments in the project area indicates that conifer invasion of aspen stands, generally causing increased transpiration, is probably not an important factor in the project area and that current management practices are leading to improvement of riparian conditions (personal communication, Robert Thompson, Forest Botanist).

Since current and future management activities overall vegetation conditions, especially in riparian areas are expected to improve. The potential adverse effects associated with the proposed action would however occur as discussed under this alternative.

Irreversible/Irretrievable Commitment of Resources

The disturbance to vegetation from the anticipated mining activities would be short-term (3-5 years) and irretrievable. Historic changes are irretrievable and irreversible.

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Short-Term Use vs. Long-Term Productivity

Anticipated mining activities are not expected to cause any long-term changes to vegetation productivity. Current activities and trends discussed under cumulative effects would most likely continue.

4.1.6.3 Alternative C

Disturbance from Surface Facilities

The effects would be the same as Alternative B'.

Subsidence

Subsidence of perennial stream channels would not occur with the possible exception of the Cunningham Drainage. No effects to riparian vegetation in the vicinity of the stream channels are anticipated. Most of the springs that maintain wetlands are located adjacent to the valley bottom and would be within the unsubsided zone. Therefore, no adverse effects to wetlands are anticipated.

Cumulative Effects

Same as Alternatives B and B', except that there would be no effects to vegetation from subsidence of perennial drainages.

Irreversible/Irretrievable Commitment of Resources

Same as Alternatives B and B', except that there would be no effects from subsidence of subsidence of perennial drainages.

Short-Term Use vs. Long-Term Productivity

Same as Alternatives B and B'.

4.1.7 Wildlife

Terrestrial wildlife species could be affected by changes in riparian habitat as discussed above and by the activity and loss of vegetation associated with surface facilities.

Effects to aquatic wildlife involve changes to stream morphology from subsidence and changes to surface water quantity and quality in Eccles Creek, Scofield Reservoir, and Electric Lake related to mine water discharge. The impacts to aquatic wildlife associated with mine water discharge could include local increases in aquatic habitat (based on higher flow and longer duration of flow), though the possibility that increased flow could influence sedimentation and

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erosion in some stream reaches also exists. The extent and duration of these impacts are difficult to predict due to the likelihood that mine water would only be pumped on an intermittent basis.

4.1.7.1 Alternative A (No Action)

Since no leasing or mining would take place, there would be no effects.

4.1.7.2 Alternatives B and B'

Monitoring of raptors and water flow and quality would be required under both alternatives under the Federal Coal Regulations and Utah Coal Rules. Under Alternative B', the Special Coal Lease Stipulations provide authority for requiring more detailed and comprehensive monitoring of wildlife densities, vegetation, and habitat, including aquatic habitat conditions in perennial streams (water flow and quality, stream morphology changes, etc.). They also provide additional authority to require mitigations. Specific monitoring plans and mitigations would be determined during mine permit review and approval.

TERRESTRIAL WILDLIFE

Disturbance from Surface Facilities

These activities are short-term, temporary activities. Big game and small animals would probably avoid the activity areas until activities are completed. The loss of vegetation and habitat is small and temporary with little consequence to populations. Some shifting of spring locations used for watering could cause animals to water at alternative locations, however this is unlikely. With the abundance of perennial springs and streams in the project area, this is not of consequence to populations.

Potential impacts to goshawks, flammulated owls, and three-toed woodpeckers could occur under Alternative B if operations occur during periods of nesting. Activities could cause territory abandonment and/or reproductive failure. These effects would relate to the disturbance associated with exploratory drilling activities the construction and maintenance of the ventilation shaft(s), the associated road(s), and the pipeline from Swens Canyon to Electric Lake.

Under Alternative B', SCLS #14 would restrict operations to times that would not adversely affect species in important seasonal habitat areas. Intensive activities such as construction and drilling would generally take place during the summer and early fall months (after July 15th and before November 1). The time restrictions in individual areas would be dependant on species present, habitat types, and weather conditions. Mitigations to protect goshawks, flammulated owls, and three-toed woodpeckers would be required. Mitigations specific to these species includes site-specific surveys following USFS protocols to locate breeding or juvenile birds and avoidance of occupied breeding territories during the breeding/nesting season. If nesting individuals are found, operations in areas that could affect them would not be allowed between late April and the end of September.

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Migratory birds could avoid activity areas while activities are occurring, but due to the small area disturbed, no effects to populations are anticipated.

Subsidence

Subsidence-induced changes would be limited to riparian vegetation (habitats). The effects would likely be gradual and limited to segments of Boulger Canyon and Flat Canyon where gradients are less than 5%. Suitable available habitat is abundant in other adjacent unaffected drainages. Therefore effects to overall populations of mobile species would be negligible. Mobile species such as birds and mammals would be affected the least, especially compared to limited-range species such as snails. Local populations of less mobile species could be affected, but again it is unlikely that overall populations found within the project area would be noticeably affected. In regard to limited range species such as aquatic snails that are dependant on specific springs and associated riparian vegetation, individual populations could be lost if springs shift in location with associated habitat loss. The potential for this to occur is low, as discussed in Sections 4.1.4 and 4.1.5. In the unlikely event this should occur, only a small number of springs in the project area and adjacent areas could be affected.

Subsidence is not expected to cause any direct effects to terrestrial species not directly dependent on riparian habitats. Surface cracks and minor changes to spring emergence locations could affect individual animals but should not affect populations.

Mine Water Discharge

Effects to terrestrial wildlife are expected to be negligible.

AQUATIC WILDLIFE

Forest Plan direction, standards and guidelines provide the basis for evaluating whether projected changes in aquatic habitat and fish populations are acceptable or unacceptable. The Forest Plan direction includes the following (pg. III-31, 02), "Give preferential consideration to riparian area dependent resources in cases of irresolvable resource conflicts" and (pg. III-22, 08) "Manage waters capable of supporting self-sustaining fish populations to provide for those populations". Plan standards include the following (pg. III-36, 01,d, (5)), "Coal leases may be denied or limited by special stipulations where operations would result in unacceptable or unmitigable impact on wildlife or fisheries" and "Proposed management activities which may cause unfavorable conditions in existing fisheries will include mitigation measures".

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Issue. Any changes in stream gradient/morphology, water flow and quality in perennial drainages, Boulger Reservoir, or riparian vegetation/wetlands could affect habitat for terrestrial and aquatic species.

Disturbance from Surface Facilities

Exploratory drilling would disturb an estimated 9.2 acres within the project area. Construction of the ventilation shaft, access road, and pipeline in the lower reach of Swens Canyon and along the highway in Upper Huntington Creek, would disturb approximately 2.9 acres of native grass and shrub vegetation in the road/pipeline corridor. This could potentially cause sediment to enter adjacent streams, either during construction or due to post-construction erosion. These temporary impacts could occur with both action alternatives. Required sediment control measures and Best Management Practices would reduce or eliminate the potential for adverse effects, due to short and long-term sedimentation into these streams, to a negligible level. An example would be the stream crossing in Swens Canyon for construction of a mine vent shaft. The road would be constructed to the channel then a bridge or bottomless arch culvert would be placed to bridge the drainage and preserve the channel environment. Sediment control such as silt fences would be installed to minimize addition of sediment to the stream. Sediment control devises would be left in place and maintained until reclamation/revegetation meets required standards. Re-establishment of vegetation along the stream banks would include riparian species.

Subsidence

Longwall mining commonly results in differential subsidence of the land surface. Longwall mining under a stream channel would cause localized changes in channel gradient. Between the outer edges of individual panels, the stream channel would be lowered by subsidence but the gradient would generally not change. Differential subsidence and associated gradient changes would occur at the outer panel edge in the area defined by the angle-of-draw. Therefore, the greatest potential for major alterations in stream morphology occurs above panel ends or above longwall gate roads. The amount of gradient change would depend on the panel orientation relative to the channel and the stream gradient, whether only one or two seams would be mined, and how the panel edges would be aligned for the overlying panels. Based on two seams of mining, with stacked fire barriers, the maximum slope change expected from subsidence under perennial drainages is approximately 3% (Table 4.1, Subsidence Point 6, Boulger Dam).

In the Burnout study (Sidel, et. al. 2000), surface changes due to subsidence were expressed mainly as increases in the extent of pools. Many of the channel attributes studied produced inconclusive results, but subsidence effects generally did not cause major detrimental impacts. Subsidence-induced changes in channel gradient at Burnout Canyon, even in the areas of maximum differential subsidence, were not great enough to cause barriers to fish movement in the stream. Extrapolation of this study must be confined to stream systems with similar gradients in the range of 5 to 7 percent. This would include the upper portions of Swens and Little Swens Canyons, Boulger Creek in the vicinity of the confluence of the left and right forks, the lower

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portion of the left fork of Boulger Creek, the lower portion of the South Fork of Boulger Creek, and Cunningham Creek.

The Burnout study should not be extrapolated to stream segments with gradients flatter than approximately 5%. This would include Flat Canyon (1.5 miles), the majority of Boulger Creek (4.0 miles), and the lower portions of Swens (0.5 mile) and Little Swens Canyons (0.5 mile). These systems have gradients flatter than the maximum slope change expected from subsidence of approximately 3%. Subsidence could cause areas of entrenchment (increased positive gradient) and pooling (negative gradient) in the vicinity of maximum differential subsidence, and increased lateral stream movement in other subsided areas.

Stream systems adjust to increased positive gradients by entrenching and by a combination of channel widening and increased lateral movement (Rosgen, 1996). This would increase the sediment load in the affected stream segments and downstream and could result in loss of some habitat features. While areas of negative gradient would result in pooling, the deposition of sediment from upstream entrenchment would reduce the habitat quality of existing pools and those created by subsidence. Some pools may be effectively lost if filled with enough sediment. New pools created by subsidence could breach at locations other than the original channel. This new channel would scour through the temporary pool and continue eroding upstream, contributing even more sediment and habitat loss. Increased lateral movement of the stream channel between zones of positive/negative gradient would result in additional sediment produced by stream bank erosion. If the channel should migrate to the edge of the valley bottom, undercutting of valley side slopes could occur, also resulting in additional sediment.

Because the majority of the fish habitat in Boulger Creek is in areas of relatively flat gradient, the possible effects of subsidence would affect the entire stream system. With Alternative B, stream channel adjustments and the consequent loss of habitat features could significantly reduce the productivity of the currently very productive fishery. Effects in the other stream systems in the project area would be less pervasive because there are fewer miles of flat gradient and the flat gradient segments are in the downstream portions of the stream system. Return to equilibrium conditions could require 10 to 30 years and may not occur in all stream segments. Alternative B and B' differ in their effects in that more intense monitoring and remedial measures would be required in B'. These measures could include intensive monitoring to measure changes to stream flow/quality, morphology, and aquatic habitat conditions and measures for temporary and permanent stream channel stabilization, grade control structures, planting of streamside vegetation, or reconstruction of segments of stream channel. The measures associated with B' would partially offset the effects of Alternative B, but might not fully mitigate the potential loss of habitat features and the effects of sedimentation.

Loss of population viability for the fish populations in Electric Lake and the connected tributaries is not expected due to the effects of subsidence. The effects described above could affect individual fish. Affected fish are likely to be displaced and move to more suitable habitat, perhaps in other stream systems connected through Electric Lake. As described in the Surface

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Water section, there is a very low probability that subsidence would affect the quantity of water in the stream systems.

Effects to macroinvertebrates from Alternative B could be dramatic in the short term (3 to 5 years). As gradients flatten and more pooling occurs in perennial streams at the downstream margins of subsidence, fine sediment could increase in these flat-water areas. This could cause changes in macroinvertebrate species composition. There could be an increase in diptera and other families and/or species that are tolerant to fine sediment. Biotic Condition Index (BCI), Density Index (DAT), and Standing Crop would all likely decrease in these new flat-water habitat areas and they would likely fall below Forest Plan Standards. Other stream segments could experience some short-term increases in fine sediment, which may affect macroinvertebrates indices but there would not be as dramatic of a change compared to the margins of subsidence. Boulger Creek from Boulger Reservoir to Electric Lake, without remedial action taken, could show an increase in fine sediment throughout the whole reach. Macroinvertebrate indices in this reach would likely fall below Forest Plan Standards.

Alternative B' would have the same short-term effect to macroinvetebrates as Alternative B. Stream conditions below Boulger Reservoir would be less affected by fine sediment due to riprap and bank erosion measure takes in the channel and less affects to macroinvertebrate indices.

Surveys for boreal toad were conducted in the spring of 2001. Habitat for this species and other amphibians were found in floodplain areas along Boulger Creek and other pot-hole-sag-ponds that capture snowmelt along Boulger Creek. Boreal toads were not found in these surveys. Habitat along perennial streams within the project area is excellent and not necessarily dependent on springs. Subsidence of springs is not expected to affect amphibian habitat. Subsidence is not expected to cause the disappearance of sag ponds and floodplain features throughout the middle of subsided areas. Lower reaches of low gradient streams may flatten out in gradient causing pooling and an increased in amphibian habitat. Upper reaches of streams may increase in gradient and cause loss of pools and possible downcutting. Only in these areas are effects to amphibian habitat expected to occur.

Under Alternative B', Boulger Reservoir Dam would be breached and a new stream channel would be established and armored with riprap and gravels to avoid potential safety concerns and prevent erosion of the reservoir sediments. The existing reservoir habitat and new stream channel through the reservoir area would be lost as effective aquatic habitat for the duration of mining and subsidence estimated at approximately 12 years. Fish and macroinvertebrate passage would be provided for in the channel design. Under Alternative B', the lessee/operator would be required to mitigate the loss of recreational fishing opportunities at the reservoir by improving another reservoir or by some other means to be decided during permit review and approval. This is discussed in more detail in Section 4.1.8 (Recreation).

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Issue. Changes to mine water discharge would affect flow and affect aquatic and terrestrial wildlife species and habitat

Change in location of mine water discharge would affect Eccles Creek and Mud Creek. That portion of Eccles Creek on National Forest Systems lands potentially affected does not support a fishery.

If all anticipated mine water is discharged to Eccles Creek, stream headcutting and sediment production would increase as discussed in the Surface Water Section 4.1.4. Loss of riparian vegetation along the streams as discussed in the Vegetation Section 4.1.6 could decrease the quality of aquatic habitat. It could take many years for the stream channels to stabilize and for riparian vegetation to become reestablished. If measures are taken by the lessee/operator, the magnitude and duration of adverse effects can be decreased.

The possible water quality effects of mine water discharge are described in the Surface Water Section. Nutrient increase in Electric Lake from mine water discharge may increase fish productivity, but not likely to the point where there are viability risks to the lake populations. Eutrophic conditions in Scofield Reservoir have resulted in periodic fish kills. If eutrophic conditions were to occur as a result of increases phosphorous in Electric Lake, individuals would be impacted but there would not likely be effects to the population viability.

The temperature of groundwater from the Skyline Mine has averaged between about 11°C and 16°C (Mayo and Associates, 1994). If this water is discharged directly into Electric Lake during the winter months when temperatures of the lake water are near 0°C, there would be an alteration of the thermal regime of the lake. This may locally result in the melting or thinning of the surface ice in the vicinity of the discharge point and affect lake thermodynamics and stratification. The increased temperature at the discharge point would likely cause an increase in biotic production in the immediate vicinity of discharge and increased zooplankton and algae growth. The increased biotic activity would likely be limited to less than 1% of the lake volume. The mixing with the lake water would dilute the overall effects to Electric Lake and there would be no overall effects to aquatic resources in Electric Lake. The flow of water from the discharge point to the surface of the lake would promote mixing and interrupt winter stratification (temperature and dissolved oxygen) that could improve over-wintering survival of fish. Currently, low dissolved oxygen levels from stratification are not a problem in Electric Lake in regard to fish survival.

THREATENED, ENDANGERED, AND SENSITIVE SPECIES

Because both Alternatives B and B' could result in draining Boulger for up to 12 years, Bald eagle foraging habitat could be reduced. However, this is a small reservoir and several larger reservoirs such as Electric Lake, Scofield Reservoir, Lower Gooseberry, Beaver Dams Reservoir, Cleveland Reservoir, and Huntington Reservoir are nearby. Therefore, there would be negligible effects to wintering or migrating bald eagles.

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Effects to Threatened, Endangered, and Sensitive Species would be negligible (Biological Evaluation and Biological Assessment, Project File).

Cumulative Effects

The affected area is different for individual species. The ranges of use by species of concern are discussed in Chapter 3 (Section 3.1.8).

Past, Present, and Reasonably Foreseeable Actions are presented in Appendix A.

Due to historic vegetation changes, development, and the high human use of the project area, habitat types have changed considerably since Euro-American settlement. The number of species, populations, and distribution of species have changed accordingly to the current condition described in Chapter 3 (Section 3.1.8) for terrestrial and aquatic wildlife. The effects described in this section relative to leasing/mining would occur in addition to those that have already occurred in the project area.

The north-facing slopes of Flat, Cunningham, and Swens Canyons have recently experienced considerable logging activities on non-Federal lands, including the associated road construction and soil and vegetation disturbances. These disturbances may contribute additional sediment to the stream systems, but to a lesser extent than that expected from stream channel adjustments caused by subsidence.

Construction and operation of the gas wells and pipeline construction on Trough Springs Ridge could cause temporary avoidance by terrestrial wildlife species in the summer and fall during construction, drilling, and reclamation operations. Timing restrictions on these operations would prevent effects to species during use of important seasonal habitats. Gravel surfacing of the road could increase traffic and recreation use along the ridge during the summer and fall seasons. The Monument Peak Road on Trough Springs Ridge is gated during the winter and spring months to prevent road damage and disturbance to wildlife.

Application of Forest Plan standards and Best Management Practices to reduce loss of habitat and minimize erosion and sediment contributions to the stream segments are expected to minimize effects such that population standards can be met. However, the effects to aquatic habitat regarding the proposed leasing and mining activity discussed in the previous section would still occur in addition to these effects.

Irreversible/Irretrievable Commitment of Resources

The effects described above relative to surface facilities and mine water discharge would be irretrievable but not irreversible.

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The effects described above relative to subsidence would be irretrievable. Measures could be taken to mitigate the effects.

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Short-Term Use vs. Long-Term Productivity

The effects of these alternatives relative to surface facilities would be short-term and would not affect long-term wildlife productivity. The effects to aquatic habitat from mine water discharge would be temporary (12 years). The effects of subsidence would be long-term.

4.1.7.3 Alternative C

TERRESTRIAL AND AQUATIC WILDLIFE

Disturbance from Surface Facilities

The effects would be the same as discussed for Alternatives B and B'.

Subsidence

Under this alternative, subsidence of perennial drainages, Boulger Dam, and Boulger Reservoir would not occur, and morphological changes to instream habitat parameters (changes in distribution of pools, riffles, glides, and runs) and any corresponding water related impacts to bank vegetation resulting from stream subsidence would not be expected to occur. Changes to aquatic habitat would be negligible.

Undermining and subsidence related impacts to springs and seeps, although unlikely, could occur along the ridge tops and mid to upper canyon slopes, but not in the stream channels and immediate floodplain areas. The potential for reductions or other changes in surface recharge to wetlands and seeps would exist but would be low to negligible. Drawdown related impacts to riparian and wetland associated plant communities throughout the tract could occur but are also expected to be negligible.

Mine Water Discharge

The effects would be the same as discussed for Alternative B'.

THREATENED, ENDANGERED, AND SENSITIVE SPECIES

Effects to Threatened, Endangered, and Sensitive Species would be negligible (Biological Evaluation and Biological Assessment (Project File).

Irreversible/Irretrievable Commitment of Resources

The effects described above would be irretrievable but not irreversible.

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Short-Term Use vs. Long-Term Productivity

The effects of this alternative relative to surface facilities would be short-term and would not affect long-term wildlife productivity. There would be no long-term effects to productivity from subsidence and seismicity. .

Cumulative Effects

The effects would be the same as those discussed for Alternative B' however the effects to aquatic habitat from subsidence would not occur. Forest Plan standards for terrestrial and aquatic wildlife could be met.

4.1.8 Recreation

Effects to recreation could result from surface disturbance for facilities, subsidence, and seismicity.

4.1.8.1 Alternative A (No Action)

There would be no effects. No mining related surface disturbance or subsidence would occur, although mining-induced seismicity from the existing mining operation would continue. People recreating in the project area may perceive some of the larger events (2.0 or greater within 3,400 feet of the location of mining) generated from mining in the existing permit area to the east. The level of perception and concern appears to be different for individuals. However, it is unlikely that the vibrations would be strong enough to cause concern. Over the last 13 years, approximately 1,000 events greater than 2.0 have been recorded and attributed to mining at the Skyline Mine. This is equivalent to an average of about one event every 5 days. Based on a distinctly perceptible limit for short duration events of 1 in/sec PPV, and event of magnitude 2.0 can be distinctly felt for a radius of about 3,400 feet from the location of mining. The Forest has not received complaints or inquiries about these events over any of the extensive areas of mining on the Wasatch Plateau. Even though some may have been perceived, they did not appear to generate concern from the general public.

4.1.8.2 Alternatives B and B'

Disturbance from Surface Facilities

Mine related traffic levels (associated with routine operations at the portal area and occasional coal hauling) currently occurring would be increased for 9-12 years. Increases in this traffic level are not expected or are expected to be negligible.

The anticipated coal drilling associated construction and traffic could temporarily decrease the recreation experience of people using the project area. These activities would occur during the summer season or fall seasons. The sights and sounds of the heavy equipment and drill rigs

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could be perceived by sight-seers, hikers, fishermen, and hunters. This activity is temporary, lasting approximately a month for individual holes. Drilling could continue for several seasons, but the activity would shift to different locations.

The construction of access roads for the vent shafts and the drilling operations would be seen and heard by people recreating in the canyon areas. During operations, the vent shaft in Swen's Canyon could be seen and potentially heard by people as they drive by the mouth of Swen's Canyon along SR-264 for a distance of approximately 150 feet. Drilling of the Boulger Canyon vent shaft would be visible and audible only from the Boulger Canyon road well above Boulger Reservoir at the upper forks. This would be a concern for fishermen and sightseers in this area. Construction of the roads and drilling of the holes could take up to 2-3 weeks. Once the shafts are completed and the roads reclaimed the disturbance from the activity and noise would cease, but the roads would be visible until vegetation grows in and blends with the surrounding area (probably 3-5 years). The ventilation shafts would exhaust air from underground workings. On infrequent occasions, when the wind currents are very calm exhaust air can move down canyon. During these conditions low-level diesel exhaust fumes could be apparent to recreation users in the general vicinity. There would be no mechanical noise but the sound of the rush of air could be perceived at short distances from the shafts.

The chain link fences at the shafts could pose a safety hazard to snowmobilers. Contributing to the hazard are the high-speed capabilities of snowmobiles and bright snow reflective conditions that often impede vision of the operators. This would be mitigated by placing high visibility signs on the fence near the top, above the snow.

No decrease in recreation use is anticipated as a result of this activity due to the short-term duration of most activities at specific locations and recreationists can use adjacent unaffected areas. Recreation users could be displaced to adjacent areas if bothered by the presence of the vent shafts (depends on the perceptions of individual users). The quality of the recreation experience could be decreased, depending on the recreational needs of individual users.

Subsidence

Boulger Reservoir

Boulger Reservoir Dam could be damaged and fail as described in Section 4.1.3.2. This could result in downstream hazards to fishermen and sightseers in the downstream channel. The dam and related facilities could remain out of service indefinitely.

Alternative B' would require measures to avoid the associated downstream effects and hazard. It could be necessary to breach the dam and take the facility out of service until subsidence is complete. Considering that mining would take place in two separate seams at different times, the reservoir could be out of service by up to 12 years. The lessee/operator would be required to reconstruct the facility after mining and subsidence are complete. Reinforcing the dam sufficient to prevent damage is also an option but would probably not be effective considering the

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magnitude of expected subsidence. In the event that the dam and reservoir are taken out of service, the lessee/operator would also be required to mitigate the loss of recreation use. Mitigations could include upgrading other facilities that would receive increased use due to loss of the reservoir. Specific mitigations would be determined in consultation with the Utah Division of Wildlife Resources, Utah Division of Oil, Gas and Mining, and lessee/operator.

Boulger Reservoir is a very popular day use fishing area during the freeze free months, with highest use between July 4 and Labor Day. Under both Alternatives B and B' there would be lost use of the still fishing recreation opportunity at the reservoir for this time period. Current use is approximately 5,000 RFDs per year (freeze free season). Multiple this by twelve years, this would be a loss of 60,000 RVDs. People would be displaced to other facilities such as Beaver Dam Reservoir, Electric, and Gooseberry Campground and Reservoir that provide similar fishing experiences.

Flat Canyon Campground

Structures at Flat Canyon Campground could be damaged by subsidence as discussed in Section 4.1.3.2. Structures that are necessary to the usability of the campground include the spring collection system/retaining wall, water tank/faucet delivery system, and the toilet, including septic tank and drain field. The related safety hazard is not considered high but is a concern. Potential safety hazards include shifting and formation of cracks in structures while in use and falling trees. Some trees in the area are already weakened due to camping related effects. Cracks to the toilet vault could occur and raw sewage could leak to the surrounding area.

Due to potential safety hazards regarding use of the Flat Canyon Campground during active subsidence, the campground would be closed. Active subsidence generally lasts 6 months after mining beneath a specific point or area on the ground surface. Since there are two seams of potential mining, it is estimated that the campground could be closed for two seasons, probably separated by at least 2 years. The campground is closed during the winter from mid-September until about the last week of June, depending on snow conditions. Closing of the campground for two summer-use seasons represents a loss of approximately 6,000 Recreation User Days (RVDs). This could involve a loss of $4,000 per year to the concessionaire with a potential total of $8,000.

Under Alternative B', the lessee/operator would be required to monitor these systems during active subsidence and to repair any damages prior to reopening the campground.

Summer Homes

The summer homes on non-Federal lands within the project area could be damaged by subsidence and it is not recommended that they be occupied during active subsidence. Potential damages are described in Section 4.1.3.2. This could cause a loss of use in two separate episodes of mining and subsidence up to approximately a year each for each seam of mining. If damages to the structures occur that render them unsafe for occupancy, there would be additional periods

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of lost use until repairs are made. Determinations regarding occupancy during active subsidence would be up to the property owners and arrangements for repairs of damages would be negotiated between private and mineral estate owners and the mining company.

Hunt Reservoir

There would be no subsidence damage or lost use from subsidence.

Dispersed Recreation

No safety hazards are expected other than those described above relative to potential failure of Boulger Dam.

Seismicity

Boulger Reservoir

Mining-induced seismicity could damage Boulger Reservoir Dam as described above in the subsidence section. Under both Alternatives B and B' the facility could be out of service for approximately 12 years.

Flat Canyon Campground/Summer Homes/Dispersed Recreation

Mining-induced seismic events could be felt by people using the campground and the summer homes, as well as other people in the project area. The seismic events are not anticipated to cause a safety hazard but could be felt by recreationists, especially campers sleeping on the ground. Under Alternative B', signs would be posted in the campground warning campers of the potential seismic activity to reduce concern.

The period of greatest potential for seismic events to cause effects to dispersed recreation, campers, and summer home users would be during the summer use season during the period of active subsidence. Since the campground would be closed during active subsidence, the effects would be minimized. Use of the summer homes decreases during the winter months.

Hunt Reservoir

Hunt Reservoir Dam could be damaged by mining-induced seismic events. If it is damaged or taken out of service, use of this small reservoir at Camp Shalom during the summer season could be lost for up to 12 years.

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Cumulative Effects

The cumulative effects area as related to the identified issues includes the project area, State Highways 264 and 31, and camping/fishing opportunities at adjacent reservoirs, including Beaver Dam Reservoir, Electric Lake, and the Gooseberry Reservoir and campground.

As described in Chapter 3 and displayed on the Table of Past, Present, and Reasonably Foreseeable Future Actions in Appendix A, increased recreation use of the project area is expected due to increasing population and demand for recreation opportunities. Plans to improve Flat Canyon Campground and facilities at Boulger Reservoir are intended to increase use capabilities.

The effects of mining described in the previous section could occur in addition to the projected recreation demand. The long-term (9 to 12 years) lost use of Boulger Reservoir and short-term (2 seasons) lost use of Flat Canyon Campground could displace recreation use to other facilities in the area, increasing usage rates and possibly surpassing the capabilities of these facilities. This could lead to a decrease in the recreation experience and increased maintenance costs at these facilities. Increased use spread among the other facilities could be equivalent to the lost use of 5,000 Recreational Visitor Days (RVDs) per year or 60,000 RVDs over the 12-year period at Boulger Reservoir. Additionally, the associated campgrounds could receive increased use of 6,000 RVDs associated with two years of potential lost use of the Flat Canyon Campground. These effects would be in combination with potential increases in recreational use (undetermined). Under Alternative B' as opposed to B, the lessee/operator would be required to take appropriate measures (to be determined during the mine permitting process) to improve other facilities to be able to accommodate the shift in use.

The gas exploration operations and pipeline construction/reclamation operations on Trough Springs Ridge could temporarily decrease the quality of dispersed recreation experience along SR-264 and a lesser extent to SR-31 during construction, drilling, and reclamation operations due to the noise, traffic, and activity.

Irreversible/Irretrievable Commitment of Resources

The effects described above would be irretrievable during the periods of lost use but would not be irreversible.

Short-Term Use vs. Long-Term Productivity

The lost use of facilities due to leasing/mining would be both short and long-term as described above. Use of the facilities would be restored upon replacement/repair.

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4.1.8.3 Alternative C

Disturbance from Surface Facilities

The effects would be the same as described under Alternatives B and B'.

Subsidence

The structures described above under Alternatives B and B' would not be subsided, therefore there would be no damage. The summer homes north of Swen's Canyon on non-Federal lands and non-Federal mineral estate could potentially be damaged by subsidence as described under Alternatives B'.

There would be no need to close Flat Canyon Campground so there would be no loss of use. Boulger Reservoir would not be subsided, but effects similar to those described for Alternative B' could occur as described below in the seismicity section.

Seismicity

The Flat Canyon Campground would not be subsided, therefore no lost use is expected. Due to seismicity concerns, Boulger Reservoir might need to be breached and taken out of service for 5-7 years. This could involve a lost recreation use of 5,000 RVDs per year or 35,000 RVDs over the 7-year period. As discussed under Alternative B', the lessee/operator would be required to take actions to help mitigate or offset this effect.

The effects relative to perceived seismic events would be essentially the same as described under Alternatives B and B' except that the severity of mining-induced seismic events perceived at the Flat Canyon Campground and at the protected private summer homes in the subsidence protection zones could be reduced because mining would not occur directly beneath these areas.

Cumulative Effects

No lost use is expected at Flat Canyon Campground. Recreation use of Boulger Reservoir and the associated facilities would occur for a shorter period of time. Lost use would be for 5 to 7 years rather than for 9 to 12 years. Increased use of the other adjacent reservoirs for fishing could be 5,000 RVDs per year or 35,000 RVDs over the 7-year period.

The effects of perceived seismicity would be as described above.

The effects related to increased traffic on SR-264 and SR-31 described under Alternative B' would be the same since the increased traffic levels associated with gas wells and pipeline construction would occur coincident with mining related traffic. Current mining related traffic volumes would be extended for 5-7 years as opposed to 9-12 years for Alternatives B and B'.

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Irreversible/Irretrievable Commitment of Resources

The effects described above would be irretrievable during the periods of lost use but would not be irreversible.

Short-Term Use vs. Long-Term Productivity

The lost use of facilities due to leasing/mining would be both short and long-term as described above. Use of the facilities would be restored upon replacement/repair.

4.1.9 Visual Quality

The only anticipated effects to visual quality would be the result of surface facilities. There would be no apparent visible effects of mining-induced subsidence and seismicity.

4.1.9.1 Alternative A (No Action)

There would be no effects; therefore no change to visual quality would occur.

4.1.9.2 Alternatives B and B'

The roads and drill pads for the exploration holes and vent shafts would degrade visual quality but would be consistent with visual quality objectives for the area.

The anticipated coal drilling associated construction and traffic could temporarily degrade the visual quality but the exact locations of exploration drill holes can't be accurately predicted at this time. These activities would occur during the summer and/or fall seasons. The sights and sounds of the heavy equipment and drill rigs could be perceived by sightseers, hikers, fishermen, motorists and hunters. Based on the topography of the project area it is likely that some of the drilling operations would be visible from SR-264 that is part of the Huntington and Eccles Canyons National Scenic Byway. Since there are no special restrictions on activities that would be visible from Scenic Byways, this would be consistent with management direction and Forest Plan direction. This activity is temporary, lasting only two to three weeks for individual holes. It is possible that not all of the holes would be drilled in a single season but could be spread out over several seasons. Once operations are complete and the pads and access roads are returned to approximate original contour and reclaimed, the disturbance would be visible because of the lack of vegetation. It is anticipated that it would take approximately 3-5 years for vegetation to become established consistent with ground cover in the adjacent undisturbed area. It could take 5-10 years before the disturbed area would completely blend with adjacent vegetation and not be noticeable as a former disturbance.

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The construction of access roads for the vent shafts and the drilling operations would be seen and heard by people recreating in the canyon areas. During operations, the vent shaft in Swen's Canyon could be seen and potentially heard by people as they drive by the mouth of Swen's

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canyon along SR-264 in the foreground. Drilling of the Boulger Canyon vent shaft would be visible and audible only from the Boulger Canyon road well above Boulger Reservoir at the upper forks in the middleground and foreground. This would be a concern for fishermen, hunters, and sightseers in this area. Construction of the roads and drilling of the holes could take up to 3-4 weeks. Once the shafts are completed, the unused portion of the pad and the road would be recontoured and reclaimed. At this point the disturbance from the activity and noise would cease, but the pad and roads would be very apparent until vegetation grows in consistent with ground cover in the adjacent undisturbed areas. It is likely that differences in vegetation would be apparent only to those familiar with the past disturbance for an additional 5-10 years, until species combinations merge. A 6-8 foot tall chain link fence around each of the vent shafts and a concrete foundation at the top of the shafts would be visible. The shaft in Swen's Canyon would be screened by a ridge as viewed from SR-264 and not apparent to passing motorists. The shaft could be visible from the Swen's Canyon road for a distance of approximately 150 feet but would not be readily apparent due to the use of colors that blend with the background. The shaft in Boulger Canyon would be visible along the upper reaches of the Boulger Canyon roads. The ventilation shafts would exhaust air from underground workings. On infrequent occasions, when the air is still and the outside air temperature is considerably colder than the vented air, a plume of water vapor could be visible from SR-264 and the adjacent area for considerable distance. There would be no mechanical noise but the low-level sound of the rush of air could be perceived only immediately at the shaft locations.

Upon completion of mining, approximately 12 years from construction, the vent holes would be backfilled. In order to backfill the shafts and reclaim the disturbance it would be necessary to again construct the temporary access roads. Backfilling of the vent holes would take approximately 2-3 weeks. The associated traffic and activity would temporarily degrade visual quality for this period of time. Dump trucks (end-dump, 10 cubic yard capacity) would most likely used to haul rock fill material to the site. Approximately 20 -25 loads would be required to fill each hole. Once backfilling is completed the pads and roads would again be recontoured, reclaimed and revegetated. It would take 3-5 years for vegetation to become established to standard but 5-10 years for vegetation to blend with the surrounding area before the disturbed area would no longer be noticeable by the casual visitor.

The Boulger Canyon Dam could be breached and taken out of service for the life of operations (up to 12 years). This would leave a dry reservoir area with little vegetation that would be very noticeable by motorists on SR-264 the Boulger Canyon Road. This would be an obvious human activity. The reservoir would be replanted to decrease visibility but it would take 3-5 years before the reservoir bed would become vegetated. It would take up to 10 years for vegetation to blend with the surrounding area and the dam and depression would still be somewhat visible. Once mining is completed and subsidence is substantially complete, the reservoir would be dredged and the dam would be rebuilt and refilled.

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Cumulative Effects

The visual landscape of the affected area has been highly modified. Man's activities dominate the foreground and middleground as viewed from SR 264. Additional improvements of private lands are projected that would increase visual modifications to the landscape. The visual effects described above regarding mining would be short-term and consistent with visual quality objectives considering all Past, Present, and Reasonably Foreseeable Future Actions.

The new gas pipelines (Questar Mainline 104 and Williams Pipeline) on Trough Springs Ridge could decrease visual quality for up to 5 years until vegetation is established to similar or better conditions than existed along the old Mainline #41 pipeline corridor. They are generally not seen from the project area except where the pipeline corridor crosses SR-264. Visual quality objections can be met.

Irreversible/Irretrievable Commitment of Resources

The effects to visual quality would be irretrievable during their duration of effect but would not be irreversible. Disturbances would be removed after use and the disturbed areas would be recontoured and reclaimed.

Short-Term Use vs. Long-Term Productivity

Disturbance for exploration drilling and construction/reclamation of vent holes would be short-term. The fences around the vent holes would be visible for only short distances for the long-term.

4.1.9.3 Alternative C

The effects would be the same as described for Alternatives B and B'.

Cumulative Effects

Same as Alternatives B and B'

Irreversible/Irretrievable Commitment of Resources

Same as Alternatives B and B'.

Short-Term Use vs. Long-Term Productivity

The effects would be the same as Alternatives B and B' except that the vent holes would remain in use for 5 to 7 years as compared to 9 to 12 years for Alternative B.

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4.1.10 T ransportation

Effects could result from the construction and operation of surface facilities, subsidence, and from the extended period of mine operations by increasing the mine life.

4.1.10.1 Alternative A (No Action)

There would be no effects.

4.1.10.2 Alternatives B and B'

Disturbance from Surface Facilities and Extended Mine Life

Construction and drilling traffic for exploration holes and the vent shafts would use SR-264 and Forest Roads for access to the project area. This would consist of the truck mounted drill rig, compressor/generator truck, drill pipe truck, two or three frac-tank trucks (if conditions don't allow digging a reserve pit), a low-boy for transport of a backhoe and a dozer, a water truck, a utility truck with fuel tank, and several pickup trucks for crew transport. This temporary increase in traffic on SR-264 is not expected to cause traffic or safety concerns, or damage to the pavement, beyond normal levels. Some damage from heavy vehicle loads could occur to native surface Forest Development Roads, especially when they are wet. The lessee/operator would be required to suspend operations when roads are wet and susceptible to damage, obtain a road-use permit for this commercial use, maintain the roads as necessary to assure safe access, and repair damages upon completion of operations. A performance bond would be required under the road-use permit to assure maintenance and repairs. Approximately 2.3 miles of temporary roads would be needed for coal drilling. Another 1,000 feet of temporary roads would be required for access to the vent shaft sites. Each individual road would only be in service for one field season prior to reclamation. Traffic increases on SR-264 and SR-31 for this short-term activity are estimated at 42 trips per day per hole. Assuming 5-10 holes per year drilled sequentially for a total of 10 holes over one or two years, this equates to an increase of 42 trips per day between July 5 and October 1.

Existing mine related traffic levels on SR-264 and SR-31, including haul trucks, support vendors, and employee traffic would continue for an additional 9-12 years. Any increased traffic levels would be negligible. Since the majority of coal is conveyed to the unit train loadout then shipped via rail, and production levels are not expected to increase, this would be a negligible effect.

Subsidence

Subsidence and damage to SR-264 is discussed in Section 4.1.3.2. Short duration traffic delays could occur as repairs to the road surface and drainage structures occur. Monitoring of the road during active subsidence and repair of hazardous cracks immediately, if they occur, would abate any potential safety hazard.

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The native surface Forest Development Roads in the project area could be subsided up to 14 feet. Maximum tension is likely to occur on the roads at the ends of longwall panels near their intersections with SR-264. Most cracks that are known to occur are narrow with no vertical offset and are not likely to even be noticed or require repairs. Since the larger cracks (greater than 2 inches in the Skyline Mine Permit Area occurred on ridge tops where slopes are actively moving through soil creep, it is unlikely that cracks large enough to cause safety problems would occur on the roads. Under Alternative B' (SCLS #13), the lessee/operator would be required to patrol the roads on a daily basis during active subsidence to discover any cracks and repair them to avoid safety problems. The cost of repairs is estimated at approximately $12,000.

Two private roads cross Flat Canyon Creek providing access to private cabins and buildings. Subsidence of the stream could cause the roads to become submerged and the saturated zones could expand laterally. The roads may become unusable until repairs can be made to properly raise the running surface to above the water level and provide adequate drainage. It is assumed that repairs would be required in the mine permit. These roads could be out of service for a couple weeks before repairs are completed.

Cumulative Effects

Traffic volumes on SR 264 are currently generally below design capacity. Timber cutting on the private lands just west of the project area and the associated hauling on SR 264 has occurred during 200 and 2001. Hauling is expected to continue through 2002. Logs are hauled on SR 264 to the west then down Fairview Canyon on SR 31. Projected increases in recreation demand and use would result in increased traffic, especially during holiday weekends and the regular big-game hunts. The increased traffic related to construction and drilling of coal exploration holes and the two vent holes would be temporary and not expected to cause significant conflicts with existing traffic. It is Forest policy to not allow mobilization of drill rigs and heavy equipment during holiday weekends or the opening weekends of the general big-game hunts. However, operations and support traffic are allowed during these times.

Existing traffic levels associated with the Skyline Mine on SR 264 and SR 31 would continue for an additional 9 to 12 years.

Traffic could be delayed on Forest System Roads and private roads during construction and drilling operations for short periods of time during mobilization of equipment.

Any subsidence caused cracks in SR 264 or to Forest System Roads and private roads would be repaired immediately upon discovery and are not expected to cause safety hazards or significant traffic delays during repair. Short delays could be required during repair similar to regular road maintenance activities.

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Pipeline construction traffic on SR-264 during the 2002 field season would be heavy (approximately 50 vehicle trips per day). This could be cumulative with logging traffic because

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these activities could overlap in time. It would not be cumulative with drilling traffic because these activities would not take place at the same time.

Considering the 1998 levels of traffic on SR-264 of 440 vehicles per day (including mine traffic) and temporary increases as described above for logging, coal drilling, and pipeline construction traffic levels could increase to design capacities for short durations of one or two years. Traffic delays could occur in the vicinity of the drilling activities and the Monument Peak Road intersection with SR-264 during these periods.

Irreversible/Irretrievable Commitment of Resources

No irreversible or irretrievable commitments are expected.

Short-Term Use vs. Long-Term Productivity

Currently existing traffic levels associated with the Skyline Mine would be extended for another 9 to 12 years.

4.1.10.3 Alternative C

Disturbance from Surface Facilities and Extended Mine Life

The effects would be the same as discussed under Alternative B except that the mine life and existing mine related traffic levels would increase by fewer years (less than 12 years).

Disturbance from Surface Facilities and Extended Mine Life

Since the highways and Forest Roads lie with the protection zones for perennial drainages they would not be subjected to subsidence and the related damages discussed under Alternative B.

Cumulative Effects

The effects would be the same as discussed under Alternative B, except that SR 264 would not be subjected to subsidence. In addition existing mine related traffic levels would only be extended up to 7 years as opposed to 12 years under Alternatives B and B'.

Irreversible/Irretrievable Commitment of Resources

Same as Alternative B.

Short-Term Use vs. Long-Term Productivity

Existing traffic levels on SR 264 and SR 31 associated with the Skyline Mine would be extended for 5 to 7 years.

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4.1.12.2 Alternatives B and B'

Fossil Sites and Footprints

Subsidence cracks could expose fossil sites that have been previously undiscovered, but no damages to fossil sites are expected from subsidence.

Continuous miners and longwall shearers cut through the coal at a rapid pace and the process does not provide an opportunity to look into the coal material before the coal is pulverized by the mining process. Fossils in the coal are destroyed in the process. As mining progresses, casts of footprints are often exposed in sandstone roof materials. Only when this occurs do they become visible. Studies by the College of Eastern Utah and other Universities have determined that these prints are common and have limited scientific significance. Underground mining could destroy dinosaur footprints, some fossilized bone, and plant imprints.

Pleistocene Mammals

Surface-disturbing activities could expose and damage Pleistocene fossils. The potential for this to occur would be minimized by requiring surface surveys and clearance prior to conducting operations. However, there is some potential for undiscovered buried fossils to be unearthed once operations begin. Lessees/operators are required to stop operations if fossils are discovered and report them to the Forest Service for inspection. Once they are recognized, they would be either protected or excavated under a plan approved by the Forest Service, but initial damage may be irreparable.

Pleistocene mammal skeletons or individual bones that could be buried beneath the deep glacial deposits in the canyons could be disturbed by subsidence. There is potential for damage to articulated skeletons if they exist if cracks form at the site location. Cracks would probably not damage individual buried bones.

Cumulative Effects

Construction and development activities discussed in the table of past, present, and reasonably foreseeable future actions have the potential to unearth previously undiscovered fossils, especially in the glacial materials. If found on National Forest System lands and potentially on private lands they would be protected from damage and potentially excavated by qualified paleontologists. Information and fossils obtained during excavation would be curated in accordance with Federal requirements. If discovered on private lands, their disposition would be subject to the desires of the owners. The effects discussed above for this alternative could occur in addition to those discussed in this section.

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Irreversible/Irretrievable Commitment of Resources

Paleontological resources are nonrenewable. Any losses would be irreversible and irretrievable.

Short-Term Use vs. Long-Term Productivity

Mining and subsidence would occur in the majority of the project area for a period of 9 to 12 years.

4.1.12.3 Alternative C

The effects would be the same as discussed under Alternatives B and B', except there would be less chance of exposing or damaging Pleistocene mammal skeletons or bones because they are most likely to occur within the subsidence protection zones.

Cumulative Effects

Construction and development activities discussed in the table of past, present, and reasonably foreseeable future actions have the potential to unearth previously undiscovered fossils, especially in the glacial materials. If found on National Forest System lands and potentially on private lands they would be protected from damage and potentially excavated by qualified paleontologists. Information and fossils obtained during excavation would be curated in accordance with Federal requirements. If discovered on private lands, their disposition would be subject to the desires of the owners. The effects discussed above for this alternative could occur in addition to those discussed in this section.

Irreversible/Irretrievable Commitment of Resources

Paleontological resources are nonrenewable. Any losses would be irreversible and irretrievable.

Short-Term Use vs. Long-Term Productivity

Mining and subsidence would occur in a smaller area of the project area than under Alternative B and for a shorter time period (5 to 7 years).

4.1.13 Socioeconomics

The socioeconomic benefits would differ considerably by alternative.

4.1.13.1 Alternative A (No Action)

The project area contains in excess of 36 million tons of coal that can be mined and recovered. The majority of the coal is in Federal ownership but some of the reserves on adjacent privately owned non-Federal lands are privately owned. If the tract is not leased, none of the reserves could be recovered and it is unlikely that it would be mined in the future once bypassed by the Skyline Mine. Access from any other location would not be economical due to the costs of

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developing alternative portal facilities on the adjacent lands and the small amount of coal that is contained under these lands. The coal would not be made available for energy production.

A competitive coal lease sale would not be made and there would be no bonus bid for the tract. The bonus bid cannot be predicted at this time but would amount to several million dollars. The Federal Treasury would not receive the bonus bid amount. The value of the estimated 36 million tons of recoverable coal reserves at the current mine-mouth value (does not include shipping costs) of $17.00 per ton is approximately $612 million. Approximately $49 million would not be paid to the Federal Treasury (8% of the mine-mouth value). The State of Utah would not receive a 50% share of the bonus bid and coal royalty and the counties would not receive their proportionate share.

The life of the Skyline mine would not be extended beyond current projections. Canyon Fuel indicated that, without the Flat Canyon Tract, the Skyline Mine could close in the year 2003. This does not consider the potential for moving into the Federal Coal Lease (U-67939) that lies directly to the north of the existing permit area. This lease contains at least 24.1 million tons of recoverable coal reserves. If mined, the life of the mine could be extended at least by 6-8 years to at least the year 2009.

When the mine closes 220 jobs will be lost at the mine. In addition, an undetermined significant number of support services jobs would be lost.

Cumulative Effects

Total direct coal mine employment has been on a downward trend since 1997, decreasing from 2,091 to 1,843 in 1999 (Utah Office of Energy & Resource Planning, July 2000).

If Skyline Mine closes in 2003, the associated loss of jobs would occur during a period of cumulative mine closures in the Wasatch Plateau and Book Cliffs Coal Fields. Two local mines closed during 2000 and 2001 and 4 additional mines are projected to close by 2003. It is also possible that one new mine could open and for an existing mine to reopen. In addition to potential job losses associated with the Skyline Mine, an additional 300 direct mining jobs and an unknown number of mine support jobs could be lost. This is having a significant economic impact to the Carbon and Emery County areas and to a lesser degree to Sanpete, Utah, Salt Lake, and Sevier Counties.

Due to the mine closures discussed above, Utah coal production and royalties received are on a downward trend and will decrease markedly over the next 5 years, decreasing revenue to the Federal, State, and local governments.

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Irreversible/Irretrievable Commitment of Resources

Coal is a nonrenewable resource. Energy and materials expended during the mining process and the coal reserves mined and consumed represent both irretrievable and irreversible commitments

of resources. Coal reserves left unmined as discussed under this alternative would be considered irretrievable and irreversible considering current mining technology and economics.

The socio-economic effects discussed in this section are irretrievable. Some economic recovery or reversal of the downward trend regarding the economic benefits of mining could occur by opening/reopening area mines, but the reserves available in Utah for mining are finite and rapidly dwindling. The Bureau of Land Management estimates that remaining mineable coal reserves in the Wasatch Plateau and Book Cliffs Coal Fields are available for less than 40 years of mining.

Short-Term Use vs. Long-Term Productivity

Reserves bypassed in the project area would be unavailable for future production considering current mine technology and economics. The life of the Skyline Mine under this alternative would not be extended and the associated socio-economic benefits would not occur.

4.1.13.2 Alternatives B and B'

As compared with Alternative A, the mine life could be extended up to 12 years. The 220 jobs at the Skyline Mine and undetermined number of support service jobs related to Skyline Mine would be extended for this period of time. Approximately 36 million tons of coal could be recovered at a total value of approximately $612 million, based on the current average mine-mouth value (does not including shipping costs) of $17.00 per ton. Royalties would amount to approximately $49 million (8% if total value) paid to the Federal Treasury. The State of Utah would receive a 50% share of the royalties and the counties would receive a proportionate share.

Under Alternative B', the cost of coal production would be increased by the costs of monitoring potentially affected resources and improvements and by the cost of mitigations and repair. No total estimates of this cost have been made. The costs would include those estimated and discussed in Section 4.1.3.2 for repair of facilities.

Cumulative Effects

Under this alternative the reserves and associated socio-economic benefits discussed above would be produced and the associated jobs and benefits would be extended another 9 to 12 years.

Irreversible/Irretrievable Commitment of Resources

Coal is a nonrenewable resource. Energy and materials expended during the mining process and the coal reserves mined and consumed represent both irretrievable and irreversible commitments of resources. Coal reserves left unmined for roof support and their economic value as discussed under this alternative would be considered irretrievable and irreversible considering current mining technology and economics.

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Short-Term Use vs. Long-Term Productivity

The coal reserves and economic benefits produced from the project area would be added to the cumulative benefit/economic base of the Federal government, State, and affected counties for 9 to 12 years.

4.1.13.3 Alternative C

The amount of coal that could be mined would be reduced by approximately one-third due to requirements for the protection of surface resources and structures. The mine life could be extended by approximately 5 to 7 years. The 220 jobs at the Skyline Mine and undetermined number of support service jobs related to Skyline Mine would be extended for this period of time.

The recoverable reserves are estimated at approximately 18 to 20 million tons at a total value of $306 to $340 million. Royalties would be approximately $24 to $27 million. However, if extensive acreage is blocked from full-extraction due to surface resource protection, the operating cost associated with the extensive development required to extract each longwall panel could lower overall mine efficiency and coal recovery (BLM, 1999). This decrease of coal mined during longwall mining relative to coal mined for development (LDR-Longwall Development Ratio) could make the overall economics of mining the tract marginal. The potential for receiving competitive bids is reduced.

The overall cost of coal production would also be increased compared to Alternatives B for resource monitoring and mitigation.

Cumulative Effects

Under this alternative the reserves and associated socio-economic benefits discussed above would be produced and employment and benefits at the Skyline Mine would be extended by approximately 5-7 years.

Irreversible/Irretrievable Commitment of Resources

Coal is a nonrenewable resource. Energy and materials expended during the mining process and the coal reserves mined and consumed represent both irretrievable and irreversible commitments of resources. Coal reserves left unmined for roof support and their economic value as discussed under this alternative would be considered irretrievable and irreversible considering current mining technology and economics.

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Short-Term Use vs. Long-Term Productivity

The coal reserves and economic benefits produced from the project area would be added to the cumulative benefit/economic base of the Federal government, State, and affected counties for 5 to 7 years.

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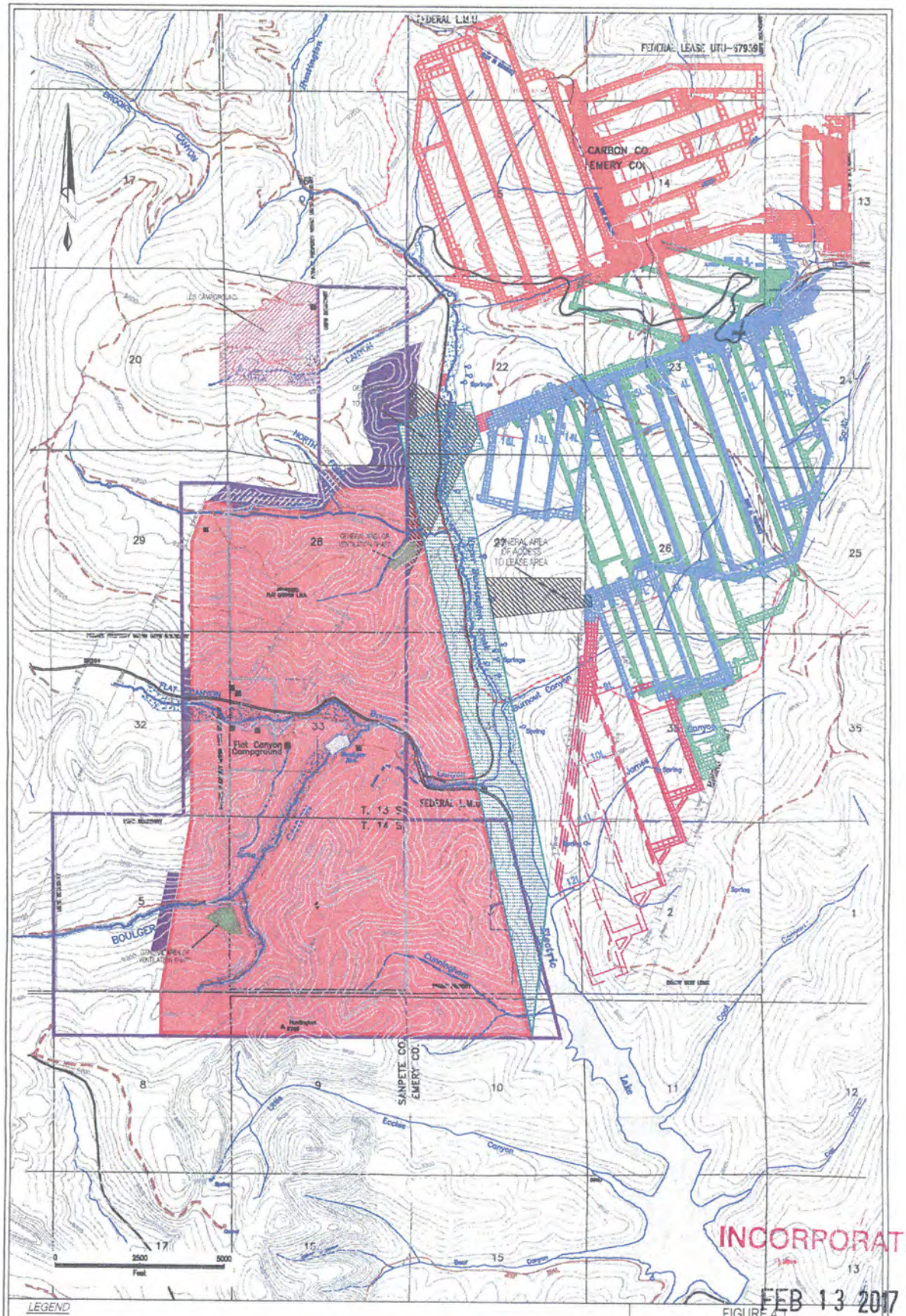

FIGURE 4.1

UPPER SEAM MINING SCENARIO
ALTERNATIVE B and B'

FILE: MINING.DWG
DATE: 10/17/2000
SCALE 1" = 2640'

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

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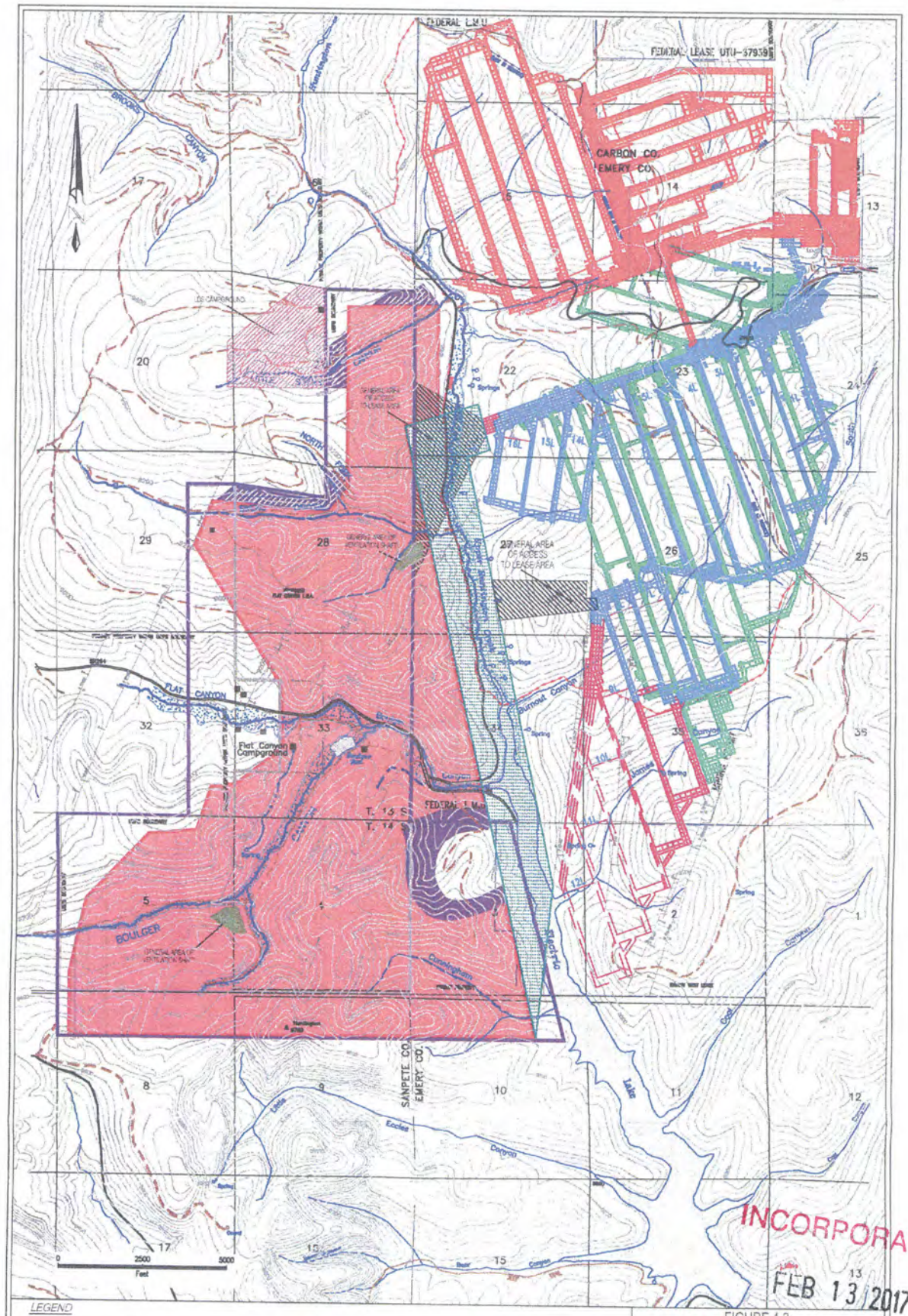

LEGEND

FIGURE 4.2
LOWER SEAM MINING SCENARIO
ALTERNATIVE B and B

FILE: MINING.DWG	SCALE: 1" = 2640'
DATE: 10/17/2000	

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

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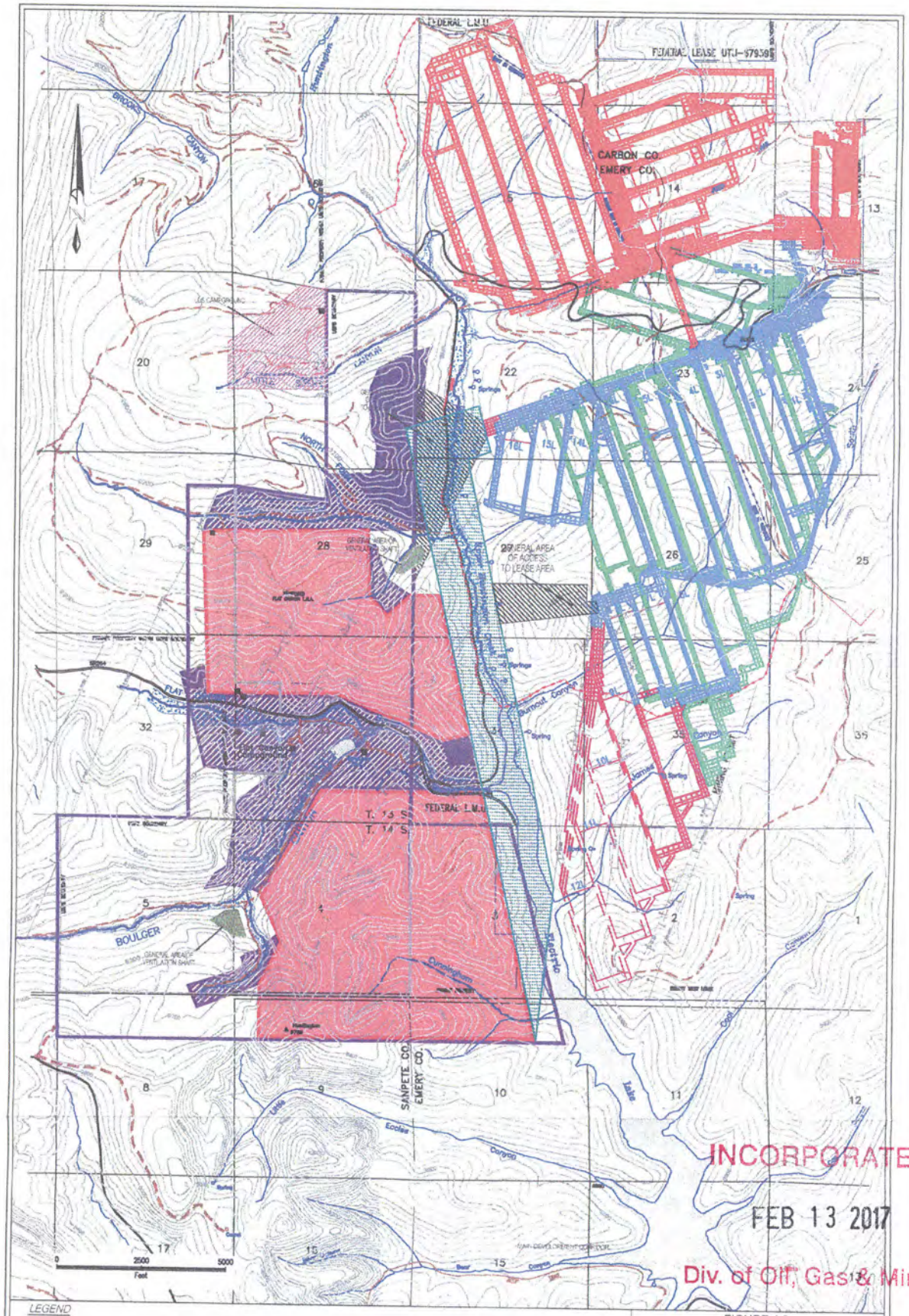

FIGURE 4.3
UPPER SEAM MINING SCENARIO
ALTERNATIVE C

FILE: MINING.DWG
DATE: 10/17/2000
SCALE: 1" = 2640'

FLAT CANYON COAL LEASE TRACT
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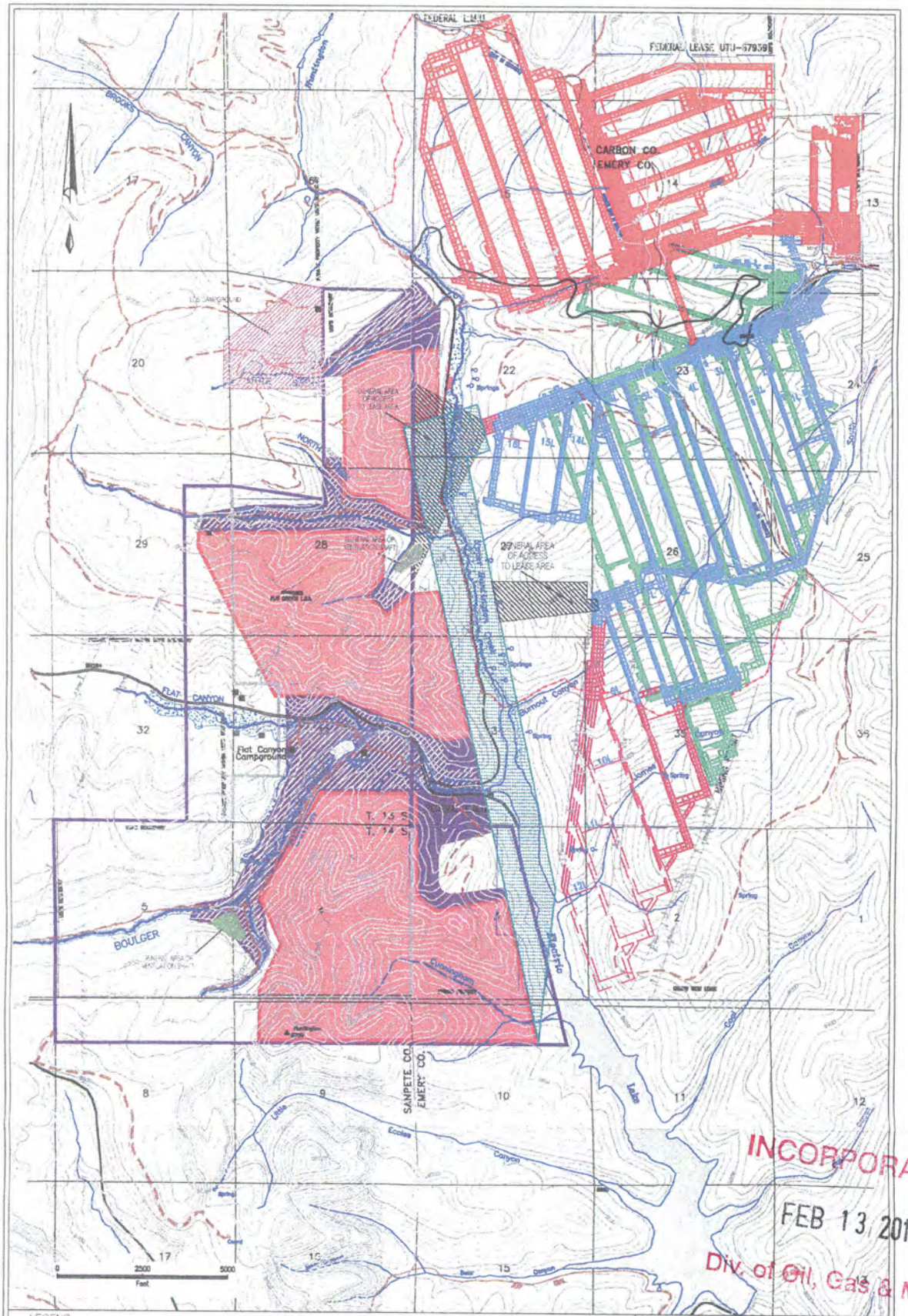

LEGEND

FIGURE 4.4
LOWER SEAM MINING SCENARIO
ALTERNATIVE C

FILE: MINING.DWG
DATE: 10/17/2000
SCALE 1" = 2640'

FLAT CANYON COAL LEASE TRACT
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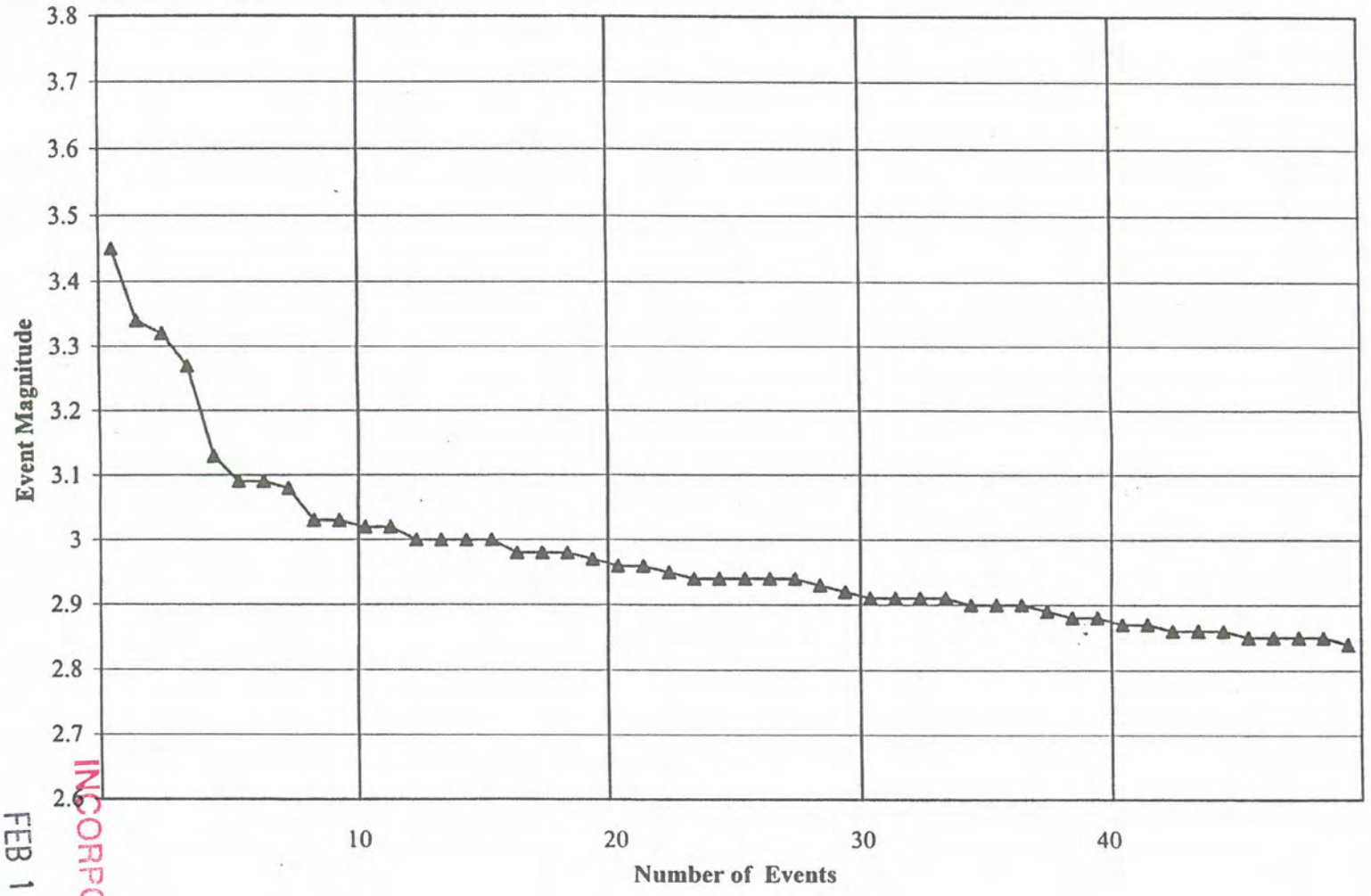
Figure 4.5
Plot of Cummulative Number of Events Versus Event Magnitude for Skyline Mine



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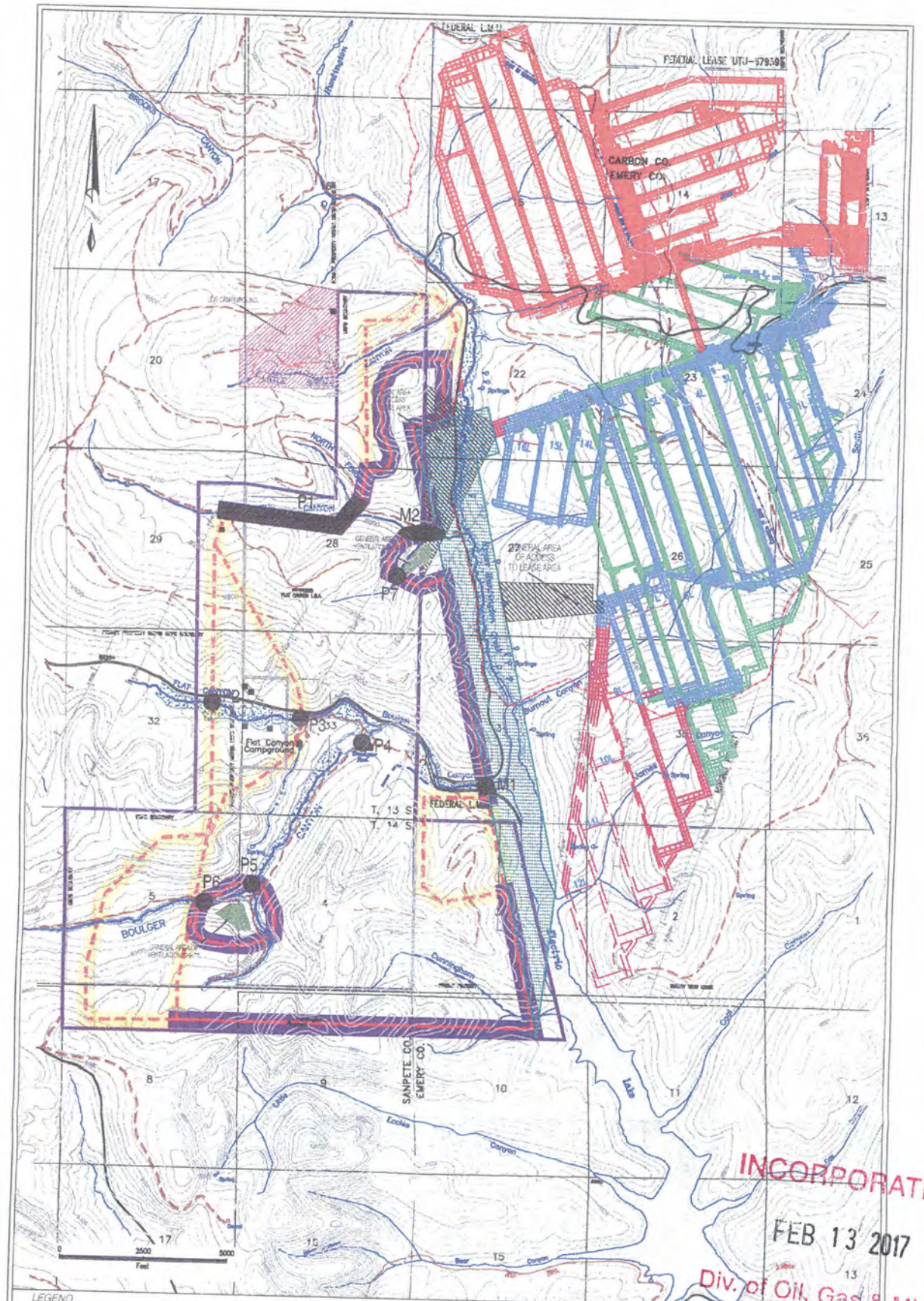

LEGEND

FIGURE 4.6
SUBSIDENCE IMPACT SENSITIVITY
ALTERNATIVE B and B'

FILE: MINING.DWG
DATE: 9/17/2000
SCALE: 1" = 2640'

FLAT CANYON COAL LEASE TRACT
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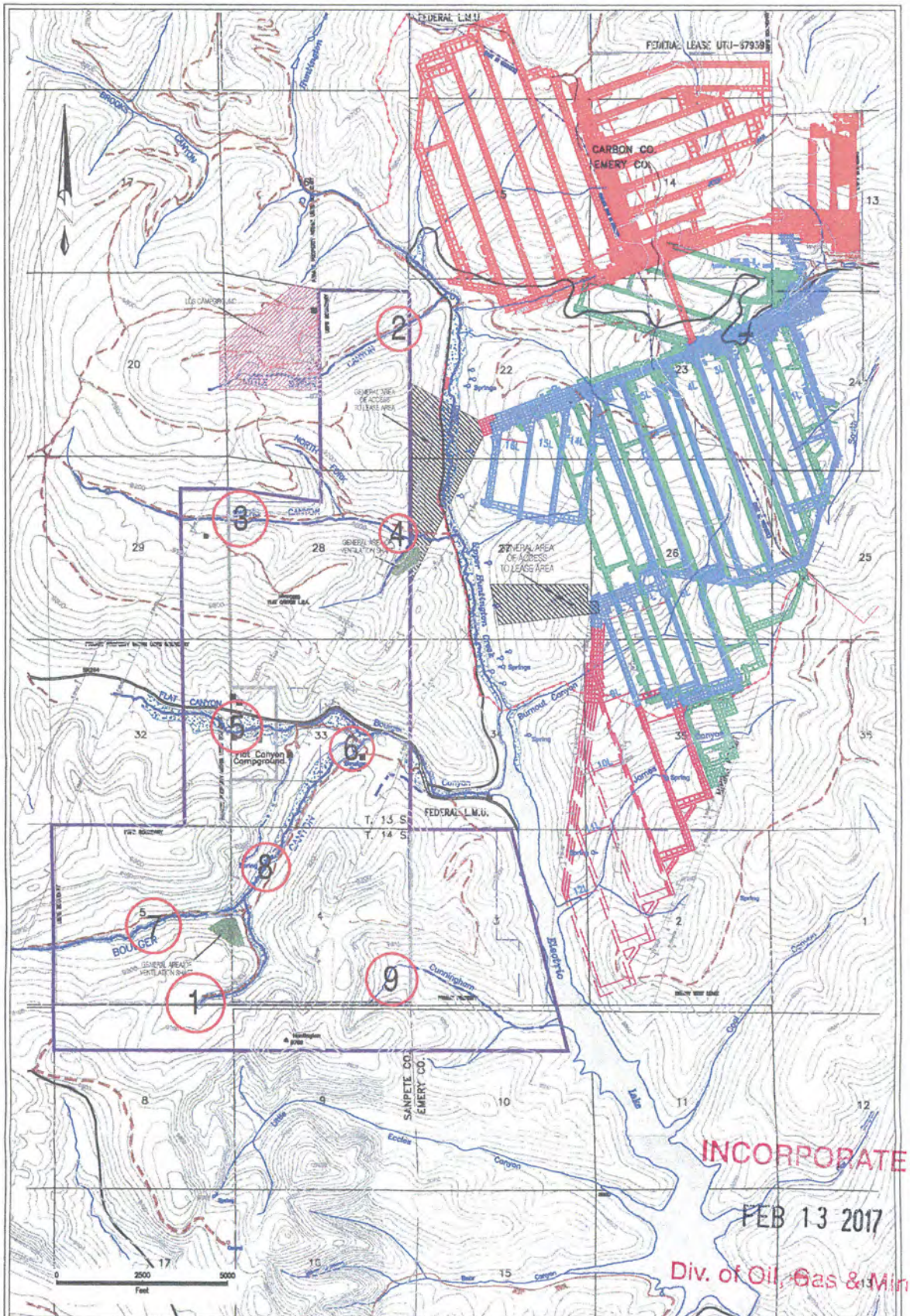

FIGURE 4.7
SUBSIDIENCE
PREDICTION POINTS
ALTERNATIVE B and B'

FILE: MINING.DWG
DATE: 10/17/2000
SCALE 1" = 2640'

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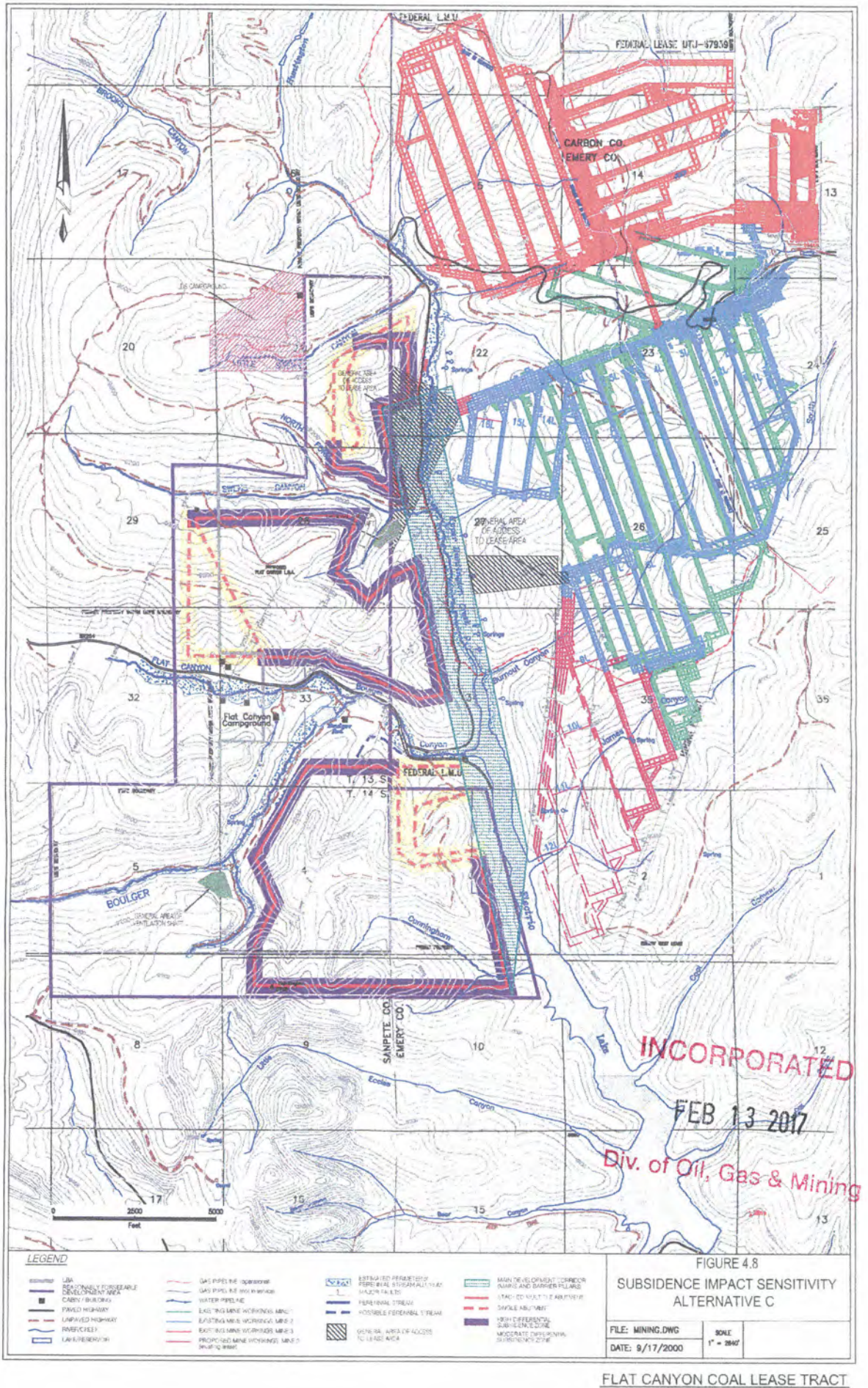

FIGURE 4.8
SUBSIDENCE IMPACT SENSITIVITY
ALTERNATIVE C

FILE: MINING.DWG
DATE: 9/17/2000
SCALE 1" = 2640'

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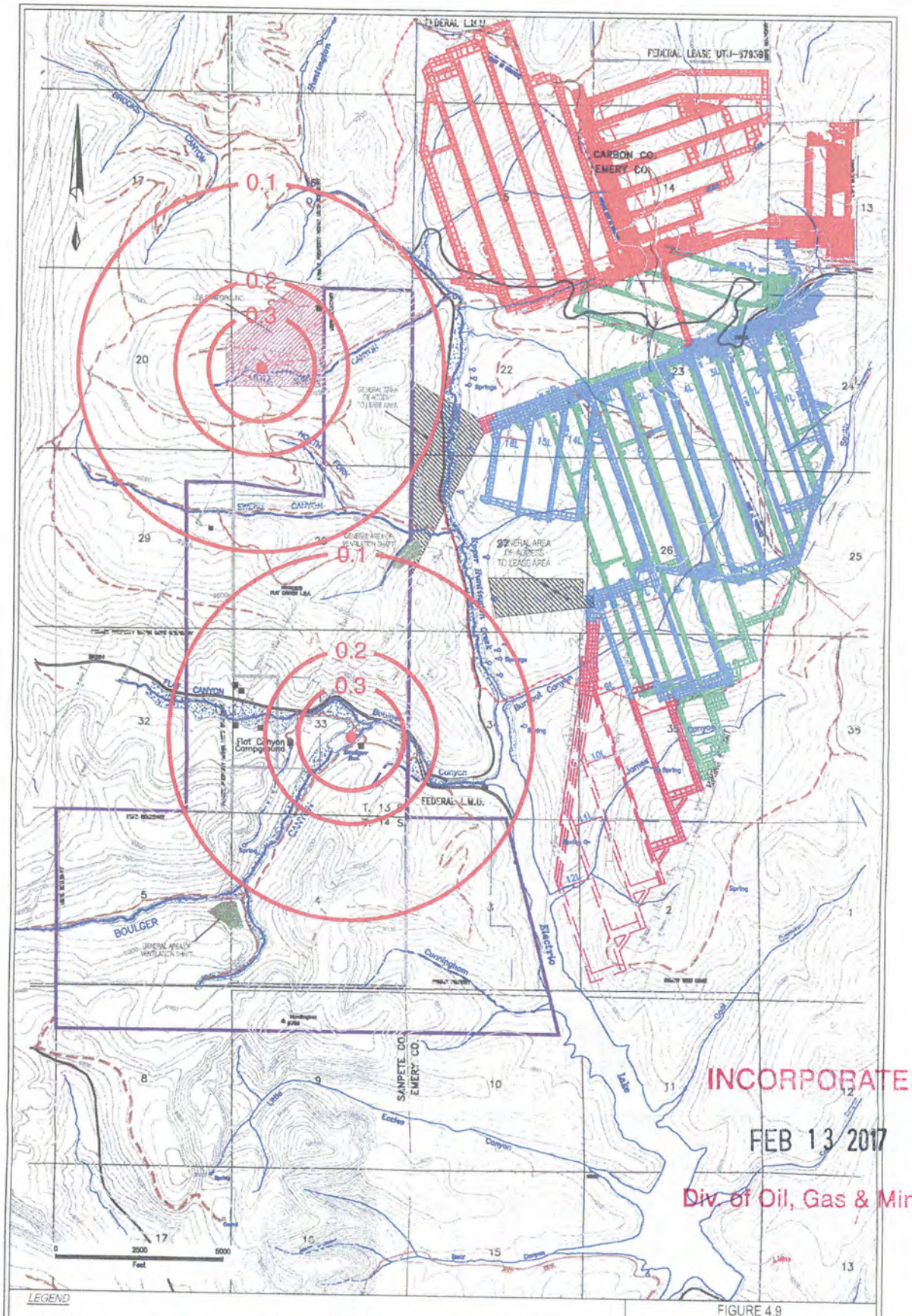

FIGURE 4.9

DAM SEISMIC ZONES

FILE: MINING.DWG

DATE: 9/17/2000

SCALE 1" = 2640'

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5.1 INTRODUCTION

This chapter displays the letters received in response to public review of the Draft Environmental Impact Statement (DEIS) and responses. Each letter was assigned a number at random. The letter numbering scheme does not represent chronological dates of receipt or importance. A bracket in the left column identifies individual comments in each letter with a number identifying the comment by letter number and comment number. For example, the first comment in Letter No. 1 is identified as comment 1.1. The responses are keyed to the comments by the identification number. Responses are provided under individual subtitles for each comment. The responses are provided below, immediately followed by copies of the comment letters.

5.2 RESPONSES

The responses to comments are presented in this section. The letters were numbered at random.

COMMENT LETTER NO. 1
CANYON FUEL COMPANY, LLC

RESPONSE TO COMMENT 1.1

The information has been reviewed and the FEIS has been revised accordingly.

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COMMENT LETTER NO. 2
UTAH ENVIRONMENTAL CONGRESS

RESPONSE TO COMMENT 2.1

See FEIS Chapter 2, Issues Identified But Not Carried Through The Analysis. The Forest Service and BLM recognize that greenhouse gasses, including carbon dioxide, would be released into the atmosphere from burning of coal from the project area. The amount of greenhouse gasses potentially released to the atmosphere from burning and generation of electricity is presented in Chapter 2 per ton of coal. In regard to global climate change, scientists have debated the potential effects for the last decade and studies with conflicting conclusions continue to be published. According to the US Environmental Protection Agency (http://www.epa.gov/globalwarming/uncertainties.html) there is certainty that human activities are adding greenhouse gasses to the atmosphere, and that these gasses tend to warm the earth. However it is not known to what degree human-generated greenhouse gasses are responsible for the global warming trend. This is because other factors, natural and human, affect the earth's temperature. Scientific understanding of factors such as natural climatic variations, changes in the sun's energy, and the cooling effects of pollutant aerosols are not well understood. There is scientific uncertainty regarding how much warming will occur, how fast warming would occur,

and what the potential adverse and beneficial effects would be. It is beyond the scope of this document to predict what potential effects burning of the coal from the project area for generation of electricity would have on the global climate. The local coal fired power plants will continue to burn coal at the current or increased rate regardless where the coal comes from. If not mined from the project area, coal would be imported from other areas with potentially greater effects due to burning of lower quality coals.

RESPONSE TO COMMENT 2.2

Age dating of waters encountered underground in the mines has been determined to be many thousands of years old, trapped in underground paleo-stream channels. Communication with surface waters, if it exists, is extremely slow, taking many thousands of years to seep into the coal-producing zone. Water pumped into underground sumps would not be in communication with surface water sources.

RESPONSE TO COMMENT 2.3

The quality of discharge water from the mines has been re-evaluated since publication of the DEIS. Considering the mixing models comparing the quality of discharge waters and the receiving drainages, it has been determined that the water quality would not change sufficiently to cause detrimental effects to the aquatic ecosystems. Due to dilution factors regarding the receiving waters and unaffected downstream tributaries, the effects to quality downstream would be negligible. See Sections 4.1.4 (Surface Water) and 4.1.7 (Wildlife) in the FEIS.

RESPONSE TO COMMENT 2.4

As discussed in the Biological Assessment (BA) and response to comment 2.3, effects to the quality of the Colorado River System would be negligible. No effects to threatened or endangered species are anticipated. Consultation with the US Fish and Wildlife Service has been completed and they concur with our assessment (Letter to the Forest Supervisor, dated November 1, 2001).

RESPONSE TO COMMENT 2.5

Boulger Dam was constructed in the 1930s by the Civil Conservation Corps. Sediment is rapidly accumulating in the reservoir causing degradation of fish habitat. The reservoir does not provide important habitat for fish reproduction. It is stocked with Rainbow trout to provide the recreation fishing opportunity. Yellowstone cutthroat trout use the reservoir mainly for access to habitat upstream of the reservoir.

As up-front mitigation for potential effects to Burnout Creek from mining, Canyon Fuel paid for construction of the fish ladder/spillway at Boulger Reservoir that currently allows Yellowstone cutthroat trout to access the reservoir and spawning habitat in Boulger Creek above the dam. Prior to construction of the fish ladder, the original spillway precluded migration of Yellowstone

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cutthroat to stream reaches above the reservoir. Removal of the dam and reservoir from use would not affect fish migration. The mine operator would be required to construct a suitable channel through the reservoir area to prevent scouring and sediment production. The channel would be designed to allow migration of aquatic species, including Yellowstone cutthroat trout, and transport of nutrients. No threatened or sensitive species would be affected. See Section 4.1.7.

RESPONSE TO COMMENT 2.6

The Forest consulted with the US Fish and Wildlife Service and obtained concurrence with conclusions of and Biological Assessment. See response to Comment 2.4.

RESPONSE TO COMMENT 2.7

The EIS discloses the cumulative effects of grazing, other activities, and the proposed action. See Section 4.1.6, Cumulative Effects. As discussed in this section, grazing has caused vegetation changes in the project area and throughout the Forest. Current management practices have resulted in improved vegetation conditions and the current situation that will continue along the current trend. The effects of leasing are discussed in addition to other activities.

RESPONSE TO COMMENT 2.8

As discussed in the Forest Plan (Page III-31), special emphasis is given to the management of riparian areas as you have stated. The FEIS (Section 4.1.7) addresses riparian areas and aquatic resources management direction and potential effects of each alternative, as well as mitigations. Resolvable and irresolvable effects will be considered in making the required decisions.

RESPONSE TO COMMENT 2.9

The wetland in the Left Fork of Boulger Creek was evaluated to determine if it is a peatland or fen. This site has been disturbed by human activities and lacks the organic soils and other important fen features to qualify as a peatland or fen (Sanderson, 2001).

It is not likely that subsidence would affect flow of perched aquifer springs such as those at the head of Boulger Canyon that provide water to this area. Many years of spring monitoring in subsidence areas has shown that effects to flow are highly unlikely (Kadnuck, 1994, NorWest, 2000), especially in areas with deep overburden. Overburden thickness in the area is approximately 1,800 feet. The wetland area conditions persist only during the spring and dry out in the fall. The wet areas are confined to the channels formed by spring drainage during baseflow conditions. The water is perched by clay shales in the Blackhawk Formation. Subsidence cracks at the surface are highly unlikely due to the thick overburden (approximately 1,800 feet). If any surface cracks occurred, they would seal quickly by the expanding clays. There would be no direct loss of water due to cracks. Only one seam of coal is mineable in this area. The slope change due to subsidence would be less than 1% and would not likely cause

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changes that would affect the wetland conditions. Any change in stream channel location would occur slowly and probably not be measurable.

RESPONSE TO COMMENT 2.10

We believe that the analysis of socioeconomic effects in Section 4.1.13 is looked at in context. At such time as the Skyline Mine closes, the associated 220 jobs directly provided by the mine would be lost. In addition, an undetermined number of support services jobs (trucking, contracted technical services, suppliers, railroad, mining equipment repair/maintenance services, etc.) would be lost. This loss of jobs would be cumulative in the local communities relative to those already lost due to mine closures. This would be an adverse economic effect to the local economies (See Letter No. 3 received from Sanpete County).

RESPONSE TO COMMENT 2.11

We agree that opening new areas to mining by existing operations such as the Skyline Mine would not create new jobs. However, leasing of the proposed tract would extend the existing 220 jobs and an undetermined number of support service jobs for the lengths of time mining operations at the Skyline Mine as specified in the EIS under the action alternatives. The text in Chapter 4 has been revised to state that the jobs would be extended by up to 12 years under Alternatives B and B' and 5-7 years under Alternative C. The slight decrease in the total number of jobs relative to increased production shown on the table you provided is the result of advances in mining technology, management practices, and adjustments by the mines to decrease production costs due to plunging coal values (State of Utah Natural Resources Office of Energy & Resource Planning, 1999 Annual Review and Forecast of Utah Coal Production and Distribution, July 2000). The EIS does not state that any new jobs would be created by the proposed leasing action as suggested by your comment.

RESPONSE TO COMMENTS 2.12 and 2.13

Baseline data on vegetation, wildlife, streams, and springs has already been collected as discussed in Chapters 3 and 4 of the FEIS, and in the BE and BA for the leasing analysis. Lease stipulations and the mine permit requirements contained in 30 CFR 700 to end, as well as the Utah Coal Rules, require sufficient inventories and monitoring to determine if monitoring activities cause effects.

In addition, the mining companies are required to conduct annual surveys for raptors in and adjacent to the mine areas in cooperation with the Utah Division of Wildlife Resources (UDWR). In addition, Canyon Fuel has conducted raptor surveys for the proposed lease area. Under Alternatives B' and C, monitoring of certain aquatic species (to be determined during mine plan review and permitting) would be monitored to determine effects to aquatic ecosystems. Monitoring data would be reported to the regulatory agencies as required in the approved permit.

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Each perennial stream in the project area would be monitored, including pre-mining baseline data. In inventory of all springs in the project area has been conducted with flow data and select quality data. Certain springs representing geographic areas, geologic formations, and drainages would be monitored to determine effects. It is not practical to monitor every spring in the project area, since there are so many. Hydrologic monitoring data is reported to the Utah Division of Oil, Gas and Mining on a periodic basis and is available for review on UDOGM Internet web site.

COMMENT LETTER NO. 3
SANPETE COUNTY

RESPONSE TO COMMENT 3.1

Thank you for your comment. This information will be taken under advisement.

COMMENT LETTER NO. 4
THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS

RESPONSE TO COMMENT 4.1

Thank you for your comment. Your private surface and coal estate lands adjacent to the project area is not included in the area anticipated for reasonably foreseeable development because Canyon Fuel has stated that at this time they do not intend to mine this area. The lands and coal estate are privately owned. Neither the Bureau of Land Management nor the Forest Service has the authority regarding mining of these lands.

COMMENT LETTER NO. 5
UNITED STATES DEPARTMENT OF INTERIOR
OFFICE OF THE SECRETARY
OFFICE OF ENVIRONMENTAL POLICY AND COMPLIANCE

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RESPONSE TO COMMENT 5.1

The potential effects to the drainages and the associated aquatic resources are discussed in Chapter 4. These effects will be considered in making the required decisions.

RESPONSE TO COMMENT 5.2

The wetland in the left fork was tested to determine if it is a peatland or fen. This site has been disturbed by human activities and lacks the organic soils and other important fen features to

qualify as a peatland or fen (Sanderson, 2001). Potential effects to perennial drainages and the associated riparian/wetlands are discussed in Chapter 4 and will be considered in making the leasing/mining decisions.

RESPONSE TO COMMENT 5.3

See response to Comment 2.5

Boulger Reservoir does not support a self-sustaining fish population but provides access to upper Boulger Creek for Yellowstone cutthroat trout. It is planted by the Utah Division of Wildlife Resources to provide a quality recreational fishing experience. If drained to allow mining, there would be no effects to Yellowstone cutthroat trout because a channel would be constructed through the reservoir sufficient to allow downstream transport of nutrients and migration of fish and macroinvertebrates.

RESPONSE TO COMMENT 5.4

Neither the Forest Service nor BLM have direct authority to approve water discharges or to require the lessee/operator to discharge specific proportions of the discharge waters to particular drainages. The authority lies with the Utah Division of Water Quality. However, because leasing of the Flat Canyon Tract could result in prolonged discharge of mine waters and Canyon Fuel is interested in obtaining a permit from the State of Utah to discharge water to Electric Lake, the potential effects have been expanded in the FEIS. The potential effects of the three discharge scenarios you suggest are presented in the Surface Water Sections of Chapters 3 (Section 3.1.5) and 4 (Section 4.1.4).

RESPONSE TO COMMENT 5.5

The potential effects to Scofield Reservoir, Electric Lake, and downstream waters are disclosed to the best of our ability to predict them in the Surface Water Section of Chapter 4 (Section 4.1.4).

RESPONSE TO COMMENT 5.6

Once mining is completed, it is not reasonably foreseeable that water diversion in Eccles Creek or mine water discharge would continue. There would be no further need for the diversions. The portal areas and breakouts lie along the up dip side of the permit area and would not naturally drain mine water. The underground mine workings lie well beneath any of the surface drainages in the area and hydrostatic heads are not sufficient to force water to any surface discharge locations.

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RESPONSE TO COMMENT 5.7

As discussed in Chapter 4 it is not likely that mine water discharge to Electric Lake would have significant adverse effects. The water quality is expected to be consistent with beneficial use standards that include culinary water use and cold water fisheries. As required under a UPDES permit, water quality would be monitored. Under Alternatives B' and C, biological monitoring would be required under lease stipulations to determine effects to the aquatic ecosystem. The specifics of monitoring would be included in the approved Mining and Reclamation Plan and/or Mine Permit.

RESPONSE TO COMMENT 5.8

Under requirements of the UPDES water discharge permit (all alternatives), the permittee would be required to monitor discharge flows and quality in accordance with Utah Division of Water Quality standards. As required in lease stipulations under Alternatives B' and C, water and biotic monitoring would be conducted. Canyon Fuel has installed automated continuous monitoring equipment in the Skyline mine discharge system that measures TDS, pH, turbidity, and oil and grease. If parameters exceed thresholds, water will be automatically rerouted to underground storage areas within the mine. The Utah Division of Wildlife Resources would be consulted regarding required monitoring during Mine Permit process, if the lease is issued.

RESPONSE TO COMMENT 5.9

In Chapter 3, the Interdisciplinary Team decided to discuss Threatened, Endangered, and Sensitive (T,E,&S) species integral with other wildlife and plant species rather than create separate heading for T,E,&S species. There are no requirements in the CEQ regulations requiring T,E,&S species to be addressed in NEPA documents under separate headings. In Chapter 4, T,E,&S species are discussed in a separate heading as you suggest. The Biological Evaluation (BE) and Biological Assessment (BA) have been referenced in the text and are included in the project file. They contain information grouped by T,E,&S status.

RESPONSE TO COMMENT 5.10

It has been determined that there would be no loss of water in the tract or in the Colorado River basin, therefore there would be no effect. This has been documented in the Biological Assessment, discussed in Chapter 4, and included in formal consultations with the US Fish and Wildlife Service. The US Fish and Wildlife Service concurred with the Forest Service determination in the letter of November 1, 2001 from the Utah Field Office, US Fish and Wildlife Service to Forest Supervisor, Manti-La Sal National Forest regarding Section 7 Consultation for the Flat Canyon Coal Lease Tract (Project File). .

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RESPONSE TO COMMENT 5.11

The analysis has determined that there would be no loss of water to either the Price or San Rafael Rivers. Potential effects of each alternative to surface waters are discussed in Chapter 4. See response to Comment 5.10.

RESPONSE TO COMMENT 5.12

It was concluded in the Biological Assessment and Biological Evaluation, Unsuitability Evaluation, and in Chapter 4 of the FEIS that there would be no effects to raptors from subsidence and seismicity. The US Fish and Wildlife Service concurred in their letter to the Forest Supervisor, dated November 1, 2001 (See response to Comment 5.10).

RESPONSE TO COMMENT 5.13

Colorado River cutthroat trout were addressed in the Biological Evaluation (BE) and it was determined that there would be no effects.

The other species mentioned are not Forest Service Sensitive species so were not specifically addressed in the BE. They are however listed by the State of Utah as "Sensitive". These species do not exist within the project area but may occur in the lower reaches of Huntington Creek below the Forest boundary. Water quality substantially degrades in this area due to contact with the highly saline, marine Mancos Shale Formation. Projections of water quality changes due to mine water discharge are addressed in Section 4.1.4. Due to dilution factors from the reservoir and downstream tributaries, as well as quality degradation by the Mancos Shale, there would be no effects to these species.

RESPONSE TO COMMENT 5.14

The cumulative effects of grazing and mining on riparian vegetation are discussed in Chapter 4. Since the Forest and Utah Division of Oil, Gas and Mining have established reclamation standards that must be met prior to bond release, reclamation standards are assured regardless of sheep grazing activities in the area. In addition to final standards, the Forest Service requires fencing of reclaimed drill pads until the reclamation and vegetation ground cover standards are met.

RESPONSE TO COMMENT 5.15

Additional detail has been added to Chapters 3 (Section 3.1.4) and 4 (Section 4.1.3) that addresses effects of subsidence and mining-induced seismicity to the pipelines.

RESPONSE TO COMMENT 5.16

Information about the difference in coal production, the longevity of existing jobs, royalty payments, and bonus bid for each alternative is presented in the Socioeconomic Section (4.1.15).

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RESPONSE TO COMMENT 5.17

A regional map showing the project area, Skyline Mine Permit Area, Electric Lake, and Scofield Reservoir has been added to Chapter 3, Surface Water (Figure 3.3a).

RESPONSE TO COMMENT 5.18

Sections S-1.7 and 2.5 have been revised as suggested in your comment.

RESPONSE TO COMMENT 5.19

This correction has been made.

RESPONSE TO COMMENT 5.20

Chapters 3 and 4 have been revised to address migratory birds.

RESPONSE TO COMMENT 5.21

See response to Comment 5.9.

RESPONSE TO COMMENT 5.22

Surveys for boreal toad were conducted in the spring of 2001. Habitat for this species and other amphibians were found in floodplain areas along Boulger Creek and other pot-hole-sag-ponds that capture snowmelt along Boulger Creek. Boreal toads were not found in these surveys. The habitat along perennial streams within the project area are excellent habitat and not necessarily dependent on springs. Subsidence of springs therefore is not expected to effect amphibian habitat. Subsidence is not expected to cause the disappearance of sag ponds and floodplain features throughout the middle of subsided areas. Lower reaches of low gradient streams may flatten out in gradient causing pooling and an increased in amphibian habitat. Upper reaches of streams may steepen in gradient and cause loss of pools and possible down cutting. Only in these areas are effects to amphibian habitat expected to occur (Section 4.1.7).

RESPONSE TO COMMENT 5.23

Effects to natural resources or to the mine by natural seismic events have not been identified as an issue, therefore are not analyzed and are beyond the scope of this analysis. Monitoring of subsidence (annual subsidence monitoring reports) and mining-induced seismic events has shown that subsidence from longwall mining is substantially complete within less than two years of mining. In addition, monitoring of subsidence is required until the lessee/operator can demonstrate that subsidence is substantially complete, even if the mine is already closed. This is a requirement of both the leases and mine permits, therefore is considered in the analysis for all action alternatives. In addition, lease stipulations and the Surface Mining Control and

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Reclamation Act of 1977 and the Utah Coal Rules require monitoring of subsidence and hydrologic resources for at least 10 years after the mine is closed and reclaimed. If monitoring detects effects of mining that require mitigation, the lessee/operator would be required to complete the mitigation work prior to permit closure or lease relinquishment. It is not likely that natural seismic events would cause additional mining-induced subsidence, once mining-induced subsidence is complete. Once subsidence is complete, the overburden rock would be fully supported. As discussed in the FEIS, mains are designed with an adequate safety factor to support the overburden indefinitely.

RESPONSE TO COMMENT 5.24

A reference to the U.S. Geological Survey Earthquake Data Base, National Earthquake Information Center has been added to the Chapter 7 Bibliography.

RESPONSE TO COMMENT 5.25

See response to Comment 5.20.

RESPONSE TO COMMENT 5.26

There are no peat wetlands in the project area (See response to Comment 5.2). The FEIS has been revised to reflect the results of testing. No disturbance to raptor nests is expected. The potential for springs to shift locations due to subsidence is possible but extremely low in areas with deep overburden as in the project area. The FEIS has been revised to indicate that snail populations associated with individual springs could be affected, but population viability would not be threatened due to the large number of springs in the area and the low potential for flow to be affected or for spring locations to change due to subsidence.

RESPONSE TO COMMENT 5.27

Effects to other species, some of which are prey species, have been considered and discussed in the FEIS, Section 4.1.7.

RESPONSE TO COMMENT 5.28

Stipulation 17 does not limit replacement of surface water sources affected by mining to developed sources. Springs are considered surface water sources; therefore ground water systems that recharge the springs would be included. Developed ground water sources such as wells are specifically mentioned for replacement, if they are affected by mining.

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COMMENT LETTER NO. 6
STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES

RESPONSE TO COMMENT 6.1

As discussed in Section 4.1.4 there is a very low risk of loss of surface water flow in perennial streams that are subsided. This determination is based on information presented by NorWest (2000a) that relies on results of the Burnout Canyon Study as well as subsidence and hydrologic monitoring conducted at the Skyline Mine. The geology and mining conditions in the existing Skyline Mine Permit Area, including Burnout Canyon are generally the same, so this information is considered reliable for the purposes of this analysis. Clay shales in the Blackhawk Formation swell when wetted and seal subsidence cracks rapidly, preventing downward movement of water.

RESPONSE TO COMMENT 6.2

The FEIS discusses the potential for changes in stream morphology and aquatic ecosystems. Even though the potential for water loss is very low (See response to Comment 6.1), stream channel morphology could be affected. The effects are discussed in Chapter 4 under Aquatic Wildlife, Surface Water Hydrology, and Vegetation.

RESPONSE TO COMMENT 6.3

The wetland area in the South Fork of Boulger Creek, suspected to be a fen, has been tested and evaluated. This site has been disturbed by human activities and lacks the organic soils and other important fen features to qualify as a peatland or fen (Sanderson, 2001).

RESPONSE TO COMMENT 6.4

Data Adequacy Standards for Federal Coal Leasing, Uinta-Southwestern Utah Coal Region, have been met.

We agree that additional baseline information collection and monitoring must be conducted by the operator, if Alternative B' is selected and implemented. Special Coal Lease Stipulations 3 and 7 require baseline data collection and monitoring sufficient to determine the progressive and final effects of mining. If this alternative were selected, specific monitoring requirements and methods would be determined through the Mine Permit Application Package review and approval process.

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RESPONSE TO COMMENT 6.5

Sections 3.1.5 and 4.1.4 have been updated in the FEIS to address water discharge to Electric Lake that has occurred since release of the DEIS and additional scenarios for water discharge.

RESPONSE TO COMMENT 6.6

Neither the Forest Service nor BLM have authority to require any specific scenario for mine water discharge, but have an obligation to discuss potential cumulative effects of potentially leasing the Flat Canyon Tract. Authority lies with the Utah Department of Environmental Quality, Division of Water Quality. As discussed in the FEIS, water discharge at Eccles Creek will probably continue or increase under any of the likely scenarios.

RESPONSE TO COMMENT 6.7

Under all of the action alternatives, water flow and quality monitoring would be required under any UPDES Permit issued, authorizing mine water discharge to Electric Lake. See response to Comment 5.8.

RESPONSE TO COMMENT 6.8

Section 4.1.8 was revised and now states that under Alternative B' the lessee/operator would be required to mitigate the loss of recreation opportunity during the time that the reservoir is not in use. Special Coal Lease Stipulation 13 requires the lessee to protect, repair, or replace Forest Service surface improvements if they are lost or damaged. "Replacement" can mean direct replacement or off-site mitigation. This stipulation sets the stage for requirements and negotiations with the lessee/operator during the Mine Permit Application Package review and approval process. If the reservoir were removed from service due to mining, the Forest Service would work with the Utah Division of Wildlife Resources, Utah Division of Oil, Gas and Mining, and the lessee/operator to determine appropriate mitigations.

RESPONSE TO COMMENT 6.9

See response to Comment 6.8. Your suggestions for mitigation of the potential loss of recreation use at Boulger Reservoir would be considered.

RESPONSE TO COMMENT 6.10

Under Alternatives B' and C, Special Coal Lease Stipulations 2 and 14 would require the lessee/operator to conduct surface operations such as coal exploration in a manner that would not cause significant effects to Threatened, Endangered, Sensitive species, big-game species, and other key wildlife habitat (see discussion in Section 4.1.7). Proposed surface disturbing activities on lease typically require additional environmental analyses that are used as the basis for Forest

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Service consent decisions to the authorizing agency, including reasonable provisions for the protection of non-coal resources. Protection measures would include timing restrictions, if appropriate. It is our policy to consult with the Division of Wildlife Resources regarding such projects.

COMMENT LETTER NO. 7
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8

RESPONSE TO COMMENT 7.1

The FEIS has been revised to include more detail.

RESPONSE TO COMMENT 7.2

See response to Comment 2.9.

The wetland in the left fork of Boulger Creek was tested to determine if it is a peatland or fen. This site has been disturbed by human activities and lacks the organic soils and other important fen features to qualify as a peatland or fen (Sanderson, 2001).

RESPONSE TO COMMENT 7.3

Special Coal Lease Stipulations 9 and 20 have evolved to the current wording and content after many years of review and negotiations, with industry, regulatory agencies, and the public.

Special Coal Lease Stipulation 9 prohibits subsidence of perennial streams, unless specifically approved. This allows the responsible agencies to specifically analyze the potential effects of subsidence and make NEPA based decisions regarding mine proposals to subside them considering all dependant resources such as riparian vegetation and aquatic habitat. The Land and Resource Management Plan for the Manti-La Sal National Forest, 1986 specifically addresses riparian areas and Riparian (RPN) Management Units. Forest plan direction requires avoidance of riparian areas for activities that could affect them, but does not prohibit activities in riparian areas. This allows the Forest Service to evaluate the tradeoffs of proposed activities and make informed decisions, and to prohibit such activities if Forest Plan objectives cannot be met. This stipulation, as written, provides the Forest Service and regulatory agencies adequate authority to manage perennial drainages and associated riparian ecosystems as needed to meet Forest Plan objectives.

Coal Lease Stipulation 20 provides the lessee ample notice that they may be assessed royalties on unmined coal and provides for an exception for coal not mined for environmental reasons. The first sentence of this stipulation requires compliance with Maximum Economic Recovery as

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defined at 43 CFR 3480.0-5(21). The definition of Maximum Economic Recovery in 43 CFR 3480.0-5(21) specifically allows for consideration of compliance with applicable laws and regulations, such as those that would prevent mining to protect other resources. In addition, the second paragraph of this stipulation requires the operator to provide justification for leaving coal reserves unmined. BLM considers requirements for protection of surface resources under other lease stipulations, laws, and regulations to be adequate justification.

The decision authority regarding issuance of UPDES permits lies with the Utah Department of Environmental Quality, Division of Water Quality. Neither the Forest Service nor BLM have authority to issue or deny UPDES permits.

RESPONSE TO COMMENT 7.4

The information presented in the FEIS regarding subsidence is sufficient on which to base the required decisions. Subsidence predictions are based on subsidence modeling as adjusted by actual subsidence monitored within the existing permit area with essentially the same geology and mining conditions. In regard to how drainages with lower gradients than Burnout Canyon would react to slope changes from subsidence, there are no known situations with gradients less than 5% and similar geologic conditions to consider as examples. Burnout Canyon has the same geologic conditions, but has a steeper average gradient. The Burnout Canyon Study demonstrated that there is negligible potential for cracks that would cause water loss. As discussed in Chapter 4, an increase in pools and some meandering may occur. There are short segments of Burnout Creek that have been subsided that have gradients less than the 5%, even though the average is greater than 5%. Subsidence of one of the low gradient segments caused establishment of a small stable pool that was determined by the Forest Service and regulatory agencies to have no adverse effect to the associated ecosystem (UDOGM Burnout Canyon Subsidence Review Report, 2000).

RESPONSE TO COMMENT 7.5

The subsidence expected would be very subtle and not apparent to Forest visitors as indicated during our joint field trips to the project area and Burnout Canyon on July 26 and August 3, 2001. Cross-sections would not adequately display subsidence changes relative to the existing topography because of the predicted subsidence amounts are so small (5 to 14 feet) relative to high topographic relief in the project area. The subsided areas and areas of potential permanent tensile strain are shown for each alternative on Figures 4.6 through 4.8.

RESPONSE TO COMMENTS 7.6

You are correct that the Bureau of Land Management (BLM), Office of Surface Mining (OSM), Utah Division of Oil, Gas and Mining (UDOGM), and the Forest Service all have roles and responsibilities regarding mine permitting, some of which overlap. The BLM is responsible for leasing with Forest Service consent. The role of each agency is explained in Chapter 1, Sections 1.3 and 1.6. Specific methods, criteria, and requirements for the monitoring plans would be

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determined through review and approval of the Permit Application Package for mining. This would be the responsibility of the Utah Division of Oil, Gas and Mining with Forest Service participation. The Utah Division of Oil, Gas and Mining, BLM, and the Forest Service would evaluate monitoring information. The BLM, UDOGM, and Forest Service would decide when remediation is necessary.

UDOGM is responsible for acquisition and administration of the reclamation bond. Both BLM and the Forest Service review the bond information for adequacy. A discussion on bonding has been added to Chapter 1.

RESPONSE TO COMMENT 7.7

The potential for subsidence of full-support main entries over the short and long-term has been evaluated extensively and is discussed in Section 4.1.2 based on modeling conducted by NorWest, 2000. Subsidence from longwall mining and full-extraction room-and-pillar mining starts within weeks of mining and would be substantially complete within one or two years of mining. There is no potential for continued mine water discharge after the mine is closed. The portal area, breakouts, and proposed discharge locations are well above the coal seams that could potentially be flooded and there would not be sufficient hydrostatic head in known aquifers to force water to these locations.

In accordance with the Surface Mining and Reclamation Act and implementing regulations, as well as the Utah Coal Rules the lessee/operator is required to monitor subsidence and hydrology until it can be demonstrated that conditions have stabilized. The responsibility period for monitoring the success of reclamation after mine closure is a minimum of 10 years. Under Alternatives B' and C, lease stipulations would require monitoring of subsidence, hydrology, and vegetation sufficient to quantify the progressive and final effects of mining. The operator would be required to demonstrate that subsidence is substantially complete and that any effects to hydrology and vegetation have stabilized.

RESPONSE TO COMMENT 7.8

The FEIS has been revised to address the current situation. Conditions at the mine have changed substantially since the DEIS was released. Large amounts of water were intercepted underground along a fault/fracture system. In addition, Canyon Fuel has drilled two wells in James Canyon to intercept and discharge ground water and prevent continued inflow into the mine workings. The water is intercepted from the Starpoint Sandstone prior to entering the mine and is not considered by the Utah Division of Water Quality to be industrial or mine water. The water is being discharged to Electric Lake. The quality of this ground water discharge to Electric Lake is good, meeting State water quality standards. In addition, discharge of mine water to Eccles Creek has increased. The changes in flow and quality resulting from this situation have been evaluated and presented in the FEIS.

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RESPONSE TO COMMENT 7.9

Canyon Fuel is required to perform quarterly Chronic and Acute testing on water discharged from the mine to Eccles Creek under their UPDES discharge permit. Both tests are performed using Flathead minnows and Ceriodaphnia dubia (water flea). The Acute test measures the survivability and Chronic test measures the reproductive success of the organisms within the tested waters. The mine passes the Acute testing for both species and the Acute testing for Ceriodaphnia, but occasionally fails the Chronic testing for Ceriodaphnia. Canyon Fuel has a Toxicity Inventory Evaluation (TIE) and has determined that minute concentrations of nickel (less than 35 micrograms/liter or parts per billion and more than 15 micrograms per liter) combined with the presence of iron in the mine water is the culprit. Mine water pumped through water sumps in gob area contains between 20 and 35 micrograms per liter of nickel, whereas water entering the mine that is not pumped through the gob typically contains less than 10 micrograms per liter of nickel. The UPDES discharge permit allows a concentration of nickel up to 4.6 milligrams per liter or parts per million which is nearly an order of magnitude above the toxic levels for Ceriodaphnia. The discharge waters are well within beneficial use standards for cold water fisheries, agricultural water, and drinking water regarding nickel. Canyon Fuel has increased their pumping capabilities and plans to pump less water into the gob areas. They plan to control nickel and TDS concentrations discharged by appropriate mixing of water directly entering the mine with water from the sump or gob areas (personal communications with Chris Hansen, Canyon Fuel Company, LLC, email dated 11/07/2001).

Under their existing UPDES permit for discharge to Eccles Creek and a UPDES permit for discharge to Electric Lake, if issued, discharges of water must meet discharge requirements of the State of Utah. Any discharge to Electric Lake, if permitted, would be required to be of quality equal or better than the receiving waters.

RESPONSE TO COMMENT 7.10

Section 4.1.4 has been revised in the FEIS to include this information.

RESPONSE TO COMMENT 7.11

The effects to Electric Lake and Huntington Creek are discussed in Section 4.1.4.

RESPONSE TO COMMENT 7.12

See response to Comments 6.6 and 7.13. Neither the Forest Service nor BLM have authority to authorize any specific scenario for mine water discharge and water quality, but have an obligation to discuss potential cumulative effects of potentially leasing the Flat Canyon Tract. Authority lies with the Utah Department of Environmental Quality, Division of Water Quality.

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RESPONSE TO COMMENT 7.13

Section 4.1.4 of the FEIS discusses effects of mine water discharge regarding surface water. Section 4.1.7 discusses potential effects to wildlife species. These sections have been expanded to address the effects in more detail than was presented in the DEIS.

RESPONSE TO COMMENT 7.14

The FEIS compares water quality discharge to existing quality of the receiving waters and to Beneficial Use Standards. Anti-degradation standards do not apply to Eccles Creek, below the Forest Boundary. Anti-degradation standards would only apply to a new UPDES permit, if issued, for discharge to Electric Lake. A UPDES permit could only be issued to Canyon Fuel for mine water discharge into Electric Lake if Electric Lake and Huntington Creek below the dam are reclassified from High Quality Water - Category 1 (no new point source discharges allowed) to High Quality Water - Category 2 (new discharge allowed if there is no degradation of water quality). The anti-degradation standards you refer to would be the existing quality of the receiving waters.

RESPONSE TO COMMENT 7.15

See responses to Comments 2.9 and 7.2. The wetland in the Left Fork of Boulger Creek has been evaluated and determined not to be a peatland.

It is not likely that subsidence would affect flow of perched aquifer springs such as those at the head of Boulger Canyon that provide water to the wetland. Many years of spring monitoring in subsidence areas has shown that effects to flow are highly unlikely (Kadnuck, 1994, NorWest, 2000). The water is perched by clay-rich shales in the Blackhawk Formation. Subsidence cracks at the surface are highly unlikely due to the thick overburden (approximately 1,800 feet). If any surface cracks occurred, they would seal quickly by the expanding clays. There would be no direct loss of water due to cracks. Only one seam of coal is mineable in this area. The slope change due to subsidence would be less than 1% and would not likely cause changes that would affect the wetland. Any unlikely change in stream channel location would occur slowly and probably not be measurable.

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COMMENT LETTER NO. 7a
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
Follow-up to Site Visits of July 26 and August 8, 2001

RESPONSE TO COMMENT 7a.1

See responses to Comments 2.9, 7.2 and 7.15. The wetland in the left fork of Boulger Creek has been tested and determined to not be a peatland. A copy of the report completed by John Sanderson (Sanderson, 2001) was sent to your office for information. The springs were addressed in this report and the potential for effects to springs was addressed in the FEIS, Section 4.1.5.

RESPONSE TO COMMENT 7a.2

Under Alternatives B' and C, monitoring of the perennial stream channels and associated wetlands would be required of the lessee/operator (Special Coal Lease Stipulations). The monitoring plan would be reviewed for approval during the mine permitting process.

RESPONSE TO COMMENT 7a.3

John Sanderson (Hydrobiologist) and Veronica Estelle (Ecologist) conducted the ivestigation. John was recommended by the US Fish and Wildlife Service as a recognized expert in this field.

RESPONSE TO COMMENT 7a.4

The soils were sampled and tested. See response to Comment 7a.1.

RESPONSE TO COMMENT 7a.5

Your comment has been noted.

COMMENT LETTER NO. 8
THE HOPI TRIBE, CULTURAL PRESERVATION OFFICE

RESPONSE TO COMMENT 8.1

A copy of the cultural resources report and letters of consultation with the Utah State Historical Preservation Office have been sent to your office as requested.

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COMMENT LETTER NO. 9

KELLY PAYNE AND ERIK PETERSEN

RESPONSE TO COMMENT 9.1

Thank you for your comment. The FEIS discusses that the potential for effects to flow quantities of springs and streams from subsidence is low.

RESPONSE TO COMMENT 9.2

Thank you for your comments. The conclusions in the FEIS are generally consistent with your statements regarding potential effects of subsidence to flow quantities of springs and streams. The FEIS also states that the potential effects to stream morphology from subsidence should be negligible for streams with similar gradients similar to Burnout Canyon (greater than 5%). The FEIS states that stream subsidence of stream reaches with gradients less than 5 to 7% could result in changes in stream channel morphology that could affect stream ecosystems. This is evidenced by the formation of a small pond in the headwater of Burnout Creek after the second seam was extracted in a short segment of the stream where the gradient was less than 5%. If similar changes should occur over long segments with shallow channel gradients as occurs in Boulger and Flat Canyon Creeks, the morphological changes could alter stream ecosystems.

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Canyon Fuel Company, LLC
Skyline Mines
HC 35 Box 380
Helper, Utah 84526
435/448-6463 Fax: 435/448-2632

Letter 1

July 2, 2001

Ms. Elaine Zieroth, Forest Supervisor
Manti-La Sal National Forest
599 West Price River Drive
Price, Utah 84501

Re: Draft EIS for Flat Canyon Federal Coal Lease Tract (UTU-77114)

Dear Ms. Zieroth:

Canyon Fuel Company appreciates the effort put forth by the Forest Service and BLM in preparing the Draft EIS for the Flat Canyon coal tract. The document appears to be complete and mostly adequate.

Canyon Fuel would like to take this opportunity to make one comment regarding the DEIS, a comment concerning references to exceedances to poorly identified quality standards of water discharges and, then, projections stemming from the exceedances. The references are made in several sections of the Effects of Implementation segment of the DEIS and state or imply that Skyline Mine has had one or a few exceedances of specific water quality limits. It seems that these exceedances, especially phosphorous and phenols, are then isolated and used to extrapolate unlikely events such as mine water discharge caused eutrophication of Scofield and/or Electric Lakes.

The Forest Service has the data in-house to demonstrate that these extrapolations are overstated. Canyon Fuel requests that the Forest Service re-examine the data it already has and, prior to completion of the Final EIS, revise the language in the DEIS to more accurately portray reasonably expected events. Because the data is at hand, this revision should not require more than a partial workday for the specialist involved. Canyon Fuel is willing to assist with identification of the data, should such help be desired. Attached is a more detailed description of specific items of concern.

We encourage the Forest Service and BLM to move this project forward rapidly and hope to realize a suitable lease offering from it.

Sincerely,

Dan Meadors
General Manager

Attachment

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Utah Environmental Congress

Letter 2

June 25, 2001

Elaine Zieroth
Forest Supervisor
Manti-La Sal National Forest
599 West Price River Drive
Price, Utah 84501

Dear Supervisor Zieroth,

The Utah Environmental Congresss (UEC) appreciates this opportunity to comment on the DEIS for the Flat Canyon Coal Lease Tract. We ask to be kept on the mailing list to receive additional information regarding this project as it moves through the NEPA process.

The UEC has several concerns with regards to this proposed action. First, we wish to raise an issue raised by both the UEC and the EPA in comments submitted to your office during the scoping phase of planning for this project. The DEIS states on pages 2-8 and 9 both the EPA and UEC raised concerns regarding the potential impacts on the climate associated with the consumption of fossil fuels such as coal. Unfortunately the Manti-La Sal National Forest deemed this concern "beyond the scope of this analysis."

Cumulative impact is "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future action regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (40 C.F.R. 1508.7). This definition does not limit an analysis to the project area if the proposed action can have impacts beyond the geographic boundaries where the project being analyzed is to take place.

While it may be difficult to assess the impacts of burning 36 million tons of coal over 9-12 years on the global climate, it should be relatively easy to calculate the amount of carbon dioxide produced through the burning of this fuel over that period of time. The DEIS does not dispute the fact that the coal will be burnt. When speaking globally 36 tons may have a minor impact, but when added to the consumption of coal in the U.S. and other nations the cumulative impact is undisputedly large. If the Forest Service is going to facilitate the continued change to the global climate by making coal on

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2.1 lands under its jurisdiction available for burning it must consider the impact such availability will have on continued climate change.

Based on the amount of subsidence described within the DEIS under all of the action alternatives, and on the concern regarding the continued use of fossil fuels discussed above, the UEC endorses the No Action Alternative. Having said that, the UEC also believes that the only action alternative that comes close to meeting the legal and moral mandate of your agency to protect the resources under your jurisdiction is Alternative C. This alternative would not allow subsidence within perennial drainages and offers greater protection to Boulger Dam and the Flat Canyon Campground.

The UEC considers Alternative B indefensible given the fact that it allows mining without any special leasing stipulations that would protect the surface resources within the project area. Alternative B' offers a greater degree of protection, but still exposes perennial drainages to the potentially heavy impacts associated with subsidence.

The UEC is troubled by the proposal to divert water produced as a result of mining into Electric Lake. The DEIS acknowledges the presence of Yellowstone cutthroat trout and describes past episodes where water discharge has violated water quality standards established under the Utah Point Discharge Elimination System (UPDES) Permit. In addition to impacts to Electric Lake, Scofield Reservoir "has been affected by the introduction of mine water discharge."

2.2 The DEIS states that in the past "Concentrations of total boron, cyanide, dissolved lead, total phosphorous, and TDS have on at least one occasion exceeded the concentration limits specified by one or more of the standards." The DEIS continues, "Concentrations of cyanide from CS-12 on one occasion exceeded the standard for aquatic wildlife." (DEIS page 4-23). The DEIS notes that if the company determines these standards are exceeded in the future water will be diverted into underground storage, but the DEIS does not make clear what will eventually happen to water placed in underground storage. To what degree are treatment methods successful in reducing discharge to limits acceptable under the UPDES Permit? How long is water stored underground and what risks are there of water seeping into ground water or being discharged through seepage and springs prior to treatment?

2.3 The FEIS needs to consider impacts to aquatic species beyond those that may exist within the project area. Water discharged from the mine will eventually make its way into the San Rafael River and the Colorado River and may impact water quality within these waters. Impacts to threatened and

2.4 endangered fish within the Colorado River watershed needs to being fully considered and consultation with the U.S. Fish and Wildlife Service regarding potential impacts to these species must be initiated.

2.5 The Manti-La Sal National Forest needs to fully consider the impact to fish and other aquatic species within Boulger Reservoir should it be drained to facilitate mining. Any TES or management indicator species that use this reservoir need to be disclosed within the FEIS, and impacts to these populations should receive a full and detailed discussion. The draining of Boulger Reservoir will have a significant and long-term impact on species that currently reside there that will be difficult if not impossible to reverse.

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The Migratory Bird Treaty Act (MBTA) makes it unlawful to take, kill, or possess migratory birds. In addition, Executive Order 13186 requires Federal agencies to comply with the MBTA and to develop an agreement between the U.S.FWS and other Federal agencies regarding the conservation of

migratory birds and to minimize the unintentional take of these species to the extent practicable. The DEIS fails to adequately consider the impacts of the proposed action to migratory birds within the project area, including raptors, and must fully disclose and discuss these impacts within the FEIS.

The UEC is concerned about the cumulative effects of grazing when combined with subsidence. This is especially a concern when considering the potential for riparian area and wetland recovery following subsidence events. The Manti-La Sal National Forest has initiated the NEPA process for permit renewal on a number of livestock allotments across the Wasatch Plateau, including the project area. The Forest Service is proposing an EIS to consider the impacts of grazing as part of this permit renewal process. Just as that EIS for grazing must consider the cumulative effects of mining when combined with grazing, so the FEIS for this project's must fully consider the impacts of grazing when combined with mining related impacts.

The DEIS draws attention to its Forest Plan regarding the direction mandated for riparian habitat. "The Forest Plan direction includes the following, 'Give preferential consideration to riparian area dependent resources in cases of unresolvable resource conflicts.' and 'Manage waters capable of support self-sustaining fish populations to provide for those populations.'" (DEIS page 4-45). Given the potential impacts associated with subsidence together with continued grazing in the area it is our opinion that there is the presence of "unresolvable" conflicts here. The preservation of the riparian resources under the jurisdiction of the Forest Service should take precedence over mining.

The DEIS also acknowledges the presence of some unique environments within the project area. Of particular concern are the peatland remnants located in the left fork of Boulger Creek. These remnants are left over from the last glacial period and may be the southern most peatlands in Utah. Given the sensitivity of these areas to hydrological changes, we urge the Forest Service not to allow any subsidence beneath these lands and to fully consider any hydrological changes that may result from any of the action alternatives.

On page 3-38 the DEIS begins to consider the socio-economic impacts associated with the proposed action. The DEIS provides data regarding the number of jobs created by the Skyline Mine and coal mining in general within the area. While the DEIS does not directly say so, the implication is definitely present that without continued mining coal mining related employment will drop and the economic well being of the region will be negatively impacted. Mining related employment figures need to be looked at in context, however.

The UEC has attached to these comments a chart documenting coal production and mining related jobs for Emery and Carbon Counties. This chart documents an increase in coal production with a corresponding decrease in mining jobs for this region. These figures are provided by the Governor's Office of Planning and Budget, and show that opening new areas to coal mining will not necessarily equate to more jobs in the future. Indeed, the DEIS admits that several other mines within the area are slated to close in the near future, and it is impossible to see how expansion of the Skyline Mine will lead to any significant increase in coal mining jobs when output is likely to drop anyway in the near term.

The UEC is concerned about the level of monitoring that has taken place in the past with regards to TES and management indicator species. Without adequate information documenting the condition of existing populations of these resources, it will be impossible for the Forest Service to

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2.13 determine whether or not mine activities are causing a downward trend in specific populations of these plants and animals. Furthermore, the Forest Service must collect water quality data and output data from each spring and stream within the area if it is to successfully determine the affects of subsidence on these waters in the future. Baseline data will be critical to any future monitoring efforts if the Forest Service decides to authorize expanding mining operations for the Skyline Mine.

Thank you again for this opportunity to comment on the proposed action. We look forward to reviewing your response to our concerns and the FEIS in the future.

Sincerely,

Craig Axford

Craig Axford
Program Director, UEC

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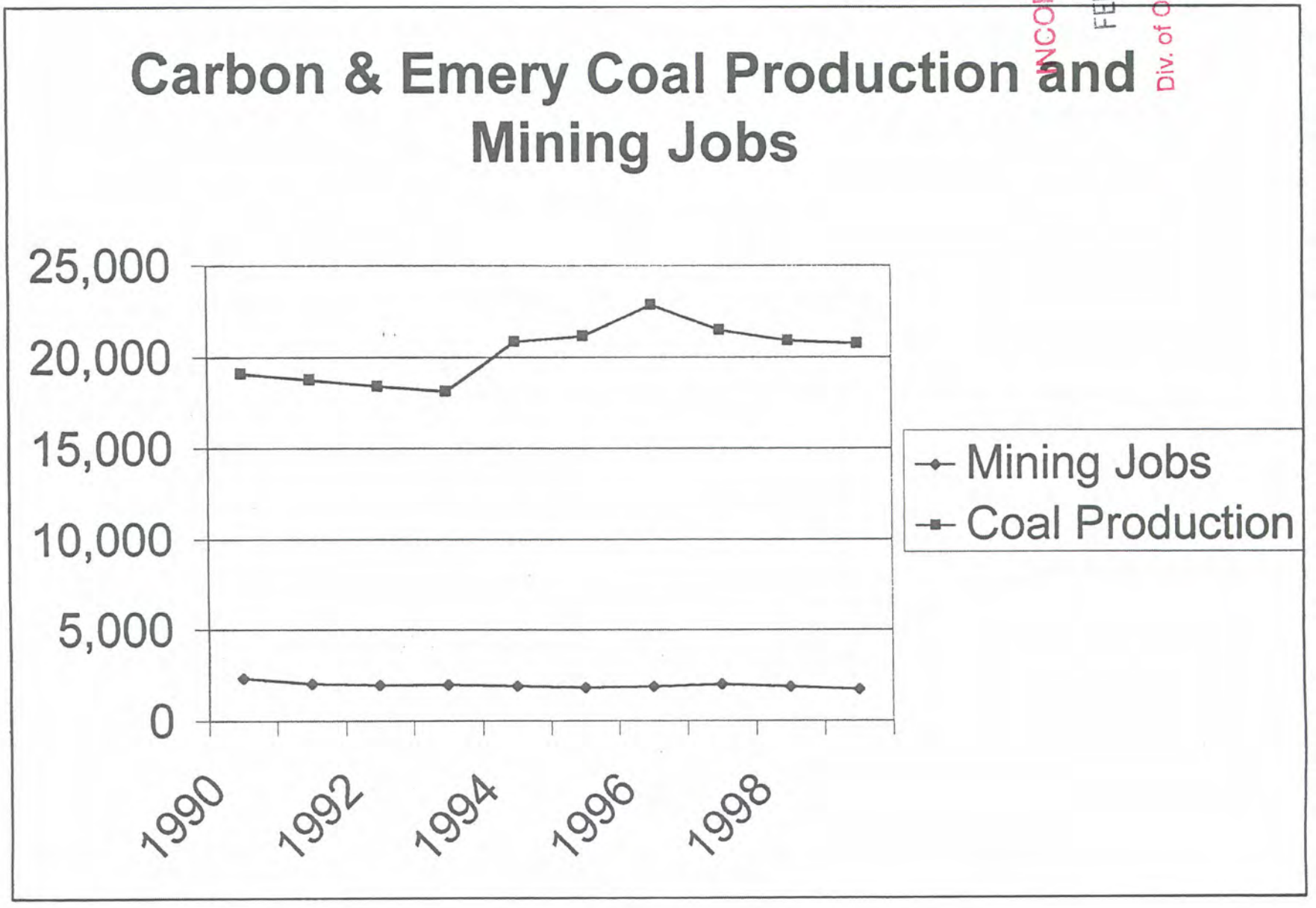

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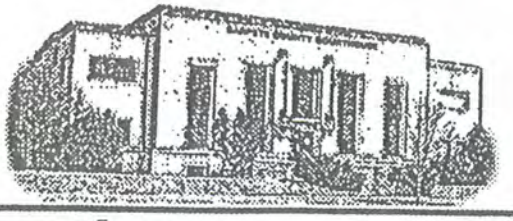

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June 15, 2001

Letter 3

Elaine Zieroth
Forest Supervisor
Manti-LaSal National Forest
599 West Price River Drive
Price, Utah 84501

Dear Ms. Zieroth,

The Sanpete County Commissioners appreciate the opportunity to provide comment on the Draft Environmental Impact Statement on the proposed lease application for the Flat Canyon Coal Tract by Canyon Fuel Co.

Sanpete County has been anxiously waiting for the time when a major coal mining operation would move into Sanpete County. Therefore we are very supportive of the proposal to bid and lease.

3.1 As you are aware more than 50% of the Skyline mines employees are from Sanpete County. Another 9-12 years of production would have an enormous and positive economic effect on the county besides the benefit of utilizing a resource that is becoming increasingly critical now, as the petroleum reserves are in short supply and being depleted.

After analyzing the draft we have determined that the B′ alternative is the proposal that we unanimously support and ask you to seriously consider.

If there is any more information that you would like to receive from us please feel free to contact us. We will be happy to work with you on any aspect of the draft.

Sincerely

Eddie Cox
Sanpete County
Commission Chair

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THE CHURCH OF
JESUS CHRIST
OF LATTER-DAY SAINTS

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Letter 4

Elaine Zieroth
Forest Supervisor
Manti-LaSal National Forest
599 West Price River Drive
Price, Utah 84501

25 June 2001

Subject: Proposed Flat Canyon Lease Tract (UTU-7714)

Thank you for the copy of the "Flat Canyon Coal Lease Tract Draft Environmental Impact Statement" dated May 2001, regarding the proposed Flat Canyon Lease Tract (UTU-77114).

Having reviewed the Draft Environmental Impact Statement (EIS), it appears the outline of the Church holdings adjacent to the tract needs to be corrected. I have attached an earlier letter which includes a copy of the figure you provided with the approximate "LDS Campground" surface area controlled by the Church highlighted in yellow. The Church also controls the mineral rights under most of this same area.

We anticipate eventual recovery of the coal resource held by the Church. We appreciate the Church holdings being included in the EIS effort.

Please let us know if there are any questions. We look forward to our continued communications.

Sincerely,

JD (Jeff) McKenzie, PE
Mining Engineer

The Church of Jesus Christ of Latter-day Saints
Natural Resource section
Real Estate Division
Twelfth Floor East, Room 1229
50 East North Temple Street
Salt Lake City, Utah 84150-0001

cc: T. Roylance w/o attachment
H. Gardner w/o attachment

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Denver, Colorado 80225-0007

ER 01/437

Letter 5

Elaine Zieroth, Forest Supervisor
Manti-La Sal National Forest
599 West Price River Drive
Price, Utah 84501

Dear Ms. Zieroth :

The Department of the Interior has reviewed the Draft Environmental Impact Statement for the Flat Canyon Federal Coal Lease Tract (UTU-77114) in Sanpete and Emery Counties, and offers the following comments provided by the U.S. Fish and Wildlife Service and U.S. Geological Survey.

The document analyzes, using four alternatives, potential impacts from leasing for coal mining a tract with an area of approximately 3,792 acres. The EIS analyzes four alternatives that have characteristics as follows:

- Alternative A--No Action: provides a baseline for estimating the effects of the action alternatives. The lease tract would not be offered and there would be no mining.

- Alternative B--Offer the tract for leasing as delineated without special leasing stipulations. This alternative does not meet Forest Plan requirements but was analyzed to disclose the effects of not including special stipulations.

- Alternative B'--Offer the tract as delineated with special coal lease stipulations but without restrictions on mining that would cause subsidence of sensitive surface resources. Extends mine life 9 to 12 years.

- Alternative C--Offer the tract for leasing as delineated with special lease stipulations, e.g., do not allow subsidence of perennial drainages, Boulger Dam and Reservoir or Flat Canyon Campground. Extends mine life 5 to 7 years.

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General Comments

We commend the Manti-La Sal National Forest and the Bureau of Land Management, as land management agencies with multiple-use mandates, for endeavoring to enhance the protection of natural resources while providing the opportunity to develop mineable Federal coal reserves.

5.1 We have serious concerns about the potential for impacts to wetlands and drainages under Alternative B'. Although there are stipulations to provide for some inventories and monitoring, we find them insufficient to protect wildlife resources (see specific comments). Notwithstanding the provisions to engage in nonsubsidence mining under the Upper Huntington Creek, we believe the plans to engage in longwall mining under Swen's, Boulger, and Flat Canyons may destroy important micro-habitats within those canyons. The document states, Upper Huntington Creek is the only disease-free source of Yellowstone cutthroat trout in Utah. They use the creek as spawning habitat, and reside in Electric Lake. Therefore, protections should be afforded the basin as a whole, including tributaries to Upper Huntington Creek.

5.2 There are other singular resources within the Boulger Creek and Flat Canyon Creek subbasins that may be irreplaceable. Both of these canyons are glacially carved cirque valleys on the west side of Upper Huntington Creek, comprised largely of Quaternary alluvium. In fact, the document states that the left fork of Boulger Creek retains a peatland remnant of the glacial epochs. It also admits that peatlands are very sensitive to hydrologic changes and typically do not recover. Furthermore, the vegetative analysis and maps of the document reveal that both Boulger and Flat Canyon Creeks contain the majority of the wetland communities within the project area.

5.3 We also have concerns that the long-term impacts to the important recreational fishery provided by Boulger reservoir may not be remediable if this canyon is undermined. While data has been accumulated on the hydrologic impacts of undermining two other tributaries of Upper Huntington Creek, there has been little study of impacts to the biota and insufficient baseline data. Additionally, the EIS notes that these two creeks on the east side of Upper Huntington, Burnout and James, are distinct from the those in the project area and cautions against extrapolating study results. In short, we have little information on the potential for impact to the fishery. Significantly, the document asserts that special lease stipulations of Alternative B' regarding subsidence will not fully mitigate the potential loss of habitat features and the effects of sedimentation.

5.4 We have additional concerns about plans discussed for the disposition of mining water from the new tract. This discussion should be substantially enlarged to include three scenarios: (1) keeping the discharge point for the entire mine in Eccles Canyon Creek, (2) diverting all the discharge water directly into Electric Lake, and (3) dividing the discharge waters into both systems, depending on the subbasin source of the mining water. As the U.S. Fish and Wildlife Service believes the region of influence of this project extends beyond the footprint of the activities, the discussion should include potential impacts to Scofield Reservoir and Electric Lake, as well as the Price and San Rafael Rivers. Also, the document states that Eccles Creek will return to premining conditions after the removal of mining discharge. The discussion should include the information that Canyon Fuel Company, LLC, owns the water rights to four points of diversion in Eccles Creek, totaling 427 acre-feet, and that the diversion of this water may

5.5

5.6

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continue for the life of the mine. Effects of these diversions on the potential recovery of the creek should be analyzed as part of the mining water discussion.

5.7 Our most serious concern regarding the disposition of the mining water is the potential for impact to Electric Lake and its population of Yellowstone cutthroat trout. While the additional volume of water may enable downstream releases approximating more natural flows, the potential for degradation to water quality is significant. This may be exacerbated by degradation due to subsidence under streams in the subbasin. The Service believes, initially, there is a need for baseline biotic and physicochemical surveys of the lake, with monitoring to continue for the life of the mine. Biotic surveys should include benthic macroinvertebrate and planktonic, as well as fish communities.

5.8 The final EIS should include an expanded analysis of the disposition of mining water. Provisions should be made for continuous monitoring of quality of mining water within the mine, cutoff valves within the mine, and installation of either water treatment equipment or fittings to allow such equipment if lake conditions warrant. Determination of conditions in the lake should be made with the advice of the Service and the Utah Division of Wildlife Resources.

5.9 The document should include separate sections for threatened and endangered species in Chapter 3, Affected Environment, and Chapter 4, Effects of Implementation, rather than address them under the general headings of Vegetation and Wildlife of the respective chapters. For example, wintering populations of bald eagle should be addressed in the final EIS.

5.10 The endangered fish species of the Colorado River should be addressed as well, and consultation is required as per the following three paragraphs.

5.11 As we have concerns about losses of water to both the Price and San Rafael Rivers, both part of the greater Colorado River Watershed, it is important that you include a description of water crossings, existing water distribution, water sources, any existing or new water depletions, and the net change in depletions in your assessment on endangered species impacts. The reason for this is as follows.

Any depletion from the Colorado River basin is considered to jeopardize the continued existence or adversely modify the critical habitat of the four Colorado River endangered fish species. However, depletions are addressed by existing interagency section 7 agreements. In 1988, the Department of the Interior, the States of Wyoming, Colorado, and Utah and the Western Area Power Administration established the Recovery Implementation Program. The purpose of the RIP is to recover listed species while providing for new water development in the Upper Colorado River Basin. Through this program, agencies developed an encompassing section 7 agreement on all *historic* and *new* depletions in the Upper Colorado River Basin. In accordance with the agreement, the Service assesses impacts of projects that require section 7 consultation and determines how the RIP will serve as a reasonable and prudent alternative.

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Depletions are categorized as (1) historic depletions, (2) new depletions less than 100 acre-feet, (3) new depletions less than 3,000 acre-feet, and (4) new depletions of 3,000 acre-feet and

greater. For historic depletions, the RIP activities serve as the reasonable and prudent alternative, and no additional requirements exist other than providing the depletion amount. For new depletions less than 100 acre-feet, an intraservice agreement based on basinwide cumulative depletions precludes the need for a depletion charge, and the RIP recovery activities are considered to offset depletion impacts. For new depletions from 100 to 3,000 acre-feet annually, a one-time depletion charge ($14.36/acre-feet for FY 2000) is paid by the project proponent to the RIP to offset depletion impacts. For new depletions greater than 3,000 acre-feet annually, the depletion charge is paid and additional items may be required to offset depletion impacts. It is important to note that the Service is required to consult on and keep track of all depletions, historic or new, of any magnitude. Therefore, a biological assessment or environmental document should describe all depletions, historic or new, large or small.

5.12 The final EIS should include a discussion of the potential for disruption of raptors during breeding and nesting seasons by subsidence and seismicity. Federal agencies have a responsibility to raptors under authority of the Migratory Bird Treaty Act (16 U.S.C. §703-712), a strict liability law which makes it unlawful to take, kill, or possess migratory birds, their parts, nests, or eggs. Executive Order 13186, issued on January 11, 2001, reinstituted the responsibilities of Federal agencies to comply with the MBTA. It also required development of a strategy for the Service to work with Federal agencies on conserving priority species by avoiding or minimizing unintentional take and taking actions to benefit these same species to the extent practicable. Accordingly, we recommend that surveys consistent with the nesting season of the birds be completed before any potentially disruptive activities take place. Buffers and avoidances should be established as needed and appropriate. We recommend use of the *Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances* (Romin and Muck 1999) which was developed in part to provide consistent application of raptor protection measures statewide and provide full compliance with environmental laws regarding raptor protection. Raptor surveys and mitigation measures are provided in the Raptor Guidelines as recommendations to ensure that proposed projects will avoid adverse impacts to raptors, including the peregrine falcon. Your analysis also should discuss how the proposed action relates to the Forest Plan Amendments concerning the Utah Northern Goshawk Project.

5.13 The document should include and analyze potential impacts to the following aquatic species: Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), a conservation agreement species, as well as bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), and roundtail chub (*Gila robusta*), three species of concern.

5.14 We appreciate the very informative Appendix A: Table of Past, Present, and Reasonably Foreseeable Future Actions. However, there are topics in this table that should be discussed separately within the document. The continued sheep grazing on allotments within the forest has potential to impact efforts to restore riparian structure and vegetation. The document should analyze the effects of sheep grazing on the success of reclamation efforts. The document should

5.15 also discuss the potential for seismicity impacts to the proposed natural gas and liquid petroleum products pipelines that may be constructed approximately 1 mile east of the Flat Canyon Tract.

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5.16 As one of the project's stated purposes is to maximize economic returns and provide electric generation, and this purpose may conflict with protection of natural resources, the document needs a more in-depth discussion regarding the economic comparison between the Alternative B and Alternative C. A crucial analysis is one detailing the calculations that produced the relative estimated yield for the two alternatives. The analysis also should indicate approximately what proportion of total economic return and electric demand would be represented by the difference between the yield of the alternatives.

5.17 The document would be improved by the addition of a regional map or maps illustrating the footprint of the project area in reference to the surrounding region of influence. The map(s) should include Scofield Reservoir and the San Rafael and Green Rivers.

Specific Comments

5.18 Section S-1.7, Alternatives Analyzed, page S-15: The statement, "Alternatives B and C define the most and least restrictive action alternatives . . .," should be amended to read, "Alternatives B and C define the least and most restrictive action alternatives . . . ." The same transposition occurs on page 2-11.

5.19 Section 3.1.5. Surface Water, page 3-8: The document states that the Skyline Mine surface facility in Eccles Canyon is west of the study area. That should be amended to "east."

5.20 Section 3.1.8. Affected Environment, Wildlife: This section also should include a discussion of migratory birds, as per Executive Order 13186. Of particular concern are riparian areas. Any subsidence that causes loss of water could reduce loss of riparian habitat available. This discussion should be carried forward to the effects analysis in Chapter 4.

5.21 *Terrestrial Wildlife*, page 3-26: The statement that the bald eagle is the only federally listed species with potential to occur in the Upper Huntington drainage should be relocated to a section on threatened and endangered species.

5.22 *Aquatic Resources*: The document limits the discussion of aquatic resources to fish species. There are significant spring, upstream reaches of creeks, and wetland resources that may provide important habitat for amphibians. A discussion to this effect should be incorporated into the analysis.

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5.23 Page 4-5 to 4-22, Section 4.1.2 Topography/Physiography, Geology (Includes Direct Surface Disturbance, Subsidence, and Seismicity) and Section 4.1.3 Facilities: Mine-induced seismicity is examined in detail; however, natural seismic hazards have not been addressed. Peak ground acceleration at Provo, Utah, is 0.43g with 2 percent probability of exceedance in 50 years. The subsidence hazard to the existing infrastructure in the area including Boulger Dam and Reservoir, State Highway 264, campgrounds and cabins, as well as drainages, should be evaluated for this

level of natural seismic event. Subsidence hazards on future, post mine, development in the area from natural seismic events for Alternatives B, B', and C also should be evaluated. Mitigation beyond the stated 12 years of the project for mine-caused subsidence as a result of natural seismic events should be analyzed and included in the final EIS.

5.24 Page 4-16, paragraph 2: The United States Geological Survey is mentioned but not referenced. A reference for the USGS data base would be helpful.

5.25 Section 4.1.7, Effects of Implementation, Wildlife, pages 4-43 and 4-44: The discussion of effects to wildlife by changes in riparian habitat should be substantially expanded. As most wildlife species in Utah rely on riparian vegetation, the potential for loss merits an in-depth evaluation. This is especially important in light of the discussion in Section 4.1.6.2 that indicates there would likely be loss of riparian vegetation under Alternative B', and we are concerned that this may be unmitigable.

5.26 Section 4.1.7.2, Effects of Implementation, Terrestrial Wildlife, page 4-45: The discussion on effects of subsidence needs to be expanded. The document states there is not expected to be any direct effect to terrestrial species, but needs to discuss indirect effects such as loss of riparian vegetation, loss of peat wetlands, and disturbance of raptor nests. The discussion should include migratory birds. The document also states that changes to spring emergence locations could affect individuals but should not affect populations. We disagree to the extent that populations of snails or other limited-range species may be impacted if they reside in the altered spring sites. The document should be amended to reflect this.

5.27 Special Coal Lease Stipulations, pages C-2 to C-5: Stipulation 2 requires inventories for threatened and endangered species of plants or animals or migratory birds of high Federal interest, if in the area. The inventories should be expanded to include other species necessary to maintain populations of these species.

5.28 Stipulation 17 requires replacement of surface and/or developed ground water sources identified for protection. This should not be limited to developed sources, but include all sources of water.

In summation, we feel that, even with stipulations, under Alternative B', there is potential for unmitigable losses to riparian and wetland resources within the ecosystem. Alternative C, protecting against subsidence under riparian areas, coupled with the amended Coal Lease Stipulations, is substantially less environmentally damaging. We appreciate the opportunity to provide these comments.

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Sincerely,

Robert F. Stewart

Robert F. Stewart
Regional Environmental Officer

Michael O. Leavitt
Governor
Kathleen Clarke
Executive Director
John Kimball
Division Director

State of Utah

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES

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Letter 6

26 June 2001

Elaine J. Zieroth
Supervisor's Office
United States Forest Service
599 W. Price River Drive
Price, UT 84501

Subject: Flat Canyon Coal Lease Tract Draft Environmental Impact Statement

Dear Ms. Zieroth:

The Utah Division of Wildlife Resources (UDWR) has reviewed the Flat Canyon Coal Lease Tract Draft Environmental Impact Statement (DEIS), and we provide the following comments:

6.1 Subsidence of Perennial Drainages
We are concerned that subsidence of the perennial drainages of Little Swens, Swens, North Swens, Flat Canyon, and Boulger Canyon may result in the decrease or loss of surface flows due to the interception of water by subsidence cracks. We believe that it would be extremely difficult to mitigate for the loss of one of these perennial streams. In addition, we are concerned that there may be increased erosion and sedimentation in the

6.2 streams due to the altering of stream morphology by subsidence. Decreased surface flow, alteration of stream morphology, and heavy sedimentation loads could significantly impact the aquatic ecosystem of both the immediate streams and the down stream

6.3 environments. Further, we are concerned that subsidence could alter the wetland and unique peatland ecosystems in the area.

6.4 If Alternative B' is selected, and the aforementioned perennial drainages are to be subsided, we recommend that data be collected, starting immediately, on flows, water quality, water chemistry, and aquatic invertebrate and fish populations. At present, there are insufficient baseline data on these streams to determine significant changes in the aquatic ecosystems post-subsidence. Skyline Mine is currently monitoring flows, water quality, and biota in James Creek and Burnout Creek. We feel that similar methods would be adequate on Little Swens, Swens, North Swens, Flat Canyon, and Boulger Canyon.

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Discharge of Produced Mine Water

6.5 Alternatives to discharge produced mine water into Eccles Creek or Huntington Creek should include a more detailed discussion of these actions. Alternatives to dispose of all water into Eccles Creek, all water into Electric Lake, or to split the discharge into both drainages should be fully considered. Discussion should include potential impacts to the Price River and the San Rafael River from these different actions.

6.6 We recommend that the amount of water currently discharged in Eccles Creek be maintained. This water is important to aquatic resources in Scofield Reservoir, Lower Fish Creek (below Scofield Reservoir), and the Price River, which contains such species as Colorado pikeminnow (federally listed as endangered), flannelmouth sucker, bluehead sucker, and roundtail chub.

6.7 Additionally, we are concerned that any water discharged into Electric Lake be of sufficiently high water quality so that lake water quality is not negatively impacted. Electric Lake is an important Yellowstone cutthroat trout fishery. We request that discharge water be carefully monitored to avoid impacting Electric Lake.

Loss of Boulger Reservoir

6.8 Under a full-recovery mining scenario, we agree that Boulger Reservoir should likely be closed to avoid problems associated with dam failure. However, we feel that the loss of this fishery should be mitigated in some manner. The DEIS reported that there would likely be a loss of some 5,000 recreational fishing days per year, or some 60,000 recreational visitor days over the twelve year closure period. UDWR creel census data support these figures. In 1996, the U.S. Fish and Wildlife Service estimated expenditures of ~$60.00 per angler day of fishing. Using this cost figure, the recreational opportunities of Boulger Reservoir over a twelve year period could be worth as much as $3.6 million. Certainly, there would not be a loss of all 60,000 visitor days, as some visitors would go to other nearby lakes. However, those lakes already have high use and adding visitors would reduce the quality of fishing opportunities. Moreover, fish stocking levels in these lakes cannot increase much from current levels without creating fish health problems. Mitigation for the loss of the significant Boulger Reservoir fishery should be discussed in more detail.

6.9 One potential project to partially mitigate for the twelve-year loss of Boulger Reservoir could be to place a pipe in a tributary to Gooseberry Reservoir that could be opened during the winter to pipe oxygen-rich water to the middle of the reservoir bottom. This would improve the Gooseberry Reservoir fishery by enhancing over-winter survival of rainbow trout, thus somewhat off-setting the effects of closing Boulger Reservoir.

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6.10

Drilling of Core-test Holes

Finally, we are concerned with the location and timing of the core test-drill holes. From May 15th through August 31st, the area provides critical habitat for nesting goshawks, as well as for deer and elk parturition and nursery herds. We therefore request that UDWR be consulted during the planning stage for the location and timing of the core hole-drilling so that detrimental impacts to wildlife can be avoided.

Thank you for the opportunity to review the DEIS and provide comment. If you have any questions, please contact Chris Colt, Habitat Biologist, at our Price Office (435-636-0260).

Sincerely,

ACTING DIRECTOR

John Kimball
Director

JK/cc/mfc

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
999 18TH STREET - SUITE 300
DENVER, CO 80202-2466
http://www.epa.gov/region08

Letter 7

June 28, 2001

Ref: 8EPR-EP

Elaine Zieroth
Forest Supervisor
Manti-La Sal National Forest
599 West Price River Drive
Price, Utah 84501

Re: Flat Canyon Coal Lease Tract – Skyline Mine Expansion, DEIS Review No. 010165

Dear Ms. Zieroth:

In accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act, Region 8 of the Environmental Protection Agency (EPA) has reviewed and rated the *Draft Environmental Impact Statement (DEIS) for Flat Canyon Coal Lease Tract*, Manti-La Sal National Forests, dated May 2001.

EPA's main concerns are impacts to water quality from mine drainage discharges, and impacts to fen wetlands and stream/riparian habitat from subsidence. Salinity, effluent toxicity and phosphorus are the major pollutants of concern, if mine drainage from the expansion is discharged through the existing outfall into Eccles Creek/ Scofield Reservoir. We have additional concerns if a discharge is added to the Huntington Creek/Electric Lake watershed. The DEIS did not adequately analyze or disclose the potential impacts of the new discharge. Unless additional environmental analysis shows only minor impacts, we recommend prohibiting the mine from discharging into this high-quality, relatively healthy watershed. Our detailed comments are attached.

Based on the procedures EPA uses to evaluate the potential effects of proposed actions and the adequacy of the information in the DEIS, Alternatives B' and B will be listed in the Federal Register in the category E0-2 (EO - Environmental Objections, 2 - Insufficient Information). This rating means that the review identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment and the DEIS does not contain sufficient information to thoroughly assess environmental impacts that should be avoided to fully protect the environment. We understand that Alternative B is not likely be implemented and was intended mainly for comparison purposes. The alternative was rated because it appears the decision maker(s) could still select Alternative B. Alternative B' (Alternative B with mitigation) will have fewer environmental impacts. However, because of water quality impacts, damage to the fen(s) and perennial streams, we have also rated this

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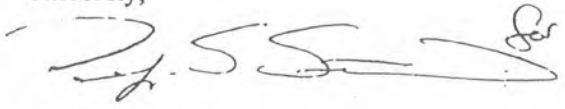
alternative as EO-2. Alternative C (limits subsidence under perennial drainages and fen area(s) will be rated as EC-2 (EC-Environmental Concerns, 2-Insufficient Information).

We would like to work with the Forest Service and BLM to reduce or mitigate environmental impacts, particularly if Alternatives B or B' are pursued as the preferred alternative or it appears that the mine will discharge into Huntington Creek. To set up a meeting or if you have any questions about these comments please contact Dana Allen at (303) 312-6870. We appreciate your interest in our comments.

Sincerely,



Cynthia G. Cody
Chief, NEPA Unit
Office of Ecosystems Protection
and Remediation

Enclosure

cc: Elaine Suriano, EPA HQ

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Fens only develop when unique hydrogeologic conditions exist. The most critical condition for preserving fens is groundwater discharge and histisolic conditions. In some cases fens have been destroyed by a minor decline in the potentiometric surface (head) for the aquifer. This can happen through subsidence or when the underlying aquifer is dewatered changing the relative heads between the fen and the lower aquifers. For Flat Canyon expansion Alternatives B and B', it appears inevitable that fen(s) would be lost when subsidence changes the unique groundwater conditions. Alternative C seems less likely to have impacts on the fen(s). It appears that the lower aquifer that will be dewatered as part of the mining operation is sufficiently isolated from the surface aquifers. For more information on the groundwater aspects of fens please contact Mike Wireman of our office at (303) 312-6719.

7.1 The FEIS of should include a description and maps of the wetlands including size, quality, locations. The FEIS should also more closely evaluate the hydrologic conditions that have created these unique wetlands.

7.2 We also disagree with the DEIS conclusion in the first paragraph of page 4-43 for Alternatives B and B' have no irreversible/retrievable wetland losses. Any fens in subsidence areas are extremely unlikely to continue functioning. The wetland resource also cannot be successfully mitigated, because of the unique conditions necessary for fens to develop. We are unaware of any successful fen replacement.

4. **Stipulations Appendix C-Special Coal Lease Stipulations** —

7.3

#9 This stipulation should be amended to include preservation of riparian habitat and suitable stream morphology.

#20 This stipulation regarding damages for wasted or unrecovered coal should be amended to exclude damages for coal which is not mined because of environmental reasons.

New A stipulation should be added to prohibit discharging mine drainage into Huntington Canyon in the Electric Lake watershed. For more information see comment 2 above.

7.4 5. **Subsidence** — The FEIS should include additional information on the impacts from subsidence. In particular, more information is needed on subsidence in shallow valleys with glacial deposits. As mentioned in the DEIS, the Burnout Creek information is only applicable to steeper and more rocky valleys. We recommend using other longwall coal mines mining under similar rock and soil types to better evaluate the impacts on streams and the impacts from differential subsidence?

7.5 To enhance the public's ability to understand this project, the FEIS should include more detail regarding the on-the-ground impacts from subsidence. Appendix D and Table 4.1- *Predicted Subsidence and Relative Degree of Effect in Comparison to Skyline*, indicate that subsidence will be highly variable and widespread, but it is not clear spatially how the topography will change. For example, how closely spaced are the longwall panels, fire

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barrier pillars and gate roads? Some typical cross-sections of the mining area or hypothetical topographical maps for an area before and after mining would be very useful in understanding the level of subsidence impacts.

6. **Mitigation Implementation and Bonding** — The FEIS should include additional information on how the Forest Service and BLM. will assure that mitigation will be implemented. Pages 1-3 & 4 explain generally how the agencies will oversee the lease and mine. But it is not clear how these overlapping authorities will assure adequate mitigation.

For example in Appendix C-Special Coal Lease Stipulations, Stipulation #9 specifies that mining be conducted . . . "to prevent surface subsidence that would: . . . (3) damage or alter the flow of perennial streams." Which agency would decide the criteria and monitoring for damaged or altered perennial streams? Will the details of the mitigation for environmental impacts be developed as part of the coal mining permit administered by DOGM? Will there be other criteria such as Forest Service guidelines which will be used to evaluate compliance with this stipulation? Which agencies will be evaluating the company's monitoring information? Who decides when remediation is necessary? BLM, DOGM, and the Forest Service appear all to have overlapping responsibilities on this particular environmental impact. 7.6

It is unclear from the DEIS if the mining company be required provide a bond to assure reclamation. The FEIS should described how the mine will be bonded, which agency holds the bond, and the type of impacts and reclamation that will be covered under the bond.

7. **Post Closure** — The FEIS should expand the discussion of potential long-term impacts after closure. For example, the access port/development corridors appear to be permanent facilities. Is there a potential for subsidence of these corridors in the future? Are there any long-term impacts to ground and surface water from preferential pathways created by mine workings? Will there be any ongoing discharges of mine drainage after closure? Are there any areas of the mine that will be subsiding after reclamation is complete? For example, it appears that some of the room and pillar type mining is present and can subside after closure. What kinds of impacts can be expected from further subsidence and how would any impacts the reclaimed after mine closure? 7.7

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Environmental Protection Agency - Region 8 Comments
Flat Canyon Coal Lease Tract DEIS
June 28, 2001

1. **Water Quality - Eccles Creek and Scofield Reservoir —** In the FEIS, the surface water quality effects section 4.1.4 should be revised to more accurately reflect current water quality problems caused or contributed to by the Skyline Mine and proposed expansion discharges. Excessive salinity in the Colorado River basin, effluent toxicity and phosphorus loadings are the main water quality concerns for the Eccles Creek discharge. The FEIS should also incorporate the mitigation measures needed to offset water quality impacts caused by the mine.

According to the State of Utah, the mine has been exceeding the salinity standard as expressed in a total dissolved solids limit. As the mine has expanded, discharge flows and the salinity loading (tons/day or year) have increased. The existing salinity loading from the mine has already exceeded acceptable levels of cumulative impacts for the Colorado River and the new expansion will increase the salinity loading. It is therefore important to develop as part of this project, mitigation actions to reduce salinity discharges. At this stage of the project, a stipulation to reduce the salinity loading by the amount specified by the State of Utah or the Salinity Forum should be incorporated into the lease or ROD. If time allows, more mitigation specifics could be developed for the FEIS. For example, the most likely type of mitigation would be an off-site salinity reduction project to reduce the overall load within the basin. Alternatively, if the mine can identify saline inflows or other sources of salinity, the mine may want to develop on-site mitigation. 7.8

Effluent from the mine has been found to be toxic to ceriodaphnia. The mine is currently in the process of identifying the parameters causing the toxicity. The FEIS should include a summary of the toxicity investigation, likely sources of the toxic parameters and estimated contributions of the toxin(s) from the existing mine and the proposed expansion. 7.9

The DEIS did mention the water quality problems in Scofield Reservoir located downstream of the mine discharge to Eccles Creek (page 4-26). However, there was no analysis of the impacts from the mine and mine expansion on Scofield Reservoir. The State, by listing the Reservoir on the 303(d) list, has determined that cumulative impacts from increased loadings of phosphorus have reached excessive levels. The State has also prepared a total maximum daily load (TMDL) calling for a 28% reduction of phosphorus. From the one analytical results for phosphorus and the high flow rates from the mine, the mine and expansion could be significant contributors of phosphorus loading. The FEIS should more thoroughly analyze the cumulative impacts from phosphorus, including a discussion of how the TMDL will be implemented at the existing mine and expansion. What is anticipated to be the maximum phosphorus loading allowed from the existing mine and expansion? How do the projected (existing mine and expansion) phosphorus discharges compare to the TMDL loading? The 7.10

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expanded analysis should also include any mitigation, treatment or alternative changes that need to be implemented to achieve the TMDL.

2. **Water Quality - Huntington Creek and Electric Lake** — The FEIS needs to more fully disclose the environmental impacts of discharging to Huntington Creek and Electric Lake because of the potential for significant impacts and the high-quality, healthy nature of the resource. In the DEIS, it appears that the federal agencies are deferring analysis of these environmental impacts to a future State water quality standard process. This analysis needs to be completed before the federal decisions are made. We also recommend that the Forest Service and BLM make the addition of this new discharge a specific decision. For example, the discharge options could be developed into specific alternatives. The decision should be recorded in the lease and/or ROD. Discharge to this watershed should be prohibited by the Forest Service and BLM if the impacts are significant or if the environmental analysis cannot be completed in time for the leasing decision. 7.11 7.12

The expanded environmental analysis should determine the impacts (direct, indirect and cumulative) of adding a new discharge. In particular, the addition of metals, salinity, toxicity, phosphorus and other nutrients, are likely to have significant impacts. The analysis should also address impacts to any sensitive aquatic species such as cutthroat trout. Using phosphorus as an example, the FEIS will need to estimate the loadings of phosphorus from the new discharge, existing sources, and reasonably foreseeable actions. The analysis will also need to determine the acceptable level of phosphorus for this watershed. 7.13

Appendix E should be revised to include the anti-degradation water quality standards that are currently applicable for discharges to Huntington Creek and Electric Lake. Depending on the parameter, the anti-degradation limits may be substantially more restrictive than the water quality standards to maintain beneficial uses. 7.14

3. **Fen Wetlands** — It is our understanding that fens, or peatlands, are present within the project area and will be affected by the mine expansion, particularly alternatives B and B'. The DEIS mentions wetlands containing peat in the Boulger Canyon area. It also appears that this type of wetland may also be in the Flat Creek valley. Fen-type wetlands have recently been designated by Region 6 of the Fish and Wildlife Service (USFWS) as Resource Category 1 with respect to the USFWS Mitigation Policy. The mitigation goal of Resource Category 1 is *no loss of existing habitat value* and makes the protection of fens a high priority. 7.15

Fens or peatlands are very rare in the Rocky Mountain Region, particularly in Utah. Fens are wetlands that have primarily organic soil material (i.e., peats or muck) and are created in areas where groundwater discharges to the surface under constant chemical and flow conditions. Because the rate of plant growth exceeds that of decomposition, organic soils form very slowly by accumulation of plant debris. Fens in the Rocky Mountains are believed to develop or accumulate at rates ranging from 4.3 to 16.2 inches per thousand years.

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Environmental Protection Agency Rating System for Draft Environmental Impact Statements
Definitions and Follow-Up Action*

Environmental Impact of the Action

LO - - Lack of Objections

The Environmental Protection Agency (EPA) review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC - - Environmental Concerns

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce these impacts.

EO - - Environmental Objections

The EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no-action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU - - Environmentally Unsatisfactory

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

Adequacy of the Impact Statement

Category 1 - - Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis of data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2 - - Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonaby available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses or discussion should be included in the final EIS.

Category 3 - - Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the National Environmental Policy Act and or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

* From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment. February, 1987.

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AUG 21 2001

Ref: 8EPR-EP

Carter Reed
EIS Team Leader
Manti-La Sal National Forest
599 West Price River Drive
Price, Utah 84501

Jim Kohler
Bureau of Land Management
Utah State Office
324 State Street, Suite 301
Salt Lake City, Utah 84111

cc: Rod Player
k. Foster
R. Davies

LETTER 7a

Re: Flat Canyon Coal Lease Tract – Skyline Mine Expansion, DEIS

Dear Messrs. Carter and Kohler:

This letter is in follow-up to EPA's June 28, 2001 comment letter on the Flat Canyon DEIS and site visits to the fen in upper Boulger Canyon on July 26, and August 8, 2001 by Dana Allen and Mike Wireman with EPA. We appreciate the arrangements the agencies made for the site visits of the fen and the area which had subsided under previous mining. As discussed in our meeting and site visits, fens are unique, irreplaceable wetlands. More information is needed to confirm this wetland is a fen and determine the potential impacts of subsidence. We have the following recommendations for further investigations of the fen regarding ground water hydrology and ecology.

7.1 1. It is important to establish the geologic source of the springs that contribute water to the fen in the upper Boulger Creek watershed. There are at least three springs which discharge above the fen and drain into and through the fen area. These springs discharge from either the Castlegate sandstone or the upper part of the Blackhawk Formation (Fm). [The two major coal seams are in the lower part of the Blackhawk Fm.] Mike Wireman's field observations indicate that at least one of the springs may discharge from the Castlegate/ Blackhawk contact and the other two may discharge from sand facies units in the upper Blackhawk Fm. This is important, because the Castlegate Fm. is less likely to be impacted by subsidence than the Blackhawk. As discussed with Mike Wireman, water chemistry and field hydrogeologic mapping can be used to make this determination.

7.2 2. We recommend that at least one nested pair of piezometers be installed near the center of the fen area (depending on accessibility). These piezometers would serve two functions:

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(a) determination of the vertical gradient (direction and magnitude) of ground water head within the fen and (b) long-term monitoring of head conditions, especially if the fen may be impacted by subsidence from mining. Data from the piezometers would help answer the questions as to whether there is an upward movement of ground water into the bottom of the fen area. This is important, because any upward discharge of ground water would be ground water contained in the Blackhawk Fm (which the fen overlies). Fen viability is very sensitive to changes in head.

7.3

3. We also recommend that a fen expert visit the site to determine if the wetland is truly a fen based on ecological/botanical criteria. As you recall, wetlands including fens are defined through three parts - hydrology, soils and vegetation. The soil and hydrology components of defining a fen are progressing. However, it appears that additional information is needed to evaluate the vegetation in the fen and take into account how grazing and other uses may have affected the plant community. Fens may also provide habitat for rare flora and fauna.

7.4

4. Depending on the level of documentation needed for each agency's decision, the Forest Service and BLM may want to collect additional information on the soil classification. Although we did not have a wetlands delineation expert at our site visits, it appears there was general agreement between agencies that the soils in this fen area were more than 18 inches of peat. We also noted the "bounce" and hollow sound when walking over the fen area which are also indicative of peat.

7.5

5. There are sheep grazing in the fen area. This area is a good candidate for reducing or eliminating grazing during the upcoming reevaluating of grazing practices on the forest.

If you have any questions about these comments please contact Dana Allen at (303) 312-6870 or Mike Wireman at (303) is 312-6719. We appreciate your interest in our comments.

Sincerely,

Cynthia Cody
Director, NEPA Program
Office of Ecosystems Protection
and Remediation

cc: Mike Suflita, DOGM

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29 June 2001

Letter 9

Mr. Carter Reed
Manti-La Sal National Forest
599 West Price River Drive
Price, Utah 84501

Subject: DEIS Flat Canyon Coal Lease Tract

Mr. Reed:

We appreciate the opportunity to review the DEIS for the Flat Canyon Coal Lease Tract.

Over the past seven years, we have extensively studied the hydrogeology and assessed hydrologic impacts at coal mines in the Wasatch Plateau and Book Cliffs. We have been on the surface and underground at nearly every major mine in the area including SUFCO, Trail Mountain, Cottonwood, Deer Creek, Crandall Canyon, Bear Canyon, Star Point, Skyline, Willow Creek, Soldier Canyon, Dugout, and West Ridge. We have reviewed much of the historic data from the Huntington #4, Hiawatha, Castle Gate, Tower, and Sunnyside Mines. We have examined hundreds of discharge hydrographs for springs, creeks, wells, and mine inflows. We have evaluated thousands of chemical analyses and collected and interpreted hundreds of isotopic samples. We have written hundreds of pages describing groundwater and surface water resources and mining impacts in the region.

9.1 It has been our experience that coal mining in the Wasatch Plateau and Book Cliffs generally does not result in significant deleterious hydrologic effects. Most springs, creeks, and shallow wells that have been undermined by longwall mining have not been negatively impacted.

9.2 We encourage the Forest Service and BLM to rely upon the science that has been presented in the DEIS and give consideration to the fact that, historically, longwall coal mining in the region has resulted in only minimal hydrologic impacts. We believe that the information presented in the DEIS adequately demonstrates that impacts to creeks and springs will be negligible in the Flat Canyon Tract. Accordingly, we believe that Alternative B-prime, which allows the subsidence of perennial creeks, could be adopted without significant environmental consequences.

Regards,

Kelly Payne

Kelly Payne
Senior Hydrogeologist
NorWest Mine Services, Inc.
136 East South Temple, 12th Floor
Salt Lake City, Utah 84111

Erik Petersen
Senior Hydrogeologist
Petersen Hydrologic
2695 North 600 East
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THE HOPI TRIBE

Letter 8

Wayne Taylor, Jr.
CHAIRMAN

Phillip R. Quochytewa, Sr.
VICE-CHAIRMAN

May 29, 2001

Elaine J. Zieroth, Forest Supervisor
Manti-La Sal National Forest
599 West Price River Drive
Price, Utah 84501

Dear Supervisor Zieroth,

Thank you for your letter dated May 17, 2001 with the enclosed Draft Environmental Impact Statement for the Flat Canton Federal Coal Lease Tract. The Hopi Tribe claims cultural affiliation to prehistoric cultural groups in southern Utah, and therefore we appreciate your solicitation our input and your efforts to address our concerns.

The Hopi Cultural Preservation Office has reviewed *Flat Canyon Coal Lease Tract, Draft Environmental Impact Statement* which states that approximately 16% of the project area has been field inventoried, that cultural resource surveys are required, and that lithic scatters are the only prehistoric Native American sites known to occur in the project area.

The Hopi Tribe considers our ancestral villages, referred to as archaeological sites, to be Hopi Traditional Cultural Places. Other Hopi Traditional Cultural Places are associated with our ancestral and modern Villages, and include shrines, trails, rock markings, and traditional gathering places. Hopi people consider prehistoric archaeological sites and isolated occurrences to be the "footprints" of our ancestors. We do not consider our ancestral sites to be "abandoned."

Therefore, to assist us in determining if these area contain cultural resources significant to the Hopi Tribe, please provide us with copies of the cultural resources surveys of the areas of potential effect for review and comment. If you have any questions or need additional information, please contact Clay Hamilton at the Hopi Cultural Preservation Office. Thank you again for your consideration.

Respectfully,

Leigh J. Kuwanwisiwma, Director
Cultural Preservation Office

xc: Utah State Historic Preservation Office
Clay Hamilton, HCPO

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P.O. BOX 123 — KYKOTSMOVI, AZ — 86039 — (520) 734-3000

6.0 LIST OF PREPARERS AND REVIEWERS

6.1 LIST OF PREPARERS

The following is a list of personnel from the responsible agencies and cooperating agencies included on the project Interdisciplinary Team (IDT):

Carter Reed (IDT Leader). Forest Geologist, USDA Forest Service, Manti-La Sal National Forest, Forest Supervisor's Office, Price, Utah

Doug Jones. Environmental Coordinator, USDA Forest Service, Manti-La Sal National Forest, Forest Supervisor's Office, Price, Utah

Rodney Player. Forest Wildlife Biologist, USDA Forest Service, Manti-La Sal National Forest, Forest Supervisor's Office, Price, Utah

Katherine Foster. Forest Hydrologist, USDA Forest Service, Manti-La Sal National Forest, Forest Supervisor's Office, Price, Utah

Robert Davies. Fisheries Biologist, USDA Forest Service, Manti-La Sal National Forest, Forest Supervisor's Office, Price, Utah

Robert Thompson. Forest Botanist, USDA Forest Service, Manti-La Sal National Forest, Forest Supervisor's Office, Price, Utah

Bill Broadbear. District Recreation Specialist, USDA Forest Service, Manti-La Sal National Forest, Ferron/Price Ranger District, Price, Utah

Brent Barney. P.E. Civil Engineer, USDA Forest Service, Manti-La Sal National Forest, Forest Supervisor's Office, Price, Utah.

Martha DeFreest. P.E. Civil Engineer, USDA Forest Service, Manti-La Sal National Forest, Forest Supervisor's Office, Price, Utah

Stan McDonald. Forest Archaeologist, USDA Forest Service, Manti-La Sal National Forest, Forest Supervisor's Office, Price, Utah

Leigh Ann Hunt. District Archaeologist, USDA Forest Service, Manti-La Sal National Forest, Moab/Monticello Ranger District, Monticello, Utah

Brent Hanchett. Forest Landscape Architect, USDA Forest Service, Ashley National Forest, Forest Supervisor's Office, Vernal, Utah

Max Nielson. Economist-Coal Lease Specialist, USDI Bureau of Land Management, Utah State Office, Salt Lake City, Utah

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George Tetreault. Mining Engineer, USDI Bureau of Land Management, Price Field Office, Price, Utah

Stan Perks. Mining Engineer, USDI Bureau of Land Management, Utah State Office, Salt Lake City, Utah

Floyd McMullen Jr. Senior Environmental Project Manager, USDI Office of Surface Mining, Western Regional Coordinating Center, Denver, Colorado

6.2 Preparers of NorWest Mine Services, Inc. Project Technical Reports

James (Jim) Alto – Co-Project Manager – NorWest;
Conrad (Con) Houser – Co-Project Manager – NorWest;
Dr. Alan Newman – President and Geotechnical Engineer – AME;
Kelly Payne – Hydrogeologist – NorWest;
Timothy (Tim) Peterson – Senior Geotechnical Engineer – NorWest; and
Richard (Dick) Wright – Senior Mining Engineer – NorWest
Erik Petersen (Surface Water), Hydrologist, Mayo
Patrick Mullen, Senior Biologist, Maxim Technologies, Inc.
Randolph (Randy) Gainer – V.P. – Maxim Technologies, Inc

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Advance Mining: Exploitation in the same direction, or order of sequence, as development.

Affected Environment: Surface resources (including social and economic elements) within or adjacent to a geographic area that could potentially be affected by proposed activities. The environment of the area to be affected by the alternatives under consideration.

Air Quality Classes: Classifications established under the Prevention of Significant Deterioration portion of the Clean Air Act that limits the amount of air pollution considered significant within an area. Class I applies to areas where almost any change in air quality would be significant, Class II applies to areas where the deterioration normally accompanying moderate, well-controlled growth would be permitted, and Class III applies to areas where industrial deterioration would generally be allowed.

Alluvial Material: Material transported and deposited by running water in riverbeds, lakes, alluvial fans and valleys. Includes clay, silt, sand, gravel, and mud.

Alternative: A combination of management prescriptions applied in specific amounts and locations to achieve a desired management emphasis as expressed in goals and objectives. One of several policies, plans, or projects proposed for decision making. One alternative need not substitute for another in all respects.

Analysis Area: A delineated area of land subject to analysis.

Angle of draw: The angle of inclination from the vertical of the line connecting the edge of the workings and the edge of the subsidence area.

Animal Unit Month (AUM): The amount of forage necessary to sustain one cow and one calf or its equivalent for one month.

Aquatic Ecosystem: All organisms in a water-based community plus the associated environmental factors.

Aquatic Wildlife or Species: Animal species that inhabit and/or depend on the aquatic ecosystems for their life processes.

Aquifer: A layer of geologic material that contains water.

Attenuation: The ability of rocks and soils to transmit ground vibrations over distance. The energy or amount of vibration transmitted through rock decreases with increasing distance from the source. The amount of energy or vibration at a specific distance from the source is dependant on the magnitude of the source event, ability of specific materials to transmit the vibrations, and the distance from the source.

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Authorized Officer: Any employee of the Bureau of Land Management delegated the authority to perform the duty described in the section in which the term is used.

Barrier: A large pillar of coal designed to isolate production areas, including longwall or room-and- pillar panels.

Beneficial Use Standards:

Best Available Control Technology: The best available air pollution control technology for a given purpose as stipulated by the U.S. EPA.

Big Game Winter Range: The area available to and used by big game (large mammals normally managed for sport hunting) through the winter season.

Big Game: Larger species of wildlife that are hunted such as elk, deer, moose, and mountain lion.

Biological Diversity: The diversity or numbers of species that collectively represent the living plants and animals within a local, regional, or continental landscape.

Biological Evaluation (BE): A documented Forest Service activities in sufficient detail to determine how an action or proposed action may affect any threatened, endangered, proposed, or sensitive species.

Bleeders: A series of parallel and interconnected development entries partially surrounding longwall panels which provide ventilation and secondary access.

Bog: A peatland that accumulates organic material that are supported primarily by rainwater, have low miner and nutrient concentrations, are acidic, and are dominated by mosses, particularly peat mosses (*Sphagnum* species).

Bonus: That value in excess of the rentals and royalties that accrues to the United States because of coal resource ownership that is paid as part of the consideration for receiving a lease.

Browse: That part of the current leaf and twig growth of shrubs, wood vines, and trees available for animal consumption.

Buffer: A large block of coal left unmined to isolate the effects of underground workings.

Bureau of Land Management: The U.S. Department of the Interior agency responsible for managing most Federal government subsurface minerals. It has surface-management responsibility for Federal lands designated under the Federal Land Policy and Management Act of 1976.

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Bypass Coal: An isolated coal deposit that cannot, for the foreseeable future, be mined economically and in an environmentally sound manner either separately or as part of any mining operation other than that of the applicant for either an emergency lease under the provisions of 43 CFR 3425.1-4, or a lease modification.

Candidate Species: Any species not yet officially listed but that are undergoing a status review or are proposed for listing according to the *Federal Register* notices published by the Secretary of the Interior or the Secretary of Commerce.

Casual Use: Activities which do not ordinarily lead to any appreciable disturbance or damage to lands, resources or improvements, for example, activities which do not involve use of heavy equipment or explosives and which do not involve vehicle movement except over already established roads and trails.

Caving: The collapse of roof strata into mined workings.

CEQ: See Council on Environmental Quality.

Certificate of bidding rights: A right granted by the Secretary to apply the fair market value of a relinquished coal or other mineral lease or right to preference right coal or other mineral lease as a credit against the bonus bid or bids on a competitive lease or leases acquired at a lease sale or sales, or as a credit against the payment required for a coal lease modification.

Compression crack: A closed crack in the ground formed in an area of compressional stress.

Compression: Stress resulting in the contraction or "squeezing" of ground strata; opposite of tension.

Continuous miner method: A mining method which uses a single "continuous miner" machine to mechanically break and load coal for transportation. Single entries are mined at a time and are separated by pillars; used for development and room-and-pillar mining.

Contrast: The effect of a striking difference in the form, line, color, or texture of an area being viewed.

Council on Environmental Quality: An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews Federal programs for their affect on the environment, conducts environmental studies and advises the President on environmental matters.

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Critical Habitat: Specific areas within the geographical area occupied by the species on which are found those physical and biological features (1) essential to the conservation of the species; and (2) which may require special management considerations or protection. Critical habitat shall not include the entire geographic area which can be occupied by the threatened and endangered species.

Critical Subsidence: At some extraction width, the maximum depth of a critical subsidence basin no longer increases. The critical subsidence basin will have a pointed bottom similar to that of a subcritical subsidence basin.

Crucial Habitat: A biological feature that, if lost, would adversely affect the species.

Cultural Resources Inventory Classes:

Class I - An existing data survey. This is an inventory of a study area to (1) provide a narrative overview of cultural resources by using existing information; and (2) compile existing cultural resource site record data on which to base the development of the Forest's site record system.

Class II - A sampling field inventory designed to locate, from surface and exposed profile indications, all cultural resource sites within a portion of an area so that an estimate can be made of the cultural resources for the entire area.

Class III - An intensive field inventory designed to locate, from surface and exposed profile indicators, all cultural resource sites within a portion of an area.

Cultural Resources Inventory: A survey of existing data.

Cultural Resources: Those fragile and nonrenewable remains of human activity, occupation, or endeavor reflected in districts, sites, structures, buildings, objects, artifacts, ruins, works or art, architecture, and natural features that were or importance in human events.

Cumulative Impact: The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time.

Depth of cover: The thickness of ground from a coal seam to surface.

Developed Recreation Sites: Relatively small, distinctly defined areas where facilities are provided for concentrated public use (i.e., campgrounds, picnic areas, and swimming areas).

Developed Recreation: Recreation that occurs a man-made developments such as campgrounds, picnic grounds, resorts, ski areas, trailheads, etc.

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Development: The mining of initial entries for access, ventilation, etc. prior to full-scale production mining.

Differential subsidence: The difference in vertical subsidence between two locations.

Director: Director of the Bureau of Land Management.

Dispersed Recreation: That portion of outdoor recreation use that occurs outside of developed sites in the unroaded and roaded Forest environment (i.e., hunting, backpacking, and camping).

Displacement: As applied to wildlife, forced shifts in the patterns of wildlife use either in location or timing of use.

Distance Zone: The divisions of a landscape being viewed. Three zones are used to describe a landscape: foreground, middleground, background.

Diversity: (1) The relative abundance of wildlife species, plant species, communities, habitats, or habitat features per unit of area; or (2) The distribution and abundance of different plant and animal communities and species within the area covered by a Land Resource Management Plan (36 CFR Part 219.3).

Duration: The length of time the management activity and its impacts will be taking place.

Ecosystem: All organisms in a community plus the associated environmental factors.

Effects (also see Impacts):

Direct Effects - Caused by the action and occur at the same time and place.
Indirect Effects - Caused by the action later in time or farther removed in distance but still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related affects on air and water and other natural systems, including ecosystems.

Endangered Species: Any species in danger of extinction throughout all or a significant portion of its range.

Entry: An underground passage used for haulage or ventilation.

Environmental Analysis: An analysis of alternative actions and their predictable short and long-term environmental effects that include physical, biological, economic, social, and environmental design factors and their interactions.

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Environmental Assessment (EA): A concise public document prepared to provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a FONSI. It includes a brief discussion of the need for the proposal, alternatives considered, environmental impact of the proposed action and alternatives, and a list of agencies and individuals consulted. Prepared by the responsible Federal agency consistent with 40 CFR 1508.9.

Environmental Impact Statement (EIS): A formal public document prepared to analyze the impacts on the environment of the proposed project or action and released for comment and review. An EIS must meet the requirements of NEPA, CEQ guidelines, and directives of the agency responsible for the proposed project or action.

Erosion Hazard Ratings:

Slight - Potential soil loss rates do not exceed tolerance soil loss. Loss in soil production potential from erosion is of low probability.

Moderate - Potential soil loss rates exceed tolerance soil loss. Loss in soil production potential from erosion is probable and significant if unmitigated. On-site investigation by watershed specialists may be needed for activities in such areas.

High - Potential soil loss rates exceed tolerance soil loss. Loss in soil production potential from erosion is inevitable and irreversible if unmitigated. These soils may require expensive measures to control erosion and sedimentation when activities are planned for such areas. On-site investigation by watershed specialists is highly recommended.

Erosion Hazard: The probability of soil loss resulting from complete removal of vegetation and litter. It is an interpretation based on potential soil loss in relation to tolerance values. Soil loss tolerance rate: an estimate of erosion that could occur over a short period of time (one year) without causing irreparable damage to long-term productivity of the soil.

Erosion: (1) The wearing away of the land surface by running water, wind, ice, or other geological agents including such processes as gravitational creep; or (2) Detachment and movement of soil or rock fragments by water, wind, ice, or gravity.

Exotic: Foreign, not native

Exploration License: A license issued by the Authorized Officer to permit the licensee to explore for coal on unleased Federal lands.

Exploration plan: A detailed plan to conduct exploration; it shows the location and type of exploration to be conducted, environmental protection procedures, present and proposed roads, and reclamation and abandonment procedures to be followed upon completion of operations.

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Exploration: Drilling, excavating, and geological, geophysical or geochemical surveying operations designed to obtain detailed data on the physical and chemical characteristics of Federal coal and its environment including the strata below the Federal coal, overburden, and strata above the Federal coal, and the hydrologic conditions associated with the Federal coal.

Extraction ratio: The ratio of mined to unmined area within a defined area.

Face: The location of the longwall mining machine and active production mining within a longwall panel.

Fair Market Value: An amount in cash, or on terms reasonably equivalent to cash, for which in all probability the coal deposit would be sold or leased by a knowledgeable owner willing but not obligated to sell or lease to a knowledgeable purchaser who desires but is not obligated to buy or lease.

Federal Land Policy and Management Act of 1976 (FLPMA): Public Law 94-579 signed by the President on Management October 21, 1976. Established public land policy; to establish guidelines for its administration; to protect for the management, protection, development, and enhancement of the public lands; and for other purposes.

Federal Lands: Lands owned by the United States, without references to how the lands were acquired or what Federal agency administers the land, including surface estate, mineral estate and coal estate, but excluding lands held by the United States in trust for Indians, Aleuts or Eskimos.

Fen: A peatland that accumulates organic material that is supported primarily by water that has percolated through mineral materials (i.e., ground water) that have moderate to high levels of minerals and nutrients, have near-neutral pH, and are dominated by sedges (*Carex* species), grasses, and possibly willows (*Salix* species). Region 6 of the United States Fish and Wildlife Service has placed all functioning fens within Resource Category 1 of the Service's "Mitigation Policy" (January 20, 1999 policy memo from the Acting Director, Region 6, US Fish and Wildlife Service), meaning every reasonable effort should be made to avoid impacting them.

First-pass mining: First stage room-and-pillar production mining at a lower extraction ratio than subsequent second-pass mining; larger pillars are left than after second-pass mining.

Floodplain: The lowland and relatively flat area adjoining inland waters including, at a minimum, that area subject to a one percent or greater chance of flooding in any given year.

Forage: All browse and herbaceous foods that are available to grazing/browsing animals.

Forest Service (FS): The agency of the United States Department of Agriculture responsible for managing National Forests and Grasslands under the Multiple Use and Sustained Yield Act of 1960.

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Fossil: The remains or traces of an organism or assemblage of organisms that have been preserved by natural processes in the earth's crust exclusive of organisms that have been buried since the beginning of historical time.

Full-extraction mining: Complete extraction of the coal seam in the horizontal extent over a particular area; no pillars are left after mining.

Full-support mining: Mining that takes place leaving unmined pillars that adequately support the overburden and prevent subsidence from occurring.

Game Species: Any species of wildlife or fish for which seasons and bag limits have been prescribed and that are normally harvested by hunters, trappers, and fishermen under State or Federal laws, codes, and regulations.

Gateroad: A series of parallel development entries along both long sides of a longwall panel; entries are separated by either yield- and/or rigid-type pillars.

Gob: The term applied to that part of the mine from which the coal has been removed and the space has been filled up with waste rock.

Government Entity: A Federal or State agency or a political subdivision of a State, including a county or a municipality, or any corporation acting primarily as an agency or instrumentality of a State, which produces electrical energy for sale to the public.

Gradient: The slope (rise/run) of a surface or stream profile.

Habitat Type Group: A logical grouping of habitat types to facilitate resource planing and public presentations.

Habitat Type: An aggregation of all land areas potentially capable of producing similar plan communities at climax.

Habitat: A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

Horizontal strain: The change in length per unit of length of ground in the horizontal plane.

Human Environment: The factors that include, but are not limited to, biological, physical, social, economic, cultural, and aesthetic factors that interrelate to form the environment.

Impact (See Effects): The effect, influence, alteration, or imprint caused by an action.

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Indicator Species: A species of animal or plant whose presence is a fairly certain indications of a particular set of environmental conditions. Indicator species serve to show the effects of development actions on the environment.

Indirect Effects: Secondary effects that occur in locations other than the initial action or significantly later in time.

Intake: The passage through which fresh air is drawn or forced into a mine or to a section of a mine.

Interest in a lease, application or bid: Any record title interest, overriding royalty interest, working interest, operating rights or option, or any agreement covering such an interest; any claim or any prospective or future claim to an advantage or benefit from a lease; and any participation or any defined or undefined share in any increments, issues, or profits that may be derived from or that may accrue in any manner from the lease based on or pursuant to any agreement or understanding existing when the application was filed or entered into while the lease application or bid is pending. Stock ownership or stock control does not constitute an interest in a lease within the meaning of this definition. Attribution of acreage to stock within the meaning of this definition.

Invertebrate: An animal lacking a spinal column.

Irretrievable: Not retrievable, irrecoverable, incapable of being recovered or regained; not capable of being restored remedied or made good.

Irreversible: Not reversible; incapable of being reversed or altered. Not having the ability to change and then revert to the original state.

Key Wildlife Area: Any area that is critical to wildlife during at least a portion of the year. This importance may be due to vegetative characteristics such as residual nesting cover or behavioral aspects of the animals such as fawning/calving areas. Key areas included: winter ranges, lambing/fawning/calving areas, dancing/strutting grounds, nesting areas, breeding grounds, elk wallows, riparian and woody draws, and roosting areas.

Leaseable Minerals: Minerals acquired only by lease and generally include oil, gas, coal, oil shale, sodium, potassium, phosphate, native asphalt, solid and semi-solid bitumen, and deposits of sulfur.

Lease Bond: The bond or equivalent security given the Department to assure payment of all obligations under a lease, exploration license, or license to mine, and to assure that all aspects of the mining operation other than reclamation operations under a permit on a lease are conducted in conformity with the approved mining or exploration plan.

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Lease Modification Area: A proposed 150-acre lease modification to the Quitchupah Lease U-63214. Specifically located within Section 10, SE¼ NW¼, E½ SW¼, E½ E½ SW¼ SW¼, E½ E½ NW¼ SW¼, E½ E½ SW¼ NW¼, Township 21 South, Range 5 East (SLM).

Lease Stipulations: Additional specific terms and conditions that change the manner in which an operation may be conducted on a lease or modify the lease rights granted.

Lease: A Federal lease, issued under the coal leasing provisions of the mineral leasing laws, which grants the exclusive right to explore for and extract coal. In provisions of this group that also refer to Federal leases for minerals other than coal, the term Federal coal lease may apply.

License to mine: A license issued under the provisions of 43 CFR Part 3440 to mine coal for domestic use.

Licensee: The holder of an exploration license.

Logical Mining Unit Reserves: Recoverable coal reserves means the sum of estimated Federal and non-Federal recoverable coal reserves in the LMU.

Logical Mining Unit: An area of land in which the recoverable coal reserves can be developed in an efficient, economical, and orderly manner as a unit with due regard to conservation of recoverable coal reserves and other resources. An LMU may consist of one or more Federal leases and may include intervening or adjacent lands in which the United States does not own the coal. All lands in an LMU shall be under the effective control of a single operator/lessee, be able to be developed and operated as a single operation, and be contiguous.

Long-Term: Describes impacts that would occur over a 20-year period or more.

Longwall mining: A mining method in which large blocks of coal (panels), outlined by gateroad entries, are completely extracted in a single, continuous operation using a longwall mining machine.

Longwall move: The disassembly, transportation, and reassembly of a longwall mining machine at the end of a mined panel to the beginning of a new unmined panel.

Longwall panel: A rectangular block of coal bounded by development entries and fully mined (no pillars left) by a longwall mining machine.

Macroinvertebrates. Aquatic insects.

Main Entry: A main haulage road.

Mains: A series of parallel interconnected development entries providing primary access to production areas, ventilation, and transportation of mined coal.

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Management Indicator Species (MIS). Management Indicator Species (MIS) are a select group of wildlife species that can indicate change in habitat resulting from activities on the Forest. MIS species for the Manti-La Sal National Forest are elk, Mule deer, macroinvertebrates, Blue grouse, Golden eagle and Abert squirrel (FLRMP). With the exception of Abert Squirrels these species utilize the habitats found within the project area.

Maximum Credible Event (MCE): The greatest mining-induced seismic event or earthquake expected to be caused by mining in and adjacent to the project area.

Maximum Economic Recovery (MER): Based on standard industry operating practices, all profitable portions of a leased Federal coal deposit must be mined. At the times of MER determinations, consideration will be given to: existing proven technology; commercially available and economically feasible equipment; coal quality, quantity, and marketability; safety, exploration, operating, processing, and transportation costs; and compliance with applicable laws and regulations. The requirement of MER does not restrict the authority of the authorized officer to ensure the conservation of the recoverable coal reserves and other resources and to prevent the wasting of coal.

Mineable or Minable Coal: That portion of a coal seam that can be mined considering the physical and economic limitations of the mining method used. Estimates of mineable reserves consider all of the in-place coal that can be mined, but not necessarily produced from the mine. It is contrasted by the term "recoverable coal" which is the amount of coal that can be physically mined and removed from the mineable coal seam or area.

Mineral Leasing Laws: The Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.), and the Mineral Leasing Act for Acquired Lands of 1947, as amended (30 U.S.C. 351-359).

Mining height: The extracted height of a coal seam.

Mining-Induced Seismicity: Earthquakes or ground vibrations caused by underground coal mining and the resulting subsidence.

Mining Plan: A resource recovery and protection plan.

Mining Supervisor: The Authorized Officer.

Mining Unit: An area containing technically recoverable coal that will feasiblely support a commercial mining operation. The coal may either be Federal coal or be both Federal and non-Federal coal.

Mitigation: Includes:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

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(b) Minimizing impacts by limiting the degree of magnitude of the action and its implementation.
(c) Rectifying the impact of repairing, rehabilitating, or restoring the affected environment.
(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
(e) Compensating for the impact by replacing or providing substitute resources or environments.

Multiple-use: Management of the surface and subsurface resources so that they are jointly used in the manner that will best meet the present and future needs of the public without permanent impairment of the productivity of the land or the quality of the environment.

National Environmental Policy Act of 1969 (NEPA): Public Law 91-190. Established environmental policy for the nation. Among other items, NEPA requires Federal agencies to consider environmental values in decision-making processes.

National Forest Management Act (NFMA): A law passed in 1976 as amendments to the Forest and Rangeland Renewable Resources Planning Act that requires the preparation of Regional and Forest plans and the preparation of regulations to guide that development.

National Forest System: All National Forest Systems lands reserved or withdrawn from the public domain of the United States; all National Forest System lands acquired through purchase, exchange, donation, or other means the National Grasslands and land use projects administered under Title III of the Bankhead-Jones Farm Tenant Act (7 U.S.C. 1010 et seq.); and other lands, waters, or interests therein which are administered by the U.S.D.A. Forest Service or are designated for administration through the U.S.D.A. Forest Service as a part of the system (16 U.S.C. 1609).

National Register of Historic Places (NRHP): A listing of architectural, historical, archaeological, and cultural sites of local, state, or national significance established by the Historic Preservation Act of 1966.

NEPA: See National Environmental Policy Act of 1969.

No Action Alternative: No action or activity would take place. Another definition is where ongoing programs described within the existing Land Management Plan continue. No decision would be made and no leases would be offered.

Nongame Species: Species of animals that are not managed as a sport hunting/fishing resource.

Nonpoint Source Pollution: Sources from which the pollutants discharged are:
(1) induced by natural processes, including precipitation, seepage, percolation, and runoff;

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(2) not traceable to any discrete or identifiable facility; and
(3) better controlled through the use of Best Management Practices, including process and planning techniques. This includes natural pollution sources not directly or indirectly caused by man.

Noxious Weeds: Rapidly spreading plants that cause a variety of major ecological impacts to both agriculture and wild lands.

Numerical (subsidence) model: A mathematical description of subsidence phenomena solved by computer, used for the prediction of ground surface deformation from mining.

Off-Road Vehicle (ORV): Any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, snow, ice, marsh, swampland or other natural terrain. It includes, but is not limited to, four-wheel drive or low-pressure-tire vehicles, motorcycles and related two-wheel vehicles, amphibious machines, ground-effect or air-cushion vehicles.

Operator: A lessee, exploration licensee or one conducting operations on a lease or exploration license under the authority of the lessee or exploration licensee.

Overburden: The geologic strata overlying a coal seam.

Overstory: The portion of a plant community consisting of the taller plants on the site; the forest or woodland canopy.

Panel centerline: The horizontal line running central and parallel to the long axis of a longwall panel.

Panel: A coal mining block that generally comprises one operating unit.

Partial-extraction mining: Incomplete extraction of the coal seam where pillars are left after mining.

Particulates: Small particles suspended in the air and generally considered pollutants.

Peak Particle Acceleration (g): A measure of ground vibration at a specific point, measured in gravity units (g). Conversion from Peak Particle Acceleration (PPA) in gravitational units to Peak Particle Velocity (PPV) for sinusoidal vibrations can be carried out using the formula (Dowding, 1985): PPV = (PPA x 386.4)/(2 x ⑥ x Frequency in Hz).

Peak Particle Velocity (PPV): A measure of ground vibration at a specific point, measured in inches per second.

Peatland: A wetland that accumulates organic material and are classified as either bogs or fens.

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Permanent strain: Ground strain that remains after the completion mining.

Phreatophyte2-14: A long-rooted plant that absorbs its water from the water table or other permanent water source.

Portal: The structure surrounding the immediate entrance to a mine.

Prehistoric Site: Archaeological sites associated with American Indians and usually occurring before contact with Europeans.

Prevention of Significant Deterioration (PSD): A classification established to preserve, protect, and enhance the air quality in National Wilderness Preservation System areas in existence prior to August 1977 and other areas of National significance while ensuring economic growth can occur in a m anner c onsistent w ith t he p reservation o f e xisting c lean a ir r esources. S pecific emission limitations and other measures, by class, are detailed in the Clean Air Act (42 U.S.C. 1875, et seq.).

Production mining: F ull-scale m ining f ollowing t he init ial m ining o f access (development) entries; in contrast to development mining.

Project Area: The area of analysis including the Flat Canyon Tract a rea and a djacent non-Federal surface and coal estates that could be mined as a result of potential leasing and mining of the Flat Canyon Coal Lease Tract.

Public Bodies: Federal and State agencies; political subdivision of a state, including counties and municipalities; rural electric cooperatives and similar organizations; and nonprofit corporations controlled by any such entities.

Range Allotment: A designated area of land available for livestock grazing upon which a specified number and kind of livestock may be grazed under an allotment management plan. It is the basic land unit used to facilitate management of the range resource on National Forest System lands administered by the U.S.D.A. Forest Service.

Rare Plants: A plant species, or subspecies, that is limited to a restricted geographic range or one that occurs sparsely over a wider area.

Reasonably Foreseeable Development Scenario (RFDS): The prediction of the most likely future coal mining actions in the project area that would likely result from the proposed action.

Reclamation: Returning disturbed lands to a form and productivity that will be ecologically balanced and in conformity with a predetermined land management plan.

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Record of Decision (ROD): A document separate from, but associated with, an environmental impact statement that publicly and officially discloses the responsible official's decision on the proposed action.

Recoverable Coal: The amount of coal that can actually be mined and transported from a coal seam or area after leaving pillars for support of operations.

Recreation Opportunity Spectrum (ROS): Land delineations that identify a variety of recreation experience opportunities in six classes along a continuum from primitive to urban. Each class is defined in terms of natural resource settings, activities and experience opportunities. The six classes are: Urban, Rural, Roaded, Natural, Semiprimitive Motorized, Semiprimitive Nonmotorized, and Primitive.

Reserves: Recoverable Coal Reserves.

Restore: To bring back landscape to a former or original condition or appearance.

Retreat: Production mining following initial development of access entries in a coal seam.

Retreating Mining: Exploitation in the direction opposite from development.

Return: The air of ventilation that as passed through all the working faces of a split.

Revegetation: The reestablishment and development of self-sustaining plant cover. On disturbed sites, this normally requires human assistance such as seed bed preparation, reseeding, and mulching.

Richter Scale: A scale by which the magnitude of earthquakes or ground vibrations are measured, generally ranging from 0 to 10 with 10 being the highest magnitude.

Rigid (abutment) pillar: A coal pillar designed to remain intact and provide complete load-bearing capacity throughout the course of mining.

Riparian Ecosystem: A transition between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetation communities that require free or unbound water.

Riparian: Riparian areas consist of terrestrial and aquatic ecosystems, those lands in a position to directly influence water quality and water resources, whether or not free water is available. This would include all lands in the active flood channel and lands immediately upslope of stream banks. These areas may be associated with lakes, reservoirs, estuaries, potholes, marshes, streams, bogs,, wet meadows, and intermittent or permanent streams where free and unbound water is available.

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Roaded, Natural (RN): A recreation opportunity classification term describing a land area that has been predominately a natural appearing environment with moderate evidence of sights and sounds of humans. Concentration of users is moderate to low. Roads of better than primitive class are usually with 0.5 mile. A broad range of motorized and nonmotorized activity opportunities are available. Management activities, including timber harvest, are present and harmonize with the natural environment.
Roadless: Refers to the absence of roads that have been constructed and maintained by mechanical means to ensure regular and continuous use.

Room-and-pillar mining: A mining method by which coal is extracted over large areas from a network of entries separated by pillars.

Rosgen Classification System: A method for classifying different stream types.

Scenic Quality Classes: The designation (A, B, or C) assigned a scenic quality rating unit to indicate the visual importance or quality of a unit relative to other units within the same physiographic province.

SCLS (Special Coal Lease Stipulations). Statements included in Section of Section 15 of BLM's standard coal lease form (Form 3400-12) that require specific actions or measures to be met by the lessee regarding actions for lease administration or development.

Scoping Process: An early and open public participation process for determining particular issues to be addressed in an environmental document and for identifying the significant issues related to a proposed action.

Second-pass mining: Final stage room-and-pillar production mining following first-pass mining; higher extraction ratios than first-pass mining are achieved by partial to full mining of remnant first- pass coal pillars.

Secretary: Secretary of the Interior.

Seismicity: The degree to which a region of the earth is subject to earthquakes.

Sensitive Species: Plant or animal species that are susceptible or vulnerable to activity impacts or habitat alterations and have been identified for monitoring and measures to prevent them from being listed as Threatened or Endangered.

Significant: An effect that is analyzed in the context of the proposed action to determine the importance of the effect either beneficial or adverse. The degree of significance is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment and when the affects on the quality of the human environment are likely to be highly controversial.

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Small Game: Birds and small mammals normally hunted or trapped.

Sole Part in Interest: A party who is and will be vested with all legal and equitable rights under a lease, bid, or an application for a lease. No one is a sole party in interest with respect to a lease or bid in which any other party has any interest.

Special Coal Lease Stipulations: Statements included in Section of Section 15 of BLM's standard coal lease form (Form 3400-12) that require specific actions or measures to be met by the lessee regarding actions for lease administration or development.

Split Estate: Land in which the ownership of the surface is held by persons, including governmental bodies, other than the Federal government and the ownership of underlying coal is, in whole or in part, reserved to the Federal government.

Sterilization: Rendering coal resources unmineable.

Stipulation: A provision that modifies standard lease right and is attached to and made a part of the lease.

Strain: Change in length per unit of length; a measure of ground deformation.

Stress: The force per unit area (also pressure), or intensity of forces distributed over a given area, responsible for deforming and fracturing ground strata.

Subcritical S ubsidence: Refers to the subsidence basin that occurs when the width of the extraction area is relatively small compared to the depth of cover. For a subsidence basin of subcritical width the bottom of the basin is pointed and the maximum subsidence at the center of the basin increases with increasing width of extraction.

Subsidence: The deformation of the ground mass above an underground mine and the resulting lowering of the ground surface. This occurs as the rock immediately above the void left by mining caves and the overlying rock layers adjust to the loss of support.

Substantial legal and financial commitments: Significant investments that have been made on the basis of a long-term coal contract in power plants, railroads, coal handling and preparation, extraction or storage facilities and other capital intensive activities. Cost of acquiring the coal in place or of the right to mine it without an existing mine are not sufficient to constitute substantial legal and financial commitments.

Supercritical Subsidence: Refers t o t he s ubsidence b asin t hat o ccurs w hen t he w idth o f t he extraction a rea b ecomes s o l arge t hat t he b ottom o f t he s ubsidence b asin b ecomes flat. T he maximum subsidence in a supercritical basin is equal to the maximum subsidence in a critical basin.

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Surface coal mining operations: Activities conducted on the surface of lands in connection with a surface coal mine or surface operations and surface impacts incident to an underground mine.

Surface Management Agency: The Federal agency with jurisdiction over the surface of federally owned lands containing coal deposits, and, in the case of private surface over Federal coal, the Bureau of Land Management, except in areas designated as National Grasslands, where it means the Forest Service.

Tension crack: A crack (typically open) in the ground formed in an area of tensional stress.

Tension: Stress resulting in the elongation or "stretching" of ground strata; opposite of compression.

Threatened And Endangered Species: Definitions: Federal codes are defined as follows:

Endangered (E): Any species that is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the ESA would present an overwhelming and overriding risk to man.

Threatened (T): Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Candidate Species (C): Status review taxa for which the USFWS currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list the taxa as an endangered or threatened species.

Forest Service Sensitive: Those plant and animal species identified by a Regional Forester for which population viability is a concern as evidenced by: (a) significant current or predicted downward trends in population numbers or density or (b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Total Dissolved Solids (TDS): Salt or an aggregate of carbonates, bicarbonates, chlorides, sulfates, phosphates, and nitrates of calcium, magnesium, manganese, sodium, potassium, and other cations that form sales that are dissolved or present in water.

Transient strain: Ground strain of a temporary or ephemeral duration, as opposed to permanent strain.

Valid existing rights: (a) Except for haul roads, that a person possesses valid existing rights for an area protected under section 522(e) of the Act on August 3, 1977, if the application of any of the prohibitions contained in that section to the property interest that existed on that date would effect a taking of the person's property which would entitle the person to just compensation under the Fifth and Fourteenth Amendments to the United States Constitution; (b) For haul roads, (1) A recorded right of way, recorded easement or a permit for a coal haul road recorded as of August 3, 1977, or (2) Any other road in existence as of August 3, 1977; (c) A person

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possesses valid existing rights if the person proposing to conduct surface coal mining operations can demonstrate that the coal is both needed for, and immediately adjacent to, an ongoing surface coal mining operation which existed on August 3, 1977. A determination that coal is ``needed for" will be based upon a finding that the extension of mining is essential to make the surface coal mining operation as a whole economically viable; (d) Where an area comes under the protection of section 522(e) of the Act after August 3, 1977, valid existing rights shall be found if-- (1) On the date the protection comes into existence, a validly authorized surface coal mining operation exists on that area; or (2) The prohibition caused by section 522(e) of the Act, if applied to the property interest that exists on the date the protection comes into existence, would effect a taking of the person's property which would entitle the person to just compensation under the Fifth and Fourteenth Amendments to the United States Constitution. (e) Interpretation of the terms of the document relied upon to establish the rights to which the standard of paragraphs (a) and (d) of this section applies shall be based either upon applicable State statutory or case law concerning interpretation of documents conveying mineral rights or, where no applicable State law exists, upon the usage and custom at the time and place it came into existence.

Vertebrate: An animal having a spinal column.

Visual Quality Objectives (VQO): Based upon variety class, sensitivity level, and distance zone determinations. Each objective describes a different level of acceptable alteration based on aesthetic importance. The degree of alteration is based on contrast with the surrounding landscape.

Preservation: In general, human activities are not detectable to the visitor.
Retention: Human activities are not evident to the casual Forest visitor.
Partial Retention: Human activities may be evident, but must remain subordinate to the characteristic landscape.
Modification: Human activity may dominate the characteristic landscape, but must, at the same time, use naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in middleground or background.
Maximum Modification: Human activity may dominate the characteristic landscape but should appear as a natural occurrence when viewed as background.
Enhancement: A short-term management alternative that is completed with the express purpose of increasing positive visual variety where little variety now exists.

Visual Resource: The composite of basic terrain, geologic features, water features, vegetative patterns, and land use effects that typify a land unit and influence the visual appeal of the unit.

Wetlands: Lands where saturation with water is the primary factor determining the nature of soil development and the kinds of animal and plant communities living under or on it surface.

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Written Consent: The document or documents that a qualified surface owner has signed that: 1) permit a coal operator to enter and commence surface mining of coal, 2) describe any financial or other consideration given or promised in return for the permission, including in-kind considerations, 3) describe any consideration given in terms of type or method of operation or reclamation for the area, 4) contain any supplemental or related contracts between the surface owner and any other person who is a party to the permission, and 5) contain a full and accurate description of the area covered by the permission.

Yield pillar: A coal pillar design to crush controllably under loading.

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APPENDIX A

TABLES
OF
PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS

PAST ACTIONS	IMPLEMENTATION DATES (Begin and End)	RESIDUAL EFFECTS
MINERALS/ENERGY Coal Exploration Drill Holes. All old holes with the exception of water monitoring wells in the current permit area have been plugged and reclaimed. Drill hole access roads have been reclaimed.	1900-present	Vegetation well established but slight benches on slopes still visible. All modern roads (1980 to present) have been recontoured and revegetated. Roads and pads reclaimed within the last 5 years still visible because of more grasses and less brush.
Oil and Gas Drilling. Several wells drilled in 1950s.	1950s	Pads and roads reclaimed and revegetated. Slight topographic change apparent.
Anschutz Ridge Runner #13-17 Wildcat Well pad constructed in 1998 and Monument Peak Road (FR 50018) reconstructed and graveled. Pad was reclaimed in 2000 without drilling.	1998-2000	Site reconstructed and drilled as discussed below. See residual effects below.

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PAST ACTIONS	IMPLEMENTATION DATES (Begin and End)	RESIDUAL EFFECTS
Mike Davis/PDC Ridge Runner #13-17 and #11-20 drilled during on Trough Springs Ridge in 2001 field season. Reclaimed pad for #13-17 discussed above was reconstructed for this project.	2001	Drilling completed and wells will be plugged and abandoned during 2002 field season. Approximately 5 acres of vegetation removed. Otherwise negligible effects due to sediment control. Sites visible but consistent with VQO.
Questar Mainline 41 Gas Transmission Pipeline This 18 inch buried pipeline traverses the Skyline Mine Permit Area in a northwest-southeast direction along Trough Springs Ridge. Constructed in the 1950s. A segment was relocated to the southwest in 1990 to avoid mine subsidence areas. This segment followed Burnout Canyon to Upper Huntington Creek, crosses the creek, then turns north under State Route 264. It turns east near the head of the Canyon and climbs the slope back to Trough Springs Ridge. This segment was deactivated in 2000 and the original segment on Trough Springs Ridge was replaced.	1950 to present 1990	Original pipeline corridor is visible due to removal of overstory vegetation. Understory vegetation has been restored. Replaced segment of old corridor has been seeded and is being monitored for success. Segment constructed in 1990 is now abandoned. All areas recontoured and revegetated to standard. Slightly visible in Burnout Canyon and Upper Huntington Canyon slope due to immature sagebrush and more grasses.
Questar Mainline 104 constructed along the existing corridor of the existing Questar Mainline #41 18 inch pipeline along Trough Springs Ridge approximately 1 mile east of the Flat Canyon Tract.	2001	Existing pipeline corridor widened from 75 feet to 125 feet. Vegetation removed. Disturbance reclaimed but understory vegetation not established. Human activity was intense during 2001 field season. It would take up to 5 years to reestablish vegetation. Erosion and sediment production minimized by best management practices. Visibility of the existing corridor increased because of the increased width.

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PAST ACTIONS	IMPLEMENTATION DATES (Begin and End)	RESIDUAL EFFECTS
TIMBER		
Historic timber cutting on private lands. Historic sawmill sites on private lands in canyons.	1850-1960	Sawmill sites. Residual conversion from timber to understory.
A conifer timber sale occurred at the head of the North Fork of Boulger Creek. In addition, aspen were cut in an effort to reactivate growth of the decadent stand. Approximately 10,000 board-feet of timber was cut.	Early 1960s	The road constructed for the sale has been retained on the road system as a Forest Road open to use by the public. Understory vegetation reestablished but aspen have not been restored.
RANGELAND/WATERSHED/VEGETATION		
Livestock Grazing, Historic Dairy sites on private lands in Flat Canyon within project area.	1850 – present	Changes in species compositions. Non-native species introduced.
Unclassified spur roads on Trough Springs Ridge reclaimed (approx. 3 miles).	1998	Some portions or roads successfully closed and revegetated. Unauthorized use continuing resulting in less revegetation than adjacent undisturbed areas.
Watershed revegetation project (200 acres) in the area between Flat Canyon and Boulger Canyon near the confluence.	1990	Vegetation has been reestablished in accordance with standards/objectives.
Noxious Weeds - Noxious weeds have been introduced due to surface disturbing activities and have become established, musk thistle, whitetop, Canada thistle and yellow toadfax	unknown	Noxious weed species outcompete native species and change species composition.

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PAST ACTIONS	IMPLEMENTATION DATES (Begin and End)	RESIDUAL EFFECTS
WILDLIFE None	NA	NA
TRANSPORTATION Forest roads and private roads developed for grazing, recreation, timber operations, private land access.	1870-present	Removal of vegetation and establishment of disturbed roadway. Human activity during summer seasons when roads are open. Snowmobile activity in winter.
Monument Peak Road (FR 50018) reconstructed for oil and gas and pipeline construction activity (see Minerals/Energy))	1998 - 2001	Roadway stabilized and decreased sediment. Construction activity intense during field season that displaced recreation activities to adjacent areas. Road closed after heavy snows in December until after July 4 weekend.
RECREATION See Present Actions		

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PRESENT ACTIONS	DATE	CURRENT EFFECTS
MINERALS/ENERGY Skyline Mine. Portal facilities located in Eccles Canyon and Permit Area lies directly east of the project area. Permit Area - T. 13 S., R. 6 E., SLM Sections 10, 11, 13, 14, 22-27, 34, and 35 Portal Facilities - T.13 S., R. 6 E., SLM Sections 13 and 24. Loadout Facilities - T. 13 S., R. 7 E., SLM Section 17 Pipelines, Gas Wells - See past actions	Mine construction began in 1980. Coal production from 1981 to present.	Portal facilities have disturbed approximately 47 acres in Eccles Canyon on National Forest System lands. Loadout facilities and the waste rock disposal area have disturbed approximately 24 acres on private lands at mouth of Eccles Canyon and near Scofield. The Permit Area subject to underground mining encompasses approximately 6,400 acres. Detailed discussion of subsidence, mine water discharge, and effects in FEIS text in Chapters 3 and 4. Monitoring of past, current actions used as baseline for prediction of effects in project area.
TIMBER Salvage timber cutting occurring on private lands east of the Flat Canyon Tract	Present	Removal of timber. Disturbance to vegetation and avoidance of wildlife in activity areas during operations. Truck traffic on roads. .
RANGELANDWATERSHED/VEGETATION Continued sheep grazing on allotments. No developed range facilities. Current range management designed to decrease effects. Noxious Weeds: Noxious weed treatment is occurring	Present Present	Continued grazing and associated limitation of vegetation densities. Riparian areas have improved and conditions are considered to be good to excellent on NFS lands. Some portions on private lands below Forest boundary in poor condition. Decreased noxious weed species densities and potential for

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PRESENT ACTIONS	DATE	CURRENT EFFECTS
throughout the project area to decrease density and spreading.		spread.
WILDLIFE	None	None
TRANSPORTATION Continued use and maintenance of Forest Roads and private roads. See Future Actions	Present	See Future Actions
RECREATION Dispersed recreation activities include hiking, motorized sight-seeing, camping, hunting, snowmobiling, and cross-country skiing. Recreation facilities include Boulger Reservoir, Flat Canyon Campground, and summer homes/cabins on private lands. See Recreation Section in Chapter 3 of EIS.	Present Present	Year-round human activity. Decreased vegetation density and erosion of some areas where unauthorized motorized vehicle use occurring. Surface disturbance and human activity and occupation. Includes year-round use of buildings on private lands.

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FUTURE ACTIONS	DATE	ANTICIPATED EFFECTS
MINERALS/ENERGY		
Liquid Petroleum Products Pipeline – Williams has proposed to construct a 10 inch pipeline to transfer gasoline, diesel fuel, and jet fuel across the Wasatch Plateau. The proposed corridor is along the same corridor as the Questar Gas Pipeline. Alternative routes are being considered in the EIS.	2002-2003	If approved, the existing Mainline 41, 104 pipeline corridor could be widened from 125 feet to 175 feet. The construction activity could take place during the 2002 and/or 2003 field seasons. Intense human activity along the corridor and increased traffic on SR-264 (50 trips/day) during construction season. Best Management Practices minimize sediment production.
Oil and Gas Exploration - No new wells proposed. Two to four wells reasonably foreseeable.	Unknown	If proposed and drilled 1.5 acres disturbance per site. Best Management Practices would be used. Would be consistent with Forest Plan objectives and sediment would be negligible.
TIMBER	None	None
RANGELAND/WATERSHED/VEGETATION		
Continued grazing in Sheep and Goat Allotments. Approximately 2000 Animal Unit Months. Managed under Deferred Grazing System.	Indefinite	Continued effects to vegetation including riparian vegetation in canyon bottoms. Monitoring of vegetation conditions is used to determine grazing use so effects are minimized. Riparian conditions are improving.
Noxious weed treatment will continue indefinitely.	Indefinite	Noxious weed densities and spreading rates should be decreased.
TRANSPORTATION		
Road maintenance	Indefinite	Continued sediment production from native surface roads even with annual maintenance.

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FUTURE ACTIONS	DATE	ANTICIPATED EFFECTS
Potential construction of new roads on private lands for access to new cabins. (See Recreation).	Indefinite	See Recreation
Reconstruction and gravel surfacing of South Trough Springs Road (FR 50018). See Minerals Section	2001-Indefinite	Decreased erosion and sediment production from roadway. Road surface stabilized by gravel surface. Road closed from December 1 through July 5th.
RECREATION Improvement and maintenance of existing developed recreation sites such as Flat Canyon Campground and Boulger Dam.	Indefinite	Increased use of facilities due to population growth and demand for recreation opportunities. Increased human activity in the area year-round.
Improvement of existing cabins and construction of new cabins on private lands. Potential for construction of new private roads for access to these facilities.	Indefinite	Increased land disturbance and year-round human presence and activity.

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BUREAU OF LAND MANAGEMENT
COAL LEASE FORM 3400-12

The terms and conditions on this form would be used on all coal leases, including Alternatives B, B', C, and others if designated and selected.

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Form 3400-12
(April 1984)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

COAL LEASE

Serial Number

PART I. LEASE RIGHTS GRANTED

This lease, entered into by and between the UNITED STATES OF AMERICA hereinafter called lessor, through the Bureau of Land Management, and *(Name and Address)*

hereinafter called lessee, is effective *(date)* . for a period of 20 years and for so long thereafter as coal is produced in commercial quantities from the leased lands, subject to readjustment of lease terms at the end of the 20th lease year and each 10-year period thereafter.

Sec. 1. This lease is issued pursuant and subject to the terms and provisions of the:

☒ Mineral Lands Leasing Act of 1920, Act of February 25, 1920, as amended, 41 Stat. 437, 30 U.S.C. 181-287, hereinafter referred to as the Act;

☐ Mineral Leasing Act for Acquired Lands, Act of August 7, 1947, 61 Stat. 913, 30 U.S.C. 351-359;

and to the regulations and formal orders of the Secretary of the Interior which are now or hereafter in force, when not inconsistent with the express and specific provisions herein.

Sec. 2. Lessor, in consideration of any bonuses, rents, and royalties to be paid, and the conditions and covenants to be observed as herein set forth, hereby grants and leases to lessee the exclusive right and privilege to drill for, mine, extract, remove, or otherwise process and dispose of the coal deposits in, upon, or under the following described lands:

SEE ATTACHED DESCRIPTION

ntaining acres, more or less, together with the right to construct such works, buildings, plants, structures, equipment and appliances d the right to use such on-lease rights-of-way which may be necessary and convenient in the exercise of the rights and privileges granted, subject to e conditions herein provided.

ART II TERMS AND CONDITIONS

Sec. 1. (a) RENTAL RATE - Lessee shall pay lessor rental annually and in advance for each acre or fraction thereof during the continuance of the lease at the rate of $ for each lease year.

(b) RENTAL CREDITS - Rental shall not be credited against either production or advance royalties for any year.

Sec. 2. (a) PRODUCTION ROYALTIES - The royalty shall be per-cent of the value of the coal as set forth in the regulations. Royalties are due to lessor the final day of the month succeeding the calendar month in which the royalty obligation accrues.

(b) ADVANCE ROYALTIES - Upon request by the lessee, the authorized officer may accept, for a total of not more than 10 years, the payment of advance royalties in lieu of continued operation, consistent with the regulations. The advance royalty shall be based on a percent of the value of a minimum number of tons determined in the manner established by the advance royalty regulations in effect at the time the lessee requests approval to pay advance royalties in lieu of continued operation.

Sec. 3. BONDS - Lessee shall maintain in the proper office a lease bond in the amount of $. The authorized officer may require an increase in this amount when additional coverage is determined appropriate.

Sec. 4. DILIGENCE - This lease is subject to the conditions of diligent development and continued operation, except that these conditions are excused when operations under the lease are interrupted by strikes, the elements, or casualties not attributable to the lessee. The lessor, in the public interest, may suspend the condition of continued operation upon payment of advance royalties in accordance with the regulations in existence at the time of the suspension. Lessee's failure to produce coal in commercial quantities at the end of 10 years shall terminate the lease. Lessee shall submit an operation and reclamation plan pursuant to Section 7 of the Act not later than 3 years after lease issuance.

The lessor reserves the power to assent to or order the suspension of the terms and conditions of this lease in accordance with, inter alia, Section 39 of the Mineral Leasing Act, 30 U.S.C. 209.

Sec. 5. LOGICAL MINING UNIT (LMU) - Either upon approval by the lessor of the lessee's application or at the direction of the lessor, this lease shall become an LMU or part of an LMU, subject to the provisions set forth in the regulations.

The stipulations established in an LMU approval in effect at the time of LMU approval will supersede the relevant inconsistent terms of this lease so long as the lease remains committed to the LMU. If the LMU of which this lease is a part is dissolved, the lease shall then be subject to the lease terms which would have been applied if the lease had not been included in an LMU.

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Sec. 6 DOCUMENTS, EVIDENCE AND INSPECTION - At such times and in such form as lessor may prescribe, lessee shall furnish detailed statements showing the amounts and quality of all products removed and sold from the lease, the proceeds therefrom, and the amount used for production purposes or unavoidably lost.

Lessee shall keep open at all reasonable times for the inspection of any duly authorized officer of lessor, the leased premises and all surface and underground improvements, works, machinery, ore stockpiles, equipment, and all books, accounts, maps, and records relative to operations, surveys, or investigations on or under the leased lands.

Lessee shall allow lessor access to and copying of documents reasonably necessary to verify lessee compliance with terms and conditions of the lease.

While this lease remains in effect, information obtained under this section shall be closed to inspection by the public in accordance with the Freedom of Information Act (5 U.S.C. 552).

Sec. 7. DAMAGES TO PROPERTY AND CONDUCT OF OPERATIONS - Lessee shall comply at its own expense with all reasonable orders of the Secretary, respecting diligent operations, prevention of waste, and protection of other resources.

Lessee shall not conduct exploration operations, other than casual use, without an approved exploration plan. All exploration plans prior to the commencement of mining operations within an approved mining permit area shall be submitted to the authorized officer.

Lessee shall carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health, or property, and prevention of waste, damage or degradation to any land, air, water, cultural, biological, visual, and other resources, including mineral deposits and formations of mineral deposits not leased hereunder, and to other land uses or users. Lessee shall take measures deemed necessary by lessor to accomplish the intent of this lease term. Such measures may include, but are not limited to, modification to proposed siting or design of facilities, timing of operations, and specification of interim and final reclamation procedures. Lessor reserves to itself the right to lease, sell, or otherwise dispose of the surface or other mineral deposits in the lands and the right to continue existing uses and to authorize future uses upon or in the leased lands, including issuing leases for mineral deposits not covered hereunder and approving easements or rights-of-way. Lessor shall condition such uses to prevent unnecessary or unreasonable interference with rights of lessee as may be consistent with concepts of multiple use and multiple mineral development.

Sec. 8. PROTECTION OF DIVERSE INTERESTS AND EQUAL OPPORTUNITY - Lessee shall: pay when due all taxes legally assessed and levied under the laws of the State or the United States; accord all employees complete freedom of purchase; pay all wages at least twice each month in lawful money of the United States; maintain a safe working environment in accordance with standard industry practices; restrict each workday to not more than 8 hours in any one day for underground workers, except in emergencies; and take measures necessary to protect the health and safety of the public. No person under the age of 16 years shall be employed in any mine below the surface. To the extent that laws of the State in which the lands are situated are more restrictive than the provisions in this paragraph, then the State laws apply.

Lessee will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and the rules, regulations, and relevant orders of the Secretary of Labor. Neither lessee nor lessee's subcontractors shall maintain segregated facilities.

Sec. 9. (a) TRANSFERS -

☒ This lease may be transferred in whole or in part to any person, association or corporation qualified to hold such lease interest.

☐ This lease may be transferred in whole or in part to another public body or to a person who will mine the coal on behalf of, and for the use of, the public body or to a person who for the limited purpose of creating a security interest in favor of a lender agrees to be obligated to mine the coal on behalf of the public body.

☐ This lease may only be transferred in whole or in part to another small business qualified under 13 CFR 121.

Transfers of record title, working or royalty interest *must* be approved in accordance with the regulations.

(b) RELINQUISHMENT - The lessee may relinquish in writing at any time all rights under this lease or any portion thereof as provided in the regulations. Upon lessor's acceptance of the relinquishment, lessee shall be relieved of all future obligations under the lease or the relinquished portion thereof, whichever is applicable.

Sec. 10. DELIVERY OF PREMISES, REMOVAL OF MACHINERY, EQUIPMENT, ETC. - At such time as all portions of this lease are returned to lessor, lessee shall deliver up to lessor the land leased, underground timbering, and such other supports and structures necessary for the preservation of the mine workings on the leased premises or deposits and place all workings in condition for suspension or abandonment. Within 180 days thereof, lessee shall remove from the premises all other structures, machinery, equipment, tools, and materials that it elects to or as required by the authorized officer. Any such structures, machinery, equipment, tools, and materials remaining on the leased lands beyond 180 days, or approved extension thereof, shall become the property of the lessor, but lessee shall either remove any or all such property or shall continue to be liable for the cost of removal and disposal in the amount actually incurred by the lessor. If the surface is owned by third parties, lessor shall waive the requirement for removal, provided the third parties do not object to such waiver. Lessee shall, prior to the termination of bond liability or at any other time when required and in accordance with all applicable laws and regulations, reclaim all lands the surface of which has been disturbed, dispose of all debris or solid waste, repair the offsite and onsite damage caused by lessee's activity or activities incidental thereto, and reclaim access roads or trails.

Sec. 11. PROCEEDINGS IN CASE OF DEFAULT - If lessee fails to comply with applicable laws, existing regulations, or the terms, conditions and stipulations of this lease, and the noncompliance continues for 30 days after written notice thereof, this lease shall be subject to cancellation by the lessor only by judicial proceedings. This provision shall not be construed to prevent the exercise by lessor of any other legal and equitable remedy, including waiver of the default. Any such remedy or waiver shall not prevent later cancellation for the same default occurring at any other time.

Sec. 12. HEIRS AND SUCCESSORS-IN-INTEREST - Each obligation of this lease shall extend to and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 13. INDEMNIFICATION - Lessee shall indemnify and hold harmless the United States from any and all claims arising out of the lessee's activities and operations under this lease.

Sec. 14. SPECIAL STATUTES - This lease is subject to the Clean Water Act (33 U.S.C. 1252 et. seq.), the Clean Air Act (42 U.S.C. 4274 et. seq.), and to all other applicable laws pertaining to exploration activities, mining operations and reclamation, including the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201 et. seq.).

Sec. 15. SPECIAL STIPULATIONS -

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SPECIAL COAL LEASE STIPULATIONS

These stipulations apply to Alternative B' and C, and potentially to any other alternatives designated as D or beyond. They would be attached under Section 15 of the BLM Coal Lease Form 3400-12 shown in Appendix B.

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SPECIAL COAL LEASE STIPULATIONS

Federal Regulations 43 CFR 3400 pertaining to Coal Management make provisions for the Surface Management Agency, the surface of which is under the jurisdiction of any Federal agency other than the Department of Interior, to consent to leasing and to prescribe conditions to insure the use and protection of the lands. All or part of this lease contain lands the surface of which are managed by the United States Department of Agriculture, Forest Service, Manti-La Sal National Forest.

The following stipulations pertain to the Lessee responsibility for mining operations on the lease area and on adjacent areas as may be specifically designated on National Forest System lands.

Stipulation #1
Before undertaking activities that may disturb the surface of previously undisturbed leased lands, the Lessee may be required to conduct a cultural resource inventory and a paleontological appraisal of the areas to be disturbed. These studies shall be conducted by qualified professional cultural resource specialists or qualified paleontologists, as appropriate, and a report prepared itemizing the findings. A plan will then be submitted making recommendations for the protection of, or measures to be taken to mitigate impacts for identified cultural or paleontological resources.

If cultural resources or paleontological remains (fossils) of significant scientific interest are discovered during operations under this lease, the Lessee prior to disturbance shall immediately bring them to the attention of the appropriate authority. Paleontological remains of significant scientific interest do not include leaves, ferns or dinosaur tracks commonly encountered during underground mining operations.

The cost of conducting the inventory, preparing reports, and carrying out mitigating measures shall be borne by the Lessee.

Stipulation #2
If there is reason to believe that Threatened or Endangered (T&E) species of plants or animals, or migratory bird species of high Federal interest occur in the area, the Lessee shall be required to conduct an intensive field inventory of the area to be disturbed and/or impacted. The inventory shall be conducted by a qualified specialist and a report of findings will be prepared. A plan will be prepared making recommendations for the protection of these species or action necessary to mitigate the disturbance.

The cost of conducting the inventory, preparing reports and carrying out mitigating measures shall be borne by the Lessee.

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Stipulation #3
The Lessee shall be required to perform a study to secure adequate baseline data to quantify the existing surface resources on and adjacent to the lease area. Existing data may be used if such

data are adequate for the intended purposes. The study shall be adequate to locate, quantify, and demonstrate the interrelationship of the geology, topography, surface and ground water hydrology, vegetation and wildlife. Baseline data will be established so that future programs of observation can be incorporated at regular intervals for comparison.

Stipulation #4
Powerlines used in conjunction with the mining of coal from this lease shall be constructed so as to provide adequate protection for raptors and other large birds. When feasible, powerlines will be located at least 100 yards from public roads.

Stipulation #5
The limited area available for mine facilities at the coal outcrop, steep topography, adverse winter weather, and physical limitations on the size and design of access roads, are factors which will determine the ultimate size of the surface area utilized for the mine. A site-specific environmental analysis will be prepared for each new mine site development and for major improvements to existing developments to examine alternatives and mitigate conflicts.

Stipulation #6
Consideration will be given to site selection to reduce adverse visual impacts. Where alternative sites are available, and each alternative is technically feasible, the alternative involving the least damage to the scenery and other resources shall be selected. Permanent structures and facilities will be designed, and screening techniques employed to reduce visual impacts and, where possible, achieve a final landscape compatible with the natural surroundings. The creation of unusual, objectionable, or unnatural landforms and vegetative landscape features will be avoided.

Stipulation #7
The Lessee shall be required to establish a monitoring system to locate, measure and quantify the progressive and final effects of underground mining activities on the topographic surface, underground and surface hydrology and vegetation. The monitoring system shall utilize techniques which will provide a continuing record of change over time and an analytical method for location and measurement of a number of points over the lease area. The monitoring shall incorporate and be an extension of the baseline data.

Stipulation #8
The Lessee shall provide for the suppression and control of fugitive dust on haul roads and at coal handling and storage facilities. On Forest Development Roads (FDR), Lessees may perform their share of road maintenance by a commensurate share agreement if a significant degree of traffic is generated that is not related to their activities.

Stipulation #9
Except at specifically approved locations, underground mining operations shall be conducted in such a manner so as to prevent surface subsidence that would: (1) cause the creation of hazardous conditions such as potential escarpment failure and landslides, (2) cause damage to existing surface structures, and (3) damage or alter the flow of perennial streams. The Lessee

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shall provide specific measures for the protection of escarpments, and determine corrective measures to assure that hazardous conditions are not created.

Stipulation #10
In order to avoid surface disturbance on steep canyon slopes and to preclude the need for surface access, all surface breakouts for ventilation tunnels shall be constructed from inside the mine, except at specific approved locations.

Stipulation #11
If removal of timber is required for clearing of construction sites, etc., such timber shall be removed in accordance with the regulations of the surface management agency.

Stipulation #12
The coal contained within, and authorized for mining under this lease shall be extracted only by underground mining methods.

Stipulation #13
Existing Forest Service owned or permitted surface improvements will need to be protected, restored, or replaced to provide for the continuance of current land uses.

Stipulation #14
In order to protect big-game wintering areas, elk calving and deer fawning areas, sagegrouse strutting areas, and other key wildlife habitat and/or activities, specific surface uses outside the mine development area may be curtailed during specified periods of the year.

Stipulation #15
Support facilities, structures, equipment, and similar developments will be removed from the lease area within two years after the final termination of use of such facilities. This provision shall apply unless the requirement of Section 10 of the lease form is applicable. Disturbed areas and those areas previously occupied by such facilities will be stabilized and rehabilitated, drainages re-established, and the areas returned to a premining land use.

Stipulation #16
The Lessee, at the conclusion of the mining operation, or at other times as surface disturbance related to mining may occur, will replace all damaged, disturbed or displaced corner monuments (section corners, 1/4 corners, etc.), their accessories and appendages (witness trees, bearing trees, etc.), or restore them to their original condition and location, or at other locations that meet the requirements of the rectangular surveying system. This work shall be conducted at the expense of the Lessee, by a professional land surveyor registered in the State of Utah, and to the standards and guidelines found in the Manual of Surveying Instructions, United States Department of the Interior.

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Stipulation #17
The Lessees, at their expense, will be responsible to replace any surface and/or developed groundwater sources identified for protection, that may be lost or adversely affected by mining operations, with water from an alternate source in sufficient quantity and quality to maintain existing riparian habitat, fishery habitat, livestock and wildlife use, or other land uses (authorized by 36 CFR 251).

Stipulation #18

STIPULATION FOR LANDS OF THE NATIONAL FOREST SYSTEM
UNDER JURISDICTION OF
THE DEPARTMENT OF AGRICULTURE

The licensee/permittee/lessee must comply with all the rules and regulations of the Secretary of Agriculture set forth at Title 36, Chapter II, of the Code of Federal Regulations governing the use and management of the National Forest System (NFS) when not inconsistent with the rights granted by the Secretary of the Interior in the license/permit/lease. The Secretary of Agriculture's rules and regulations must be complied with for (1) all use and occupancy of the NFS prior to approval of a permit/operation plan by the Secretary of Interior, (2) uses of all existing improvements, such as Forest Development Roads, within and outside the area licensed, permitted or leased by the Secretary of Interior, and (3) use and occupancy of the NFS not authorized by a permit/operating plan approved by the Secretary of the Interior.

All matters related to this stipulation are to be addressed to:

Forest Supervisor
Manti-La Sal National Forest
599 West Price River Drive
Price, Utah 84501

Telephone Number: 801-637-2817

who is the authorized representative of the Secretary of Agriculture

_____
Signature
Licensee/Permittee/Lessee

Stipulation #19
ABANDONMENT OF EQUIPMENT:
The lessee/operator is responsible for compliance and reporting regarding toxic and hazardous material and substances under Federal Law and all associated amendments and regulations for the handling of such materials on the land surface and in underground mine workings.

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The lessee/operator must remove mine equipment and materials not needed for continued operations, roof support and mine safety from underground workings prior to abandonment of mine sections. Exceptions can be approved by the Authorized Officer (BLM) in consultation with the surface management agency. Any on-site disposal of non-coal waste must comply with 30CFR § 817.89 and must be approved by the regulatory authority responsible for the enforcement of the Surface Mining Control and Reclamation Act (30 U.S.C. 1201, et seq.). Creation of a situation that would prevent removal of such material and equipment by retreat or abandonment of mine sections, without prior authorization would be considered noncompliance with lease terms and conditions and subject to appropriate penalties under the lease.

All safe and accessible areas shall be inspected prior to being sealed. The lessee shall notify the Authorized Officer in writing 30 days prior to the sealing of any areas in the mine and state the reason for closure. Prior to seals being put into place, the lessee shall inspect the area and certify through documentation any equipment/machinery, hazardous substances, and used oil that is intended to be left underground. The Authroized Officer may participate in this inspection. The purpose of this inspection will be: (1) to provide documentation for compliance with 42 U.S.C. 9620 section 120 (h) and State Management Rule R-315-15, and to assure that certification will be meaningful at the time of lease relinquishment, (2) to document the inspection with a mine map showing location of equipment/machinery (model, type of fluid, amount remaining, batteries, etc.) that is proposed to be left underground. In addition, these items will be photographed at the lessee's expense and shall be submitted to the Authorized Officer as part of the certification.

WASTE CERTIFICATION:
The lessee shall provide on a yearly basis and prior to lease relinquishment, certification to the lessor that, based upon a complete search of all the operator's records for the mine and upon their knowledge of past operations, there has been no hazardous subanances defined as per (40 CFR 302.4) or used oil as per Utah State Management Rule R-315-15, deposited within the lease, either on the surface or underground, or that all remedial action necessary has been taken to protect human health and the environment with respect to any such substances remaining on the property. The back-up documentation to be provided shall be described by the lessor prior to the first certification and shall include all documentation applicable to the Emergency Planning and Community Right-to-know Act (EPCRA, Public Law 99-499), Title III of the Superfund Amendments and Reauthorization Act of 1986 or equivalent.

Stipulation #20
Notwithstandin the approval of a resource recovery and protection plan by the BLM, lessor reserves the right to seek damages against the operator/lessee in the event (1) the operator/lessee fails to achieve maximum economic recovery [as defined at 43 CFR § 3480.0-5(21] of the recoverable coal reserves or (2) the operator/lessee is determined to have caused a wasting of recoverable coal reserves. Damages shall be measured on the basis of the royalty that would have been payable on the wasted or unrecovered coal.

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The parties recognize that under an approved R2P2, conditions may require a modification by the operator/lessee of that plan. In the event a coal bed or portion thereof is not to be mined or is rendered unminable by the operation, the operator shall submit appropriate justification to obtain approval by the Authorized Officer to leave such reserves unmined. Upon approval by the Authroized Officer, such coal beds or portions thereof shall not be subject to damages as described above. Further, nothing in this section shall prevent the operator/lessee from exercising its right to relinquish all or portion of the lease as authorized by statute and regulation.

In the event the Authorized Officer determines that the R2P2 as approved will not attain MER as the result of changed conditions, the Authorized Officer will give proper notice to the operator/lessee as required under applicable regulations. The Authorized Officer will order a modification if necessary, identifying additional reserves to be mined in order to attain MER. Upon a final administrative or judicial ruling upholding such an ordered modification, any reserves left unmined (wasted) under that plan will be subject to damages as described in the first paragraph under this section.

Subject to the right to appeal hereinafter set forth, payment of the value of the royalty on such unmined recoverable coal reserves whall become due and payable upon determination by the Authorized Officer that the coal reserves have been rendered unminable or at such time that the lessee has demonstrated an unwillingness to extract the coal.

The BLM may enforce this provision either by issuing a written decision requiring payment of the MMS demand for such royalties, or by issuing a notice of non-compliance. A decision or notice of non-compliance issued by the lessor that payment is due under this stipulation is appealable as allowed by law.

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DESCRIPTION OF EXPECTED MINING AND SUBSIDENCE (AFTER NORWEST, 2000)

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DESCRIPTION OF EXPECTED MINING AND SUBSIDENCE (AFTER NORWEST, 2000)

1.0 SUBSIDENCE PREDICTION

During longwall extraction, coal-supporting overburden is fully removed. The strata above caves into the void. Rock strata failure is a complicated process and dependent upon rock strength, discontinuities, in-situ stress, orientation, and area extracted. Failure of rock strata is transmitted to the surface, resulting in ground subsidence. Prediction of the extent and magnitude of surface subsidence is dependent on local geological variation and is more accurate where empirical data on mining parameters is combined with a surface subsidence monitoring program to derive the main subsidence parameters.

A number of previous studies have been carried out at Skyline relating to the effects of subsidence on perennial streams, springs, highways, ridges, and a gas pipeline. These studies provide a valuable data set defining the local conditions and the degree of impact subsidence is likely to have on the surface and on sub-surface strata. Aspects relating to surface water and groundwater are discussed in more detail in the technical report on surface water and groundwater.

A numerical prediction method has been adopted for this study that enables the major parameters to be modified to simulate the behavior of a wide series of strata characteristics and mining conditions. The ability of this model to simulate more complex mining conditions and multiple seam mining enables the main parameters to be developed by back analyzing the response over previously mined panels. This process is referred to as calibration of the model to local mining and geologic conditions.

The areas that are outside of the longwall mineable zone, and recoverable by room and pillar mining with full extraction, are extremely limited (see Figures 4.1 and 4.2 for Alternative B and Figures 4.3 and 4.4 for Alternative C). The only significant zone is for the upper seam in the northeast corner of the Tract. This area is relatively small and is in an area that may be influenced by a sandstone channel above the upper seam that could greatly restrict the mineable area. It is also located under an area of the surface that has no important structures or resources requiring special consideration. Consequently, if this area is mined by room and pillar extraction with full extraction and subsidence predictions are based on the assumption that it is longwall mined, then this represents a conservative approach with an insignificant error.

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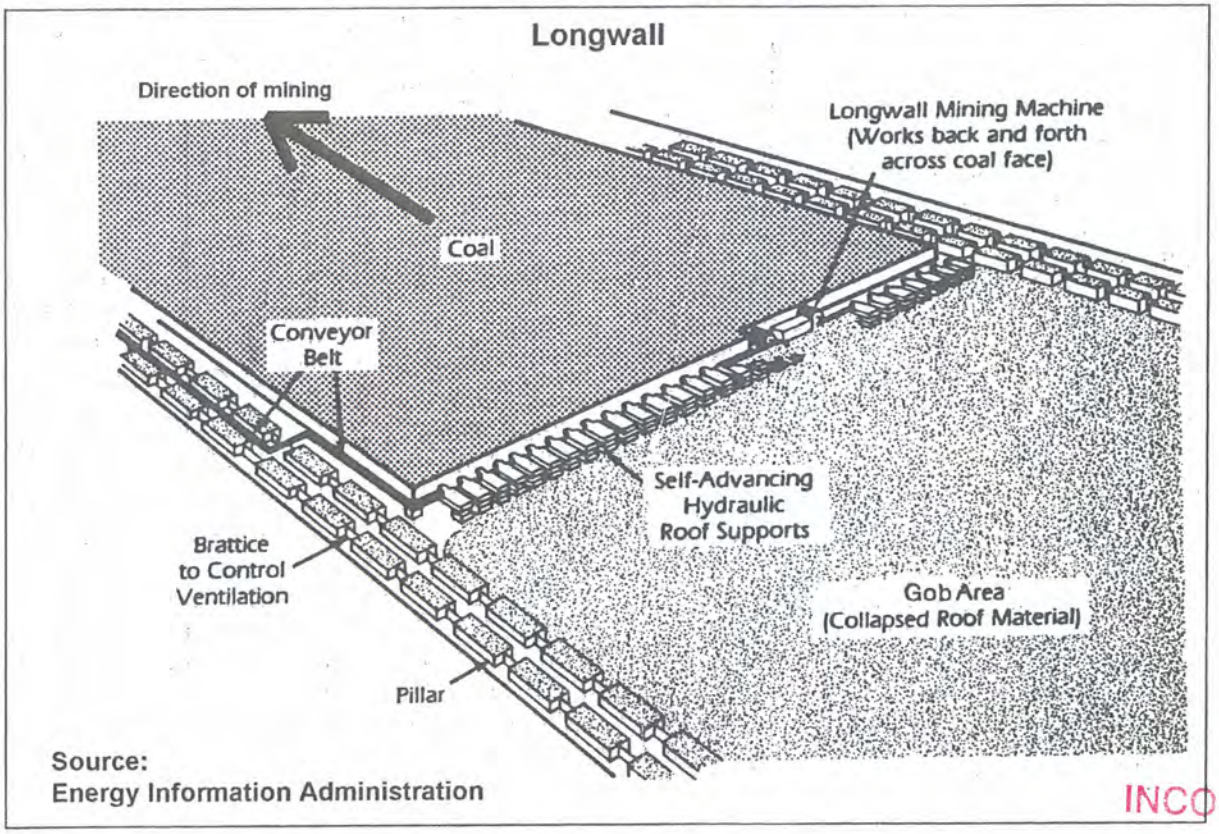
1.2 SUBSIDENCE CHARACTERISTICS

In order to understand the subsidence characteristics from longwall mining a description of the mining method is appropriate. Initially a rectangular panel of coal is developed by room and pillar methods and then completely extracted by the longwall equipment using an automated cutting head (shearer) that moves along a track parallel to the working coal face. The shearer contains two rotating drums that cut a thin slice of coal on each successive pass. The cut coal falls onto a chain conveyor and is transported along the working face to the gate roads and eventually out of the mine. The coal within a longwall panel occupies a rectangular area that is about 800 ft in width and from 3,000 to 15,000 ft in length. Hydraulic roof supports are used to protect mine workers and equipment. As the shearing machine progresses through the panel, the roof supports are advanced. The unsupported mine roof and overlying rock then collapse into the void left behind the advancing roof supports. Once the panel is mined, the longwall machine is moved to an adjacent panel and the process is repeated resulting in near-complete extraction of the coal seam over large areas (See Figure 1.1).

Figure 1.1 Schematic Diagram of a Longwall Mining Panel



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The overburden caving and subsidence process can be divided into four main zones of strata movement above the mine where different subsidence behaviour is observed. These zones are

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not distinctly separate, but they transition into one another with some degree of variability dependent upon geologic conditions. These zones are presented in the schematic cross section in Figure 5.2 and described below, together with the approximate extent of the zone that might be expected.

The Cave Zone where the roof rock fail in discrete blocks and fall into the void behind the longwall supports. This is immediate and continues upwards until the bulking of these rocks provides support to the strata above. This height of this zone is dependent upon the bulking ratio and height of extraction and is typically in the range of 5 to 8 times seam height. It is expected to be in the range of 35 to 180 ft for the variation in conditions expected in the Tract. As the overburden fails above the vertical load will be transferred onto the cave zone and it will re-consolidate to support this load.

The Fractured Zone where the rocks are subjected to high stresses and fail along weakness planes and in some cases intact rock. It is a zone where the rock is fractured vertically and typically horizontally along bedding forming blocks. However, the discrete blocks remain in their relative position and no significant bulking occurs. This zone is dependent on the height of extraction and is expected to extend above the seam up to 30 times the extraction height. It is expected to extend above the seam for 210 to 675 ft for conditions expected in the RFDS area.

The Flexure Zone where the strata are not subjected to such high displacements and stresses to fail intact rock, being able to bend and flex. Movement is still expected on existing joints and bedding planes which can open up in zones of tension. Some shear movement along individual blocks may give rise to stepped vertical displacement of joints in strong beds or along fault planes. Vertical movement along fractures typically remains within individual beds and is not vertically extensive unless massive strong beds are in the zone. This zone extends to the soil interface and the effect diminishes with deeper workings and smaller extraction heights. In weaker rocks the upper part of this zone may flex without causing failure along joints or tension cracks to form. However, it should be noted that the upper end of this range is conservative, as it does not take into account multiple seam interactions that reduce the height.

The Soil Zone where the material is weak and does not generally fail in shear due to it's ability to flex with subsidence movement. However, it does fail in tension and this is observed as tension cracks that open up in the active tensile zone. It can also fail in compression and result in localized heave conditions. Fractures opened in tension will close again when the compression zone reaches them, unless they are in a permanent tension zone where they will take longer to heal and close. This zone can vary in thickness from zero where the rock is exposed to 90 ft in Flat Canyon.

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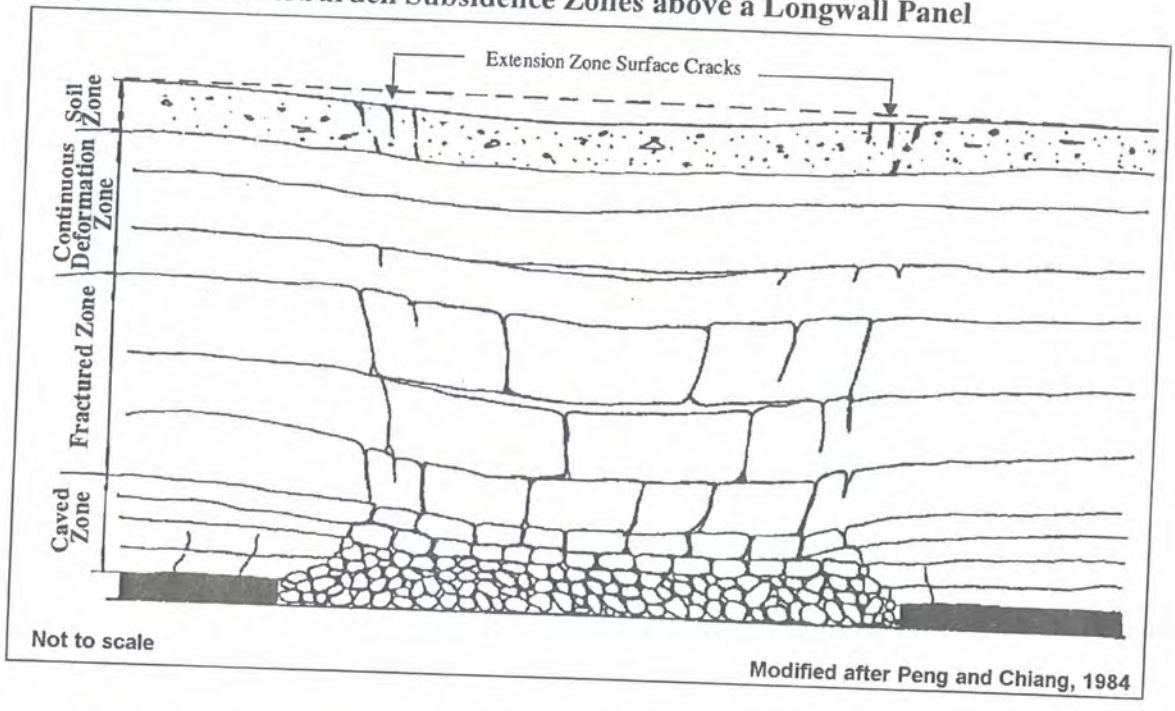
Figure 1.2 Overburden Subsidence Zones above a Longwall Panel



The extent of these zones for the RFDS area should be regarded as conservative, as they are based on a multiplication factor for the combined extraction from two seams. In the case of multiple seam mining, extraction of the second seam does not produce the same extent for the cave and fracture zones due to the previous subsidence that has already taken place (Peng, 1992). The extent of this reduction has not been empirically confirmed for Skyline and is not believed to be critical at the planned mining depths; hence we have taken a conservative approach and assumed no reduction for the lower seam. The range of extent for the cave and fracture zones is dependent upon the extraction height and is tabulated below for the Tract:

Table 1.1 Range of Cave and Fracture Zones Heights (ft)

Zone	Upper Seam		Lower Seam		Multiple Seam	
	From	To	From	To	From	To
Cave Zone	43	100	35	80	78	180
Fracture Zone	255	375	210	300	465	675

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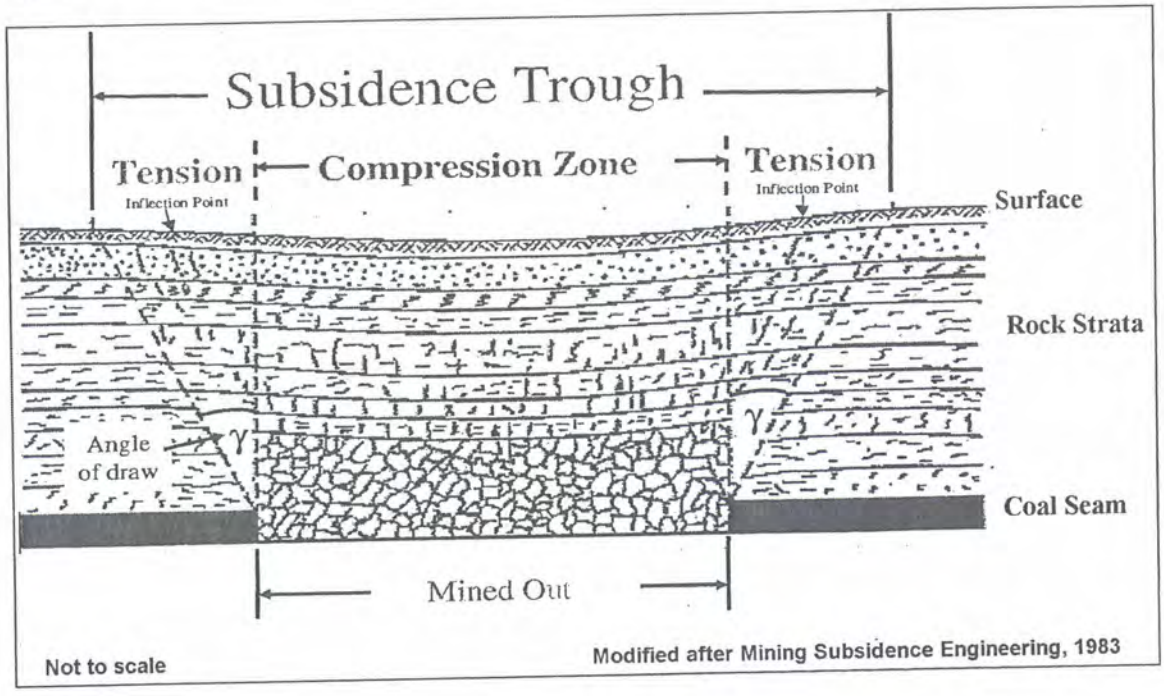
Surface subsidence above longwall panels forms in the shape of a trough. The surface area within a subsidence trough is normally larger than the area of the extracted coal seam due to the effect of the angle of draw. This is the angle that the line joining the limit of extraction to the limit of subsidence on the surface makes with the vertical. A cross section showing a typical subsidence profile is presented in Figure 1.3, which also shows the zones of surface tension that are located on the edge of the subsidence trough. The angle of draw (γ) shown in the schematic is estimated to be 22 degrees to the vertical for the Tract. The amount of vertical subsidence seen on surface is only a portion of the full extraction height. This is mainly due to bulking and reconsolidation of material in the cave zone, opening up of fractures in the fractured zone and to some extent dilation of rock in the flexure zone.

Figure 1.3 Cross-section of Typical Subsidence Trough



Ground movements within a subsidence trough have both vertical and horizontal components. Downward vertical movement usually occurs at all areas within the trough. The vertical movement is usually greatest at the center, and it progressively decreases at points along the trough profile until the limit of the affected surface area is reached.

Horizontal movement or displacement also occurs within the subsidence trough, as points on the surface tend to move horizontally toward the center. For adjacent points near the center, the horizontal distance between points is reduced resulting in compressive strains at the surface. The amount of compression decreases at points further from the center as the distance between neighboring points is reduced by lesser amounts, until a position is reached where the

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compression is zero. No horizontal movement will be experienced at this location. This position in the trough is referred to as the inflection point. Beyond this, the distance between neighboring points is increased, resulting in tensile strains on the surface. The inflection point also represents the location where the shape of the subsidence profile changes from concave to convex.

The areas of compressive and tensile strains within the subsidence trough are known as the *compression* and *tension* zones, respectively. The compression zone makes up the central portion of the subsidence trough, and develops above the center of the area of failure within the mine. The tension zone makes up the remainder of the subsidence trough, and usually extends beyond the extracted area. These zones can be seen in Figure 1.3.

The relationships between the width and length of the longwall panel, the thickness of the mined coal seam, and the type and thickness of the overburden play an important role in the development of a subsidence trough. When longwall subsidence occurs, the maximum vertical movement is at the center of the longwall panel. In theory, when the length and width of the panel reach a critical size, subsidence at the center of the trough will reach a maximum possible value. Once this panel size is exceeded it becomes 'supercritical' and the profile will subside the maximum amount forming a trough with a flat-bottomed central area, as shown in Figure 1.4. The maximum amount of subsidence will not increase regardless of how wide or long the panel becomes. Conversely, if the extraction area is less than this critical value, the maximum possible theoretical subsidence will not be achieved, and the resulting profile will be shallower and will not flatten out in the center.

Since the width of the panel is the shorter dimension, it plays the primary role in the determination of the maximum amount of subsidence. Critical width occurs when the width of the extracted area is typically in the range of 1 to 1.5 times the overburden thickness.

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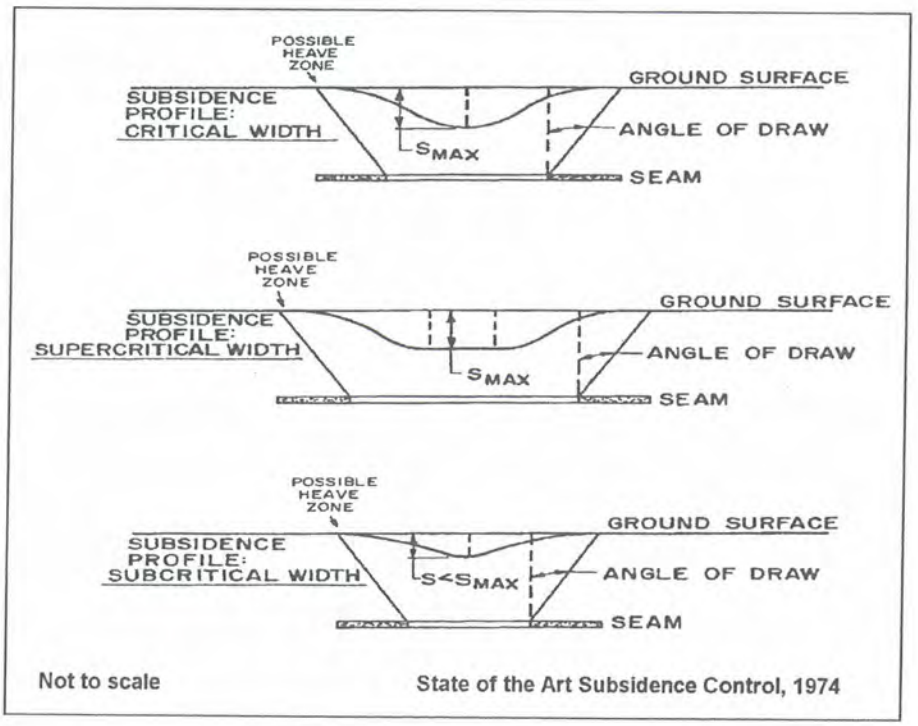
Figure 1.4 Critical, Supercritical, and Subcritical Widths



The development of a subsidence trough is a progressive event. When a longwall panel begins operation, initial surface subsidence will result in a subcritical trough. As the panel advances, the trough reaches critical dimensions, and ultimately flattens out as supercritical conditions are reached. A structure may initially be located in the tension zone of the basin as the panel approaches, causing a pulling of the structure towards the longwall face. Cracks and separations at structural interfaces may occur as a result of the dropping and extension of the ground surface. In addition, structures may tilt towards the approaching longwall face.

As the face advances below the ground surface the zone of tension now becomes a zone of compression, since it is now located near the center of the subsidence trough. Cracks that may have opened up in the tensile zone may now close. The induced slope of the ground surface may now return to the original slope unless it is located on the margins of the panel.

The time dependent changes of the ground surface as the longwall passes below a given area is referred to as dynamic subsidence and is illustrated in Figure 1.5. Cracks in the surface land and structures may open and close as the subsidence 'wave' passes through.

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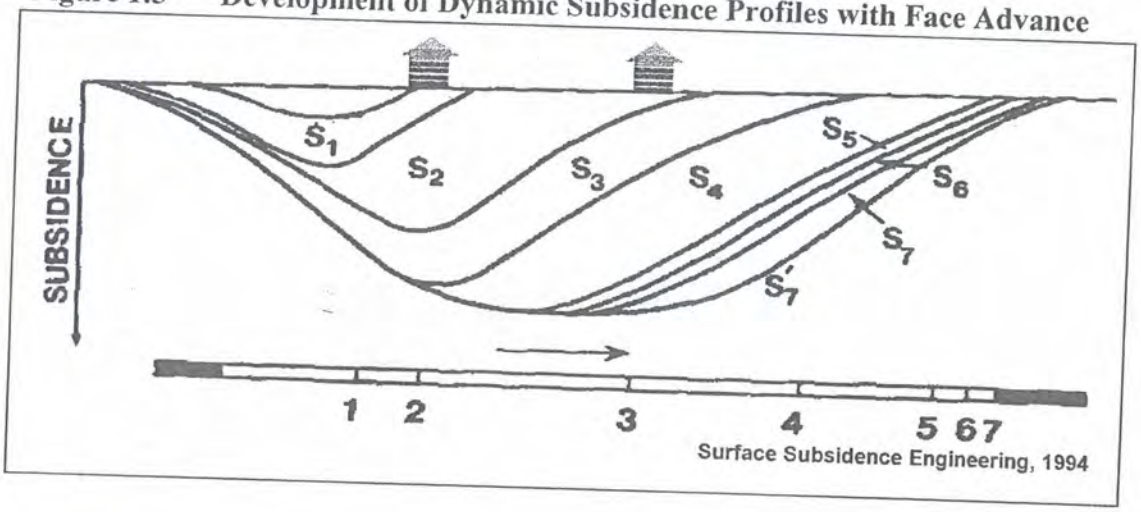
Figure 1.5 Development of Dynamic Subsidence Profiles with Face Advance



A short discussion of the variation in subsidence factors related to the existing Skyline Mine experience and those expected in the Tract is given below. Reference is made to subsidence impact studies carried out by CFC at Burnout Creek, Trough Springs Ridge and State Highway SR 264. Discussion of relevant aspects of these impacts will be included with the technical reports relating to each area of impact.

1.1.1 Tension Fractures & Hydraulic Communication

Tension fractures can form at surface due to flexure of the strata as a result of differential subsidence. Where these cracks are observed they are often within 10 degrees from the vertical alignment of permanent coal pillars and their severity is dependent upon the degree of subsidence. The potential for surface cracking increases with the following factors:

- thicker or multi-seam extraction;
- shallower overburden depths;
- vertical alignment (stacking) of pillars in multi-seam mining;
- stacking of fire barrier pillars;
- reduced lateral constraint at escarpments and ridge crests;
- steeper slopes where gravitational components are greater;
- thicker and stronger beds that are shallow and jointed;
- thinner and more brittle soil cover; and
- surface features sensitive to cracking, such as roads;

Experience at the Skyline Mines where comparable overburden depths are greater than 600 ft. indicates that the formation of significant zones of surface tension fracture are relatively rare. They are seldom observed during mining of the upper seam and are generally associated with mining of the lower seam where abutment or fire barrier pillars are vertically aligned in the vicinity of exposed ridges with low lateral constraint. Over the whole of the Skyline Mine area

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where depths are greater than 600 feet there are about 2,640 acres that have been influenced by subsidence. Regular subsidence inspections have identified less than 12 acres with significant fracture zones, representing less than 0.5 % of the deep mining areas.

Some minor tension cracks have been observed at State Highway SR264 above single seam extraction in the Skyline No.3 Mine at a depth greater than 600 feet. Generally these cracks were less than ¼" wide. In at least one case a vertical offset of about four inches was observed. No other significant tension cracks have been reported above single seam extraction areas, except where the depth is less than 300 feet.

A zone of significant tension cracks was observed at Skyline in the Trough Springs Ridge area, associated with an area of intensive tension above a stacked fire barrier pillar at a depth of about 900 ft. Extraction of the upper seam took place without incident, but extraction of the lower seam resulted in a very significant zone of tension fractures forming. Extraction totaled about 22 ft. of coal in this location and the fire barrier pillars in both seams were vertically aligned. Although the fire barrier extended for about 6,000 feet, less than 1,500 feet experienced cracking and this was at a ridge where a sandstone bed was located near the surface. A section of Burnout Creek passed through the same tension zone without any evidence of tension cracks or any significant hydraulic communication observed between surface water and groundwater systems.

A detailed study was not carried out by Skyline staff at the time, but the available data indicates that tension cracks at Trough Springs Ridge were over 5 ft wide in some places. It can be concluded that over 5 ft of total extension was experienced in this tensile zone, although the effect of possible slope movement on the ridge cannot be discounted. This is consistent with subsidence predictions that indicate the cumulative extension over the tensile zone would be expected to be in the region of 8 ft if the ground surface was flat.

Similar conditions to those observed at Trough Springs Ridge are unlikely to occur with the same degree of severity in the valley floors found within the Tract.

It should also be noted that the severity of tension crack formation that occurred above the Plateau Mine in the North Fork of the Right Fork of Miller Creek located on the steep eastern margin of the Wasatch Plateau (Slaughter et al., 1995) should not occur in the RFDS area. At the Plateau Mine, tension crack formation over multiple seam extraction under shallow cover (300 to 500 feet) caused the diversion of a perennial stream into mine workings. The greater depth of cover and the location of the RFDS area away from the plateau escarpment should preclude such catastrophic events as those observed at Miller Creek.

The potential for hydraulic communication between surface water, groundwater and the mine workings is generally restricted to the cave and fractured zones. Due to the expected overburden depths and strata, no significant vertical connection between surface water and groundwater is expected in the Tract. This topic is discussed in more detail in the technical report on surface water and ground water.

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1.1.2 Dynamic Subsidence

The majority of areas will experience the temporary dynamic effects of subsidence as the longwall face retreats below them. These transient effects are likely to result in limited tension cracks opening up and then as the compression zone arrives they will self-heal and close up again. However, at the edge of workings the tension zone may remain for a longer time (months / years) until the adjacent panel is mined, or remain permanently where it is located at the edge of workings. This process may be repeated for mining of the lower seam where multiple seam mining is carried out.

The dynamic subsidence and impact as the longwall passes beneath a particular point on the surface in the center of a panel is less than above the gate roads and at the edge of panels and fire barriers. The effects generally reduce with the rate of longwall face retreat and at a rate of about 50 ft per day, as projected by CFC, the dynamic slope and horizontal strains may be reduced by up to 50% of the static value (Peng, 1992). Conversely, the maximum vertical subsidence velocity will increase in an approximately linear rate with the rate of face retreat. A value of about 0.2 vertical ft per day is projected for the overburden depths in the Tract (Peng, 1992).

5.1.3 Sinkhole Development

Where the thickness of bedrock above the coal seam is less than the potential cave zone there is the potential for sinkholes to develop due to void migration. The maximum height of the cave zone is conservatively estimated to be about 180 ft and the minimum depth of workings about 800 ft with no possibility that sinkholes could develop in the Tract. However, there is the potential for small holes to develop in tensile zones where shallow bedrock is fractured and soil migrates into the fractures at localized failure zones.

1.2 GEOTECHNICAL INFLUENCES

The main geotechnical influence on subsidence is the behavior observed with strong strata reducing the subsidence percentage and reducing the horizontal influence beyond the excavated area (angle of draw). The influence of strong beds has been estimated from the amount of sandstone in the overburden, as determined by exploration drilling and both cuttings and geophysical borehole logs. Each subsidence prediction point has been allocated a percentage of sandstone which is used in the numerical model as a key input parameter.

1.3 IMPACT OF TOPOGRAPHY AND SURFICIAL MATERIALS

Subsidence is often evaluated on the assumption that the coal seam and ground surface are both horizontal. In the proposed Tract the dip of the seam is expected to be in the range from 2 to 6 degrees. For the evaluation of subsidence this is considered to be flat and hence no corrections have been applied for inclined workings.

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The surface topography is generally undulating and cannot be considered to be flat, except in some of the valleys. Where steeper terrain is encountered; having ridges, cliffs and canyons, there are likely to be more significant topographic effects on subsidence. This can partly be

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explained by the lack of lateral confinement at steep slopes and cliffs. There is also the effect of the gravitational component of the slope weight that has the tendency of allowing material to move slightly down the slope or in extreme cases lead to slope failure.

Over the Tract there are only a few minor cliffs; and these are generally associated with the Castlegate Sandstone Formation that is typically thin and only found on some of the higher ridges. No prominent cliff escarpments were observed during the field visit. The canyon slopes are not generally steep, but in some cases may increase the effect of subsidence.

Previous experience at the Skyline Mine has encountered no major slope failures. Small localized movements have been observed. A detailed evaluation of slope impacts would require a specific detailed mine plan and sequence of extraction in order to estimate the location and extent of subsidence in relation to particular slopes. Without a specific mine plan this topic is discussed in general terms and the likely range of impact estimated. Slope stability aspects will be discussed further in Section 8.

The opening of tension fractures is possible where high tensile strains are imposed on brittle strata for significant periods of time. A series of tension fractures resulted on Trough Springs Ridge from prior mining. In this case, an extensive zone of tension was created when fire barrier coal pillars were vertically aligned in two thick coal seams. The existence of a strong sandstone bed near to surface, on a ridge without lateral confinement on both sides, resulted in the very high tensile strains being focused on particular joint sets within the sandstone bed. The combination of these factors resulted in significant short-term impact due to the formation of fractures that opened in the bedrock. Some of the fractures were over 5 ft wide and 25 ft deep, with longitudinal extent over 200 ft in places. They were mitigated by filling with soil and no long-term adverse impact is expected for the area.

It is possible that similar conditions might exist in the vicinity of some ridges at higher elevations in the Tract, especially if stacked fire barriers are developed. However, it is likely that the magnitude would be less, as mining in the Tract is generally deeper over most of the area and extraction heights generally less than the Trough Springs Ridge area. If similar conditions of mining, topography and near surface sandstone exist, then similar fractures might occur, although the likelihood is believed to be low.

1.4 NUMERICAL PREDICTION METHOD

The Surface Deformation Prediction System (SDPS) numerical model was used to predict surface subsidence. This is discussed in more detail in Appendix F of the NorWest Technical Report for Geology, Mining, Subsidence, and Seismicity (Project File), together with a presentation of the results for the main subsidence parameters. The model was calibrated against actual subsidence monitoring data from the Skyline Mine.

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Without a specific mine plan for the RFDS, a characterization process was used to estimate the likely range of subsidence for different mining scenarios based upon a generic longwall mining

layout at each location. Single and multiple seam layouts, based on typical Skyline mine layouts, were developed for this purpose. These layouts are presented in Appendix F and are identical for each type of subsidence prediction point. They have not been placed at a particular location or assumed orientation. In order to evaluate the effect of mining at different orientations the layout can be rotated in order to simulate the orientation effects. The validity of rotating the generic layout to evaluate orientation effects is sufficient for the level of detail required to assess the general range of values likely to be encountered. It also enables a conservative approach to be adopted when evaluating location and orientation impacts.

1.5 NUMERICAL MODEL CALIBRATION

Calibration was based on subsidence data supplied by CFC from undermining of State Highway SR264 by longwall extraction of the Upper O'Connor Seam in the Skyline Mine. The model calibration is discussed in Appendix F. The percentage of hard rocks (sandstone) in the overburden for this area is estimated to be about 55 %. The calibration results indicate that an angle of draw of 18.4 degrees and a maximum vertical subsidence factor of 50 % of extraction height provide the best fit to the measured subsidence data. However, a conservative approach has been adopted for this study by assuming for the numerical model analysis that the angle of draw is 22 degrees, with a vertical subsidence factor of 55% for single seam extraction cases.

Further evidence at Skyline from Mining of the Upper O'Connor and Lower O'Connor B Seams indicates that there is a higher vertical subsidence factor for mining of the lower seam after the upper seam has already been extracted. This effect has been observed elsewhere (NCB, 1975 and USBM IC-9194). There is some limited evidence from subsidence monitoring data for the Questar Gas Transmission Pipeline, using photogrammetric survey techniques with a reported accuracy of ±1 ft., that suggests a vertical subsidence factor of 75% for mining of the second seam. However, this factor should be treated with caution, as it has not been confirmed by more reliable surveying techniques. In the absence of reliable subsidence monitoring data for multiple seam conditions, we believe that it is a reasonable basis for the evaluation at this point in time. The numerical model cannot accept different subsidence factors for each seam when multiple seam conditions are being modeled. In these cases we have assumed that a weighted average of the combined subsidence factors is applied to both seams at these locations.

The angle of draw used in the numerical model has been assumed to be constant at a value of 22 degrees. However, a slightly different angle of draw is recommended when defining mining restrictions to allow for the possibility that local variability may be observed due to operational and geologic variations. No rigorous evaluation has been carried out regarding the degree of local variability that might be expected. Previous work by Harding Lawson Associates (See Section 8 of this Report) indicated that the observed angle of draw was in the range of 18 to 23 degrees. We propose that the upper value of 23 degrees should be used as the basis for defining subsidence protection zones. In addition a buffer zone should be included to allow for the possibility of anomalous conditions due to variable geology and the possibility of pillar failure in the abutment area over time. The buffer against sensitive features can be incorporated into the Angle of Draw estimates by defining a conservative angle of draw. For sensitive resources and

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structures a protection zones is recommended based on an Angle of Draw of 30 degrees from longwall extraction areas and is discussed later in the report.

1.6 PREDICTION RESULTS

The detailed results from the numerical model runs are presented in Appendix F. The three main subsidence factors likely to influence surface stability [vertical subsidence (ft), horizontal strain (millistrain), and induced slope change (%)] are presented for each subsidence prediction location as a series of contours overlain on the generic panel layout.

Vertical subsidence is the parameter most commonly quoted for impact evaluation, as the other main parameters are typically related to it. Subsidence predictions normally assume uniform flexure of the surface with subsidence occurring in small discrete steps. Flexure of the ground surface, due to differential subsidence, results in horizontal ground strains and induced slope changes that often occur soon after the longwall face passes underneath.

Horizontal strains are expressed in millistrain in this Report, with 1 millistrain being equivalent to a net change of 1 unit for each 1000 units of length. Tensile strains are positive and are equivalent to extension of the ground surface and compressive strains are negative. A measure of the degree of strain intensity is given by the maximum strain value and width of the zone of tension. The total extension possible over the tensile zone gives an indication of the degree to which tensile strains have the potential to result in tension cracks opening up at surface.

The seams depths and sandstone percentages for each subsidence prediction point are summarized in Table 1.2, together with the maximum values estimated for each of the main subsidence parameters at the worst case position in relation to the mine layout. For the model results the worst case is generally represented by a fire barrier pillar in single seam extraction and a stacked abutment pillar in multi-seam extraction cases. Further details of the model runs and the generic mine layout used for the model are presented in Appendix F, together with the contour plots of subsidence parameters that were used to estimate the maximum parameter values presented in the table.

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Table 1.2 Subsidence Point Characteristics and Maximum Predicted Values

Parameter	Subsidence Prediction Point								
	1 Boulger South	2 Little Swens	3 Swens West	4 Swens East	5 Flat West	6 Boulger Dam	7 Boulger West	8 Boulger Central	9 Cunn-ingham
Overburden Thickness above Lower Seam (ft)	1850	1600	1700	1100	1500	1200	1750	1500	1600
Number of Seams Mined	2	1	2	2	1	2	1	2	2
Amount of Hard Rocks in Overburden (% sst)	50	65	65	65	60	65	50	50	50
Estimated Thickness of Surficial Material (ft)	20	30	20	30	120	120	80	80	20
First Seam Maximum Vertical Subsidence (ft.)	5.5	5.5	4.7	5.5	4.7	6.9	5.0	6.6	6.9
Maximum Total Vertical Subsidence (ft)	11.5	5.5	10.7	13.0	4.7	14.4	5.0	14.1	12.9
Maximum Horizontal Tensile Strain (millistrain)	7	9	8	16	8	16	7	11	10
Average Tensile Strain in Tensile Zone (millistrain)	5	5.5	4.5	8.5	4.5	9	4	7	5.5
Width of Tensile Zone (ft)	500	500	600	450	500	500	600	600	600
Approximate Maximum Extension Possible in Tensile Zone (ft)	2.5	2.8	2.7	3.8	2.3	4.5	2.4	4.2	3.3
Maximum Horizontal Compressive Strain (millistrain)	-8	-5	-8	-16	-5	-16	-5	-12	-10
Maximum Slope Change (%)	1.5	0.9	1.5	2.8	0.7	3.0	0.7	2.2	1.9

The parameter values presented in Table 1.2 have been estimated for permanent locations with maximum impact such as the edge of abutment pillars or above fire barriers, depending upon the parameter and single or multiple seam cases. These areas represent a relatively small proportion of the overall mining area and should not be regarded as representative. In reality, the subsidence parameters will vary over the mining area and with time. They can be sub-divided into permanent (at the edge of pillars), short term (between adjacent panels with durations measured in months) or dynamic (above the moving longwall face with durations measured in days). The range of subsidence parameter variation is dependent on the mining layout and geologic conditions. The numerical modeling results presented in Appendix F have been evaluated further in relation to the mining layout features listed below:

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- panels (in the center of panels);
- single abutment (at the edge of solid coal pillars);
- stacked abutment (where both seams are next to solid coal pillars);
- single fire barriers (where a fire barrier is in one seam only);
- stacked fire barriers (where fire barriers in two seams are aligned);
- gate roads (where gate road pillars are left between panels); and
- longwall face (dynamic effects as the face retreats).

The significant parameter values for each of these areas are presented in Table 1.3 for each subsidence prediction point. It should be noted that these values are approximations that have been taken in most cases from the contour plots presented in Appendix F. In some multi-seam cases the parameter is not taken directly from the subsidence model output, but is estimated by applying a typical ratio derived from the single seam case. The figures relate to the cessation of mining, except for dynamic subsidence that applies to longwall-face retreat or single-abutments that exist for a short time between panels.

Table 1.3 Range of Predicted Subsidence Parameter Values at Different Mine Features

Parameter	Subsidence Prediction Point								
	1 Boulger South	2 Little Swens	3 Swens West	4 Swens East	5 Flat West	6 Boulger Dam	7 Boulger West	8 Boulger Central	9 Cunn-ingham
Overburden Thickness above Lower Seam (ft)	1850	1600	1700	1100	1500	1200	1750	1500	1600
Number of Seams Mined	2	1	2	2	1	2	1	2	2
Maximum Subsidence (ft)									
Panels	10	5	10	12	4	13	4	13	12
Single Fire Barrier	7	2	6.5	7	2	9	2	8	7
Stacked Fire Barriers	4.5	-	4.5	5.4	2	6	3.5	5.9	5.4
Gate Roads	9.5	4.5	9.5	11.5	3.5	12.5	3.5	12.5	11.5
Maximum Horizontal Tensile Strain (millistrain)									
Single Abutment	2	4	2	6	4	6	2	4	4
Stacked Abutment	6	-	8	16	-	14	-	10	10
Single Fire Barrier	4	8	4	12	8	12	6	8	8
Stacked Fire Barrier	12	-	16	32	-	28	-	20	20
Gate Roads	2	2	2	4	2	4	1	2	2
Longwall Face (Dynamic)	1	2	1	3	2	3	1	2	2
Maximum Slope Change (%)									
Single Abutment	0.6	0.8	0.6	1.4	0.6	1.2	0.6	1.0	0.8
Stacked Abutment	1.4	-	1.4	3.0	-	2.8	-	2.2	1.8
Single Fire Barrier	0.6	0.7	0.6	1.4	0.6	1.2	0.6	1.0	0.8
Stacked Fire Barrier	1.4	-	1.4	3.0	-	2.8	-	2.2	1.8
Gate Roads	0.2	0.1	0.2	0.4	0.2	0.4	0.1	0.2	0.2
Longwall Face (Dynamic)	0.3	0.4	0.3	0.7	0.3	0.6	0.3	0.5	0.4

From the table it can be seen that the different underground mine structures produce significantly different results for some parameters. It should also be noted that some of the values are slightly different from the figures presented in Table 1.2 due to the approximations used in reading contour intervals from the plots in Appendix F of the NorWest Technical Report for Geology,

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Mining, Subsidence, and Seismicity (Project File). Some of the most important observations are discussed below with the relative variation of parameter values.

Vertical Subsidence
For vertical subsidence the highest value is in the center of the panel and is only slightly reduced above gate roads. There is a significant reduction over fire barriers in a single seam which is further reduced to about half of the maximum value for stacked fire barriers in multiple seam cases. The highest value ranges from 10 to 13 feet for multi-seam cases and the lowest is 2 feet above single seam fire barriers.

Maximum Horizontal Tensile Strain (millistrain)
Low horizontal tensile strain (1 to 4 millistrain) is expected over gate roads and during dynamic subsidence. Low to Moderate values are expected over a single seam abutment or offset abutments in two seams (2 to 6 millistrain). Moderate to high values (4 to 16 millistrain) are expected over a stacked abutment in two seams and fire barrier in a single seam. A stacked fire barrier in two seams is expected to produce High to Very High values (12 to 32 millistrain).

Based on empirical observations at Skyline, the potential for significant tension fractures to develop is negligible at tensile strain values below about 6 millistrain, low for values between 6 and 16 millistrain and moderate for values over 16 millistrain. The potential increases significantly at ridges without lateral constraint and strong beds near surface, and decreases significantly at valley floors with increased lateral constraint and thicker soil layers. There is insufficient data to reliably estimate the dimensions of individual tension cracks characteristic of particular tensile strain values.

Maximum Slope Change (%)
The slope change is estimated to be very low (0.1 to 0.4 %) for gate roads and very low to low (0.3 to 0.7 %) for dynamic subsidence. It is estimated to be low to moderate (0.6 to 1.4 %) for a single abutment and single fire barrier, and moderate to high (1.4 to 3.0 %) for stacked abutments and stacked fire barriers in multi-seam mining.

These figures give an indication of the likely range of values in the vicinity of mine layout features. They do not represent exact figures, but should be treated as a reasonable approach to predicting the likely range of values for particular features and are useful in assessing the possible effect that these mine layout features would have at particular locations. Over the longwall mineable zone in Alternative 3 it would be expected that about 10% of the area would be subjected to abutment effects (single and stacked), about 5% to fire barrier effects (single and stacked), about 20% to gate roads and the remaining 65% to dynamic subsidence.

Based upon qualitative definitions of relative degrees of subsidence from the Skyline Mine experience evaluated over the tract it is estimated that about 85 % of the mining area will be subjected to a low degree of subsidence, 10 % to a moderate degree of subsidence and 5% to a high degree of subsidence. It should be noted that these are approximations and do not represent

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the impact, but are intended to provide an indication of the relative value of subsidence parameters.

When a specific mine plan is available a more accurate estimation for subsidence parameters can be made, but in the meantime this approach is sufficient for characterization of the range of impact and evaluation of particularly sensitive areas. The numerical model has been calibrated on single seam mining only, as the available data was only suitable for this case. Further subsidence monitoring and evaluation for the Tract is recommended to confirm the parameters used in the model predictions.

It should be noted that without a specific detailed mine plan the values for some of the mining features listed in Table 1.3 may not in some cases be consistent with the layout presented in the applicable mining scenarios for either of the two main alternatives. The results are discussed in more detail in relation to each of the alternatives separately.

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SKYLINE MINE WATER DISCHARGE WATER QUALITY PARAMETERS TABLE

Note: Data displayed on the table are compiled from water monitoring prior to large increases in ground water flow into the Skyline Mine and subsequent increases in mine water discharge (January 2001). More recent water quality monitoring information is available from Canyon Fuel Company, LLC (project file).

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Comparison of Skyline Mine Discharge Water Quality to State of Utah Beneficial Use Standards (UAC R317-2)

		Beneficial Use Standards				CS-12				CS-14				UPDES Outfall			
Parameter	Unit	1C Domestic	2A, 2B Recreation	3A 4-Day Aquatic Wildlife	4 Agriculture	n	Max	Min	Average	n	Max	Min	Average	n	Max	Min	Average
226 Radium	pc/l	5				0	---	---		0	---	---		1	0	0	
Alpha gros	pc/l	15			15	0	---	---		0	---	---		1	0	0	
Ammonia N	mg/l			About 2		42	1.8	0	0.34	30	1.5	0	0.33	1	0.17	0.17	0.17
Arsenic-T*	mg/l	0.05		0.19	0.1	0	---	---		0	---	---		1	0	0	
B.O.D. 5	mg/l		5	5	5	1	7	7		0	---	---		1	9.3	9.3	9.30
Barium-D	mg/l	1				7	0.061	0	0.03	9	0.089	0	0.03	0	---	---	
Beta gross	pc/l	50		50	50	0	---	---		0	---	---		1	0	0	
Boron-T	mg/l				0.75	13	0.8	0.109	0.38	10	0.7	0.16	0.42	1	0.04	0.04	0.04
Cadmium-T*	mg/l	0.01		0.0011	0.01	0	---	---		0	---	---		1	0	0	
Chromium-T*	ug/l	0.05		0.011	0.1	0	---	---		0	---	---		1	0	0	
Copper-D	mg/l			0.012	0.2	7	0.01	0	0.00	9	0.01	0	0.00	0	---	---	
Cyanide	mg/l			0.0052		13	0.01	0	0.00077	10	0	0	0.00	1	0.014	0.014	0.0140
Fluoride	mg/l	2.4				17	2.07	0.1	0.65	10	1.52	0	0.45	1	0.33	0.33	0.33
Iron-D	mg/l			1 (Max)		7	0.23	0	0.07	8	0.23	0	0.03	0	---	---	
Lead-D	mg/l	0.05		0.0032	0.1	7	0.008	0	0.00114	9	0.008	0	0.00133	0	---	---	
Mercury-T*	ug/l	0.002		0.012		0	---	---		0	---	---		1	0.2	0.2	0.20
Nickel-T*	ug/l			0.16		0	---	---		0	---	---		1	0	0	0.00
Nitrate N	mg/l			4		29	2.7	0	0.80	20	12.32	0	2.47	1	0.84	0.84	0.84
NO2+NO3 N	mg/l	10				5	0.8	0.4	0.56	11	2.4	0	1.20	0	---	---	
Phenol	ug/l			0.01		18	1330	0	87.22	18	230	0	33.06	0	---	---	
Phos.-T	mg/l		0.05	0.05		38	0.21	0	0.04	19	0.99	0	0.13	1	0.62	0.62	0.62
TDS @ 180C	mg/l				1200	140	2084	288	797.08	67	2570	405	1104.12	28	718	120	311.21
Missing																	
Selenium		X		X	X												
Silver		X		X													
Zinc				X													
Residual Chlorine				X													
H2S				X													
TSS			X	X													
Strontium-90		X															
Tritium		X															

*Total used in lieu of dissolved because dissolved data not availble

FLAT CANYON COAL LEASE TRACT (UTU-77114) UNSUITABILITY ASSESSMENT

Unsuitability Criteria as described in 43 CFR, Subpart 3461, are used to determine the suitability of lands for coal leasing. The criteria are applied when Federal lands are being considered for coal leasing. This coal unsuitability assessment addresses the Flat Canyon Coal Lease Tract, encompassing approximately 2,692 acres adjacent to the west boundary of the permit area for the Skyline Mine. The tract consists of National Forest System lands administered by the U.S.D.A. Forest Service, Manti-La Sal National Forest (FS), with Federal coal administered by the Bureau of Land Management (BLM).

Both the FS and BLM are currently analyzing the potential effects of leasing and mining of the tract and are jointly preparing an Environmental Impact Statement.

This coal unsuitability analysis will determine if any of the lands within the tract are unsuitable for coal leasing and mining for each of the 20 "Unsuitability Criteria" in 43 CFR 3461.5 (Criteria for assessing lands unsuitable for all or certain stipulated methods of coal mining).

The 20 criteria for assessing lands unsuitable for all or certain stipulated methods of coal mining (CFR 43, Subpart 3461.5) have been applied to the proposed Flat Canyon Coal Lease Tract. Criteria 4, 8, 14, 17, 18, 19, and 20 were addressed in the Forest Plan (FS, 1986 - Table C-2) as not applicable because the specific resources discussed do not exist within the Manti-La Sal National Forest (MLS). Criteria 2, 3, 5, 6, 12, and 16 are not applicable to the Flat Canyon Coal Lease Tract because the resources addressed in the criteria do not occur.

Exceptions apply to Criteria 1, 7, 9, 10, 11, 13, and 15. Detailed information pertaining to Federally listed threatened and endangered species and FS special status species was provided in the Biological Assessment/Biological Evaluation. The FS has initiated formal consultation with the U.S. Fish and Wildlife Service (USFWS), Utah Division of Wildlife Resources (UDWR), and Utah State Historical Preservation Office (SHPO).

CRITERIA AND ASSESSMENTS

Criterion Number 1: All Federal lands included in the following land systems or categories shall be considered unsuitable: National Park System, National Wildlife Refuge System, National System of Trails, National Wilderness Preservation System, National Wild and Scenic Rivers System, National Recreation Areas, lands acquired with money derived from the Land and Water Conservation Fund, National Forests, and Federal lands in incorporated cities, towns, and villages.

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Assessment: The entire Flat Canyon Coal Lease Tract lies on National Forest System lands. An exception to this criterion can be made because surface operations and impacts would be incident to an underground mine. The Forest Plan and Flat Canyon Coal Lease Tract EIS have

determined that leasing can occur without significant impacts to recreational, timber, economic, or other values that may be incompatible with the lease. Underground coal mining is allowed on National Forest lands [43 CFR 3461.5 (a)(2)(i)].

Criterion Number 2: Federal lands that are within rights-of-way or easements or within surface leases for residential, commercial, industrial, or other public purposes, on federally owned surface shall be considered unsuitable.

Assessment: This criterion is not applicable because lands proposed for leasing do not contain designated rights-of-way for easements of public residential, commercial, or industrial purposes. The adjacent private lands with privately owned coal reserves would be mined only as agreed by the proponent and private landowners under State law. Any damages would be fairly repaired and/or compensated.

Criterion Number 3: The terms used in this criterion have the meaning set out in the Office of Surface Mining Reclamation and Enforcement regulations at Chapter VII of Title 30 of the Code of Federal Regulations. Federal lands affected by section 522(e) (4) and (5) of the Surface Mining Control and Reclamation Act of 1977 shall be considered unsuitable. This includes lands within 100 feet of the outside line of the right-of-way of a public road or within 100 feet of a cemetery, or within 300 feet of any public building, school, church, community, or institutional building or public park or within 300 feet of an occupied dwelling.

Assessment: There are no public buildings, parks, schools, churches, community, or institutional buildings, or cemeteries within the proposed lease area. Private buildings/dwellings on adjacent private lands with private coal would be mined only by agreement between the mining companies and private land and coal owners in accordance with state law. Underground mining and subsidence of State Highway 264 and the associated right-of-way could take place only as approved by the Utah Department of Transportation and agreement between the Utah Department of Transportation and the lessee/operator providing for immediate repair of damages. The subsidence analysis discusses possible minor cracking of the asphalt surface but the risk of impacts to public safety would be very low based on the results of subsidence of this State Highway in the Eccles Canyon area.

Criterion Number 4: Federal lands designated as wilderness study areas shall be considered unsuitable while under review by the Administration and the Congress for possible wilderness designation.

Assessment: This criterion was addressed in the Forest Plan as not applicable because no existing or proposed wilderness study areas exist within the Manti Division of the Forest that contains minable coal reserves.

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Criterion Number 5: Scenic Federal lands designated by visual resource management analysis as Class I Scenic areas of outstanding scenic quality but not currently on the National Register of Natural Landmarks shall be considered unsuitable.

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Assessment: This criterion is not applicable because there are no lands within the proposed lease area that are designated as areas of outstanding scenic quality (Class I). Lands within the tract have a visual quality objective of "partial retention". Partial retention provides for management activities that are visually subordinate to the characteristic landscape.

Criterion Number 6: Federal lands under permit by the surface management agency, and being used for scientific studies involving food or fiber production, natural resources, or technology demonstrations and experiments shall be considered unsuitable.

Assessment: This criterion is not applicable because no lands in the proposed lease area are designated for or being used as scientific studies.

Criterion Number 7: All publicly or privately owned places that are included in the National Register of Historic Places (NRHP) shall be considered unsuitable.

Assessment: There are no prehistoric sites within the tract, but past surveys have identified two lithic scatters in the area. Neither are eligible for listing in the NRHP.

Five historic sites (42Sp220, 42Sp399, 42Sp400, 42Sp444, and 42Sp447) are located within the lease area, and five more historic sites (42Sp393, 42Sp442, 42Sp443, 42Sp445, and 42Sp446) are located on adjacent private lands that could potentially be mined if authorized by the regulatory agencies and mineral estate owners. Site 42Sp445, a homestead, is recommended as eligible to the NRHP under criterion C, due to the fact that the site consists of standing in-period habitation structures which embody the characteristics of a type, period, or method of construction. The remaining sites, which are not eligible for listing in the NRHP, include sawmills, homesteads, wagon roads, dairies, and aspen art localities.

Because site 42Sp445 is located on private land, it may only be mined with the consent of the landowner. The Forest Service has no authority to approve or disapprove mining on private lands. The structures at site 42Sp445 are built of logs, so the chance of being damaged by subsidence would be very low.

The sites within the lease area have been excepted because all or certain stipulated methods of coal mining may be allowed if, after consultation with the Advisory Council on Historic Preservation and the State Historic Preservation Office, they are approved by the FS, and where appropriate, the State or local agency with jurisdiction over the historic site. The sites will be protected or mitigated according to the required consultations.

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Criterion Number 8: Federal lands designated as natural areas or as National Natural Landmarks shall be considered unsuitable.

Assessment: This criterion was addressed in the Forest Plan as not applicable because no designated natural areas or National Natural Landmarks occur within the Flat Canyon Coal

Lease Tract Project area.

Criterion Number 9: Federally-designated critical habitat for listed threatened or endangered plant and animal species, and habitat proposed to be designated as critical for listed or proposed species, or habitats determined by the USFWS to be of "essential value".

Assessment: There are no endangered species, or species proposed for listing, known to occur within the project area. However, four threatened species are known to occur, or have historical range, in Sanpete County. They are Heliotrope milkvetch (*Astragalus montii*), bald eagle (*Haliaeetos leucocephalus*), Canada lynx (*Lynx canadensis*), and Utah prairie dog (*Cycomys parvidens*). None of these species have federally-designated critical habitat within or near the proposed Flat Canyon coal lease tract.

Criterion Number 10: Federal lands containing habitat determined to be critical or essential for plant or animal species listed by a state pursuant to state law as endangered or threatened shall be considered unsuitable.

Assessment: The State of Utah has listed as endangered or threatened seven species that have the potential to occur on or within the project area. State-listed endangered species include: American peregrine falcon (*Falco peregrinus anatum*), southwestern willow flycatcher (*Empidonax trailli extimus*), and black-footed ferret (*Mustela nigripes*). The State listed threatened species are: bald eagle (*Haliaeetus leucocephalus*), ferruginous hawk (*Buteo regalis*), Utah prairie dog (*Cynomys parvidens*), and wolverine (*Gulo gulo*). Of these species, all but the ferruginous hawk and wolverine are also Federally listed as either endangered or threatened; therefore, assessments for these five species are included under other Criterion (9, 11, 12, and 13).

Ferruginous hawks are widely distributed throughout the grassland and steppe-desert areas of the United States and southern Canada. Although ferruginous hawks nest in a variety of sites, pinyon-juniper woodland provides preferred nest-sites. Nesting usually takes place in scattered junipers overlooking broad, open valleys. Ferruginous hawks are consistently absent from areas of steep-sided canyons, cliffs, or heavily wooded areas, including the interior of pinyon-juniper woodlands. These hawks are open country hunters. Based on a review of data adequacy information provided by the FS, there is no indication that ferruginous hawks nest within the project area. The project area provides only marginal habitat for this species. Therefore, impacts from any of the proposed action alternatives would be negligible for this species.

Wolverines are usually found in temperate coniferous forests from mid-elevation to timberline. They are associated primarily with extensive forests of the north but populations of wolverines do occur in some of the more remote and forested mountains of the continental United States. Common tree species in wolverine habitat include subalpine fir and lodgepole pine. Wolverine apparently prefer remote areas that are infrequently used by humans. The last unverified sighting of a wolverine in the Manti Range was made in 1992. Based on a review of data adequacy information, there is no indication that wolverine inhabit the project area. Therefore,

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impacts from any of the proposed action alternatives would be negligible for this species.

Criterion Number 11: A bald or golden eagle nest or site on Federal lands that is determined to be active and an appropriate buffer zone of land around the nest site shall be considered unsuitable.

Assessment: Historical records and a 1999 aerial survey have documented that there are no golden or bald eagle nests in the project area or within 1 mile.

Criterion Number 12: Bald and golden eagle roost and concentration areas on Federal lands used during migration and wintering.

Assessment: This criterion is not applicable because no bald or golden eagle winter roost or migration concentration areas occur in the project area.

Criterion Number 13: Federal lands containing a falcon cliff-nesting site with an active nest and a buffer zone of Federal land around the nest site shall be considered unsuitable.

Assessment: There are no active peregrine falcon cliff nest sites in the project area or within 2 miles of the proposed mining area.

Criterion Number 14: Federal lands which are high priority habitat for migratory bird species of high Federal interest on a regional or national basis, as determined jointly by the surface management agency and the Fish and Wildlife Service, shall be considered unsuitable.

Assessment: This criterion was addressed in the Forest Plan as not applicable because no high priority habitat for any migratory bird species of high Federal interest exists within the Project Area.

Criterion Number 15: Federal lands which the surface management agency and the state jointly agree are habitat for resident species of fish, wildlife and plants of high interest to the state and which are essential for maintaining these priority wildlife and plant species shall be considered unsuitable.

Assessment: The Flat Canyon Tract provides summer and winter range for mule deer and elk and an elk migration corridor has been identified in the Flat Canyon/Upper Huntington Creek area. Underground mining is not likely to affect the big game winter range or the elk migration. No long-term impacts to mule deer and elk winter range or the elk migration.

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Electric Lake and Upper Huntington Creek drainage are spawning habitat for Yellowstone cutthroat trout. The Upper Huntington Creek drainage was certified as the only certified disease-free source of eggs for hatcheries in Utah. Collection of eggs for hatcheries in this area was discontinued by the Utah Division of Wildlife Resources in the year 2000 and there are no plans to manage the habitat in the near future for this purpose. Leasing and underground mining are

not expected to cause effects that would jeopardize this habitat.

Criterion Number 16: Federal lands in riverine, coastal and special floodplains (100-year occurrence interval) on which the surface management agency determines that mining could not be undertaken without substantial threat of loss of life or property shall be considered unsuitable for all or certain stipulated methods of coal mining.

Assessment: This criterion is not applicable since the proposed lease areas do not contain any of these areas and would not be a substantial threat of loss of life or property.

Criterion Number 17: Federal lands which have been committed by the surface management agency to use as municipal watersheds, shall be considered unsuitable.

Assessment: This criterion was addressed in the Forest Plan as not applicable because there are no designated municipal watersheds on the Manti Division of the Manti-La Sal National Forest. Although Huntington Creek is utilized as a water supply for the town of Huntington, it has not been officially designated as a municipal watershed.

Criterion Number 18: Federal lands with National Resource Waters, as identified by states in their water quality management plans, and a buffer zone of Federal lands 1/4 mile from the outer edge of the far banks of the water, shall be unsuitable.

Assessment: This criterion was addressed in the Forest Plan as not applicable because there are no designated National Resource Waters within coal lands on the Manti-La Sal National Forest.

Criterion Number 19: Federal lands identified by the surface management agency, in consultation with the state in which they are located, as alluvial valley floors.

Assessment: This criterion was addressed in the Forest Plan as not applicable because no part of the Manti-La Sal National Forest is considered to be an alluvial valley floor.

Criterion Number 20: Federal lands in a state to which is applicable a criterion (i) proposed by the state or Indian tribe located in the planning area, and (ii) adopted by rulemaking by the Secretary, shall be considered unsuitable.

Assessment: This criterion was addressed in the Forest Plan as not applicable because no such lands occur within the Manti-La Sal national Forest.

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Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations.": Based on comments received during scoping, no adverse environmental or human health effects on minority or low income populations have been identified that could result from the proposed action and subsequent decisions. Environmental justice means that, to the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered on, are allowed to share in the benefits of, and not excluded from, and are not affected in a disproportionately high and adverse manner by, government programs and activities affecting human health or the environment. Decisions must be consistent with this Order. The decisions of the responsible officials will seek and incorporated public involvement. The decisions must not have a discernible effect on minorities, American Indians, or women, or the civil rights of any United States citizen. Nor must they have a disproportionate adverse impact on minorities or low-income individuals.

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Record of Decision
based on the
Final Environmental Impact Statement
for the
Flat Canyon Coal Lease Tract (UTU-77114)

USDA Forest Service
Manti-La Sal National Forest
Ferron-Price Ranger District
Sanpete and Emery Counties, Utah

January 2002

Responsible Agency:	USDA Forest Service, Intermountain Region
Responsible Official:	Elaine J. Zieroth Forest Supervisor Manti-La Sal National Forest 599 West Price River Drive Price, Utah 84501
Information Contact:	Carter Reed Team Leader Manti-La Sal National Forest 599 West Price River Drive Price, Utah 84501 (435) 637-2817

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I. INTRODUCTION

A. Proposed Action Overview

The proposed action is for BLM to offer the Flat Canyon Coal Lease Tract (UTU-77114) for competitive leasing in response to Canyon Fuel's (Canyon Fuel Company, LLC) application for leasing under the Lease-on-Application process contained in Federal Regulations 43 CFR 3425. The purpose of offering the tract for competitive leasing is to provide an opportunity to develop mineable Federal coal reserves by underground methods. Leasing would prevent bypassing mineable coal reserves adjacent to an existing mine that may otherwise not be mined. The coal is needed for the generation of electricity, other industrial uses, and to provide economic returns to the National, State and local economies.

Canyon Fuel's application is to obtain the right to mine known Federal coal reserves in the Flat Canyon Tract, immediately to the west of the current permit area for their Skyline Mine and extend the life of the mine. Canyon Fuel would extend their underground coal workings to the west into the Flat Canyon Tract and beyond into private (fee) coal reserves. It is not likely that any other company would bid on the tract. The coal does not crop out within or adjacent to the tract and the amount of coal available does not economically warrant the cost of developing new portal facilities that would access the coal through a complex of shafts.

The tract was delineated by an Interagency Tract Delineation Team to assure that it is reasonable and meets requirements of the responsible agencies. The Flat Canyon Tract encompasses 2,692.16 acres of Federal coal reserves of the Wasatch Plateau Coal Field on National Forest System lands within the Manti-La Sal National Forest in Sanpete County, Utah. This area is described in the FEIS as the "Tract Area" as follows (FEIS, Figures 1.1 and 1.2):

T. 13 S., R. 6 E., SLM,

Section 21, lots 1-4, E1/2E1/2;
Section 28, lots 1-8, S1/2NW1/4, SW1/4;
Section 33, E1/2, E1/2W1/2, NW1/4NW1/4, SW1/4SW1/4;

T. 14 S., R. 6 E., SLM,

Section 4, lots 1-4, S1/2N1/2, S1/2;
Section 5, lots 1-4, S1/2N1/2, S1/2.

The tract encompasses 2,692.16 acres. Additional non-Federal lands with non-Federal coal (both in private ownership) adjacent to the Federal coal lease tract, referred to as the "Private Lands (approximately 1,100 acres)," could be mined as a result of this lease action. They are described below:

T. 13 S., R. 6 E., SLM,

Section 29, E1/2SE1/4, SE1/4NE1/4, S1/2NE1/4NE1/4;
Section 32, E1/2E1/2.

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T. 14 S., R. 6 E., SLM,

Section 3 (portion as shown on Figure 1-2)
Section 8, N1/2N1/2;
Section 9, N1/2N1/2;
Section 10 (portion shown on Figure 1-2).

The Tract area and adjacent private lands are collectively referred to in this FEIS as the "Project Area". Therefore, the total area analyzed is approximately 3,792 acres.

B. Decisions to be Made

The USDI, Bureau of Land Management (BLM) has the leasing authority for all Federal coal reserves under the Mineral Leasing Act of 1920, as amended. The BLM Utah State Director must decide:

- whether or not to offer the Flat Canyon Tract for competitive leasing.
- what terms, conditions, and stipulations are needed on the lease to ensure compliance with the Mineral Leasing Act of 1920, as amended.

The USDA, Forest Service is the Surface Management Agency. The Forest Supervisor, Manti-La Sal National Forest, must decide:

- whether or not to consent to leasing by BLM, under authority of the Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1975.
- what special coal lease stipulations are needed for the protection of non-mineral resources.

The Forest Service decision to consent to leasing, with measures for protection of non-mineral resources, would also allow approval of mining in the tract by the regulatory agencies as long as it is determined (with concurrence of the Forest Service) that the effects to non-mineral resources on National Forest System lands would be consistent with determinations of the FEIS and Forest Service Record of Decision.

Since Forest Service and Bureau of Land Management decisions involve separate and distinct procedures and appeals, the agencies are releasing separate Records of Decision based on the FEIS.

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II. THE DECISIONS

A. The Selected Alternative

After careful review of the public comments, the analysis disclosed in the FEIS, and project file, I have decided to select a combination of Alternative B' and C. My decision is hereafter referred to as the "Selected Alternative". The Selected Alternative closely resembles Alternative B' except that (similar to C) there would be a limit on the amount of subsidence that could occur beneath perennial streams,

Boulger Dam and Reservoir, State Route 264, and Flat Canyon Campground on National Forest System lands within the project area. Therefore, I consent to leasing and subsidence of the Flat Canyon Tract, with Forest Service and BLM Special Coal Lease Stipulations (Attachment 1) but subsidence of the areas noted above would be limited to that which would occur from a single-seam of full-extraction mining. This would allow development in two overlapping seams with full-extraction in one seam and only full-support (no subsidence) mining in the second seam within the limited subsidence zones. It would also provide for two overlapping seams of full-extraction mining outside of the limited subsidence zones. The limited-subsidence areas would be established as discussed in Special Coal Lease Stipulation #9 (Attachment 1). In addition, detailed and comprehensive monitoring of the effects of mining would be required in Forest Service consent/concurrence to approval of the Mining and Reclamation Plan (MRP) and Mine Permit to be issued by the Department of Interior. The lessee/operator would also be required to promptly commence and complete measures specified to mitigate effects. Attachment 2 is a list of monitoring and mitigation requirements that will be incorporated during the MRP and Mine Permit review and approval process.

I did not select Alternative A (No Action) because it would not be consistent with the Presidents Energy Policy and would not make coal reserves available for development consistent with Forest Plan direction, considering that development could occur and direction for management of other resources can likely be achieved. Alternative B was not selected because it would not include Special Coal Lease Stipulations needed to minimize effects to other resources consistent with Forest Plan direction. Alternative B' would include Special Coal Lease Stipulations, but could result in effects of mining-induced subsidence to structures and perennial streams that may not be effectively mitigated. Alternative C was not selected because it limited the potential mining area to small blocks that may not be mineable from an economic standpoint and a valuable reserve of coal could be bypassed.

III. REASONS FOR DECISION

After reviewing the Flat Canyon Coal Lease Tract FEIS, and examining the issues and effects analysis of the alternatives, I believe that the Selected Alternative provides a reasonable balance between meeting the Nation's energy needs/President Energy Plan, providing socioeconomic benefits to the local communities, State of Utah, and United States, and managing natural resources on National Forest System lands and adjacent non-Federal lands. It however, involves reasonable compromises by limiting the amount of coal that can be mined and allowing short-term, local decreases in recreation opportunities and changes to the natural environment. With required monitoring and mitigation of effects described in Attachment 2, I believe that Forest Plan goals and objectives can be achieved consistent with management direction.

I have chosen the Selected Alternative for the reasons discussed below in this section. Attachment 3 contains corrected and expanded versions of Tables 2.1 (Comparison of Alternatives, Direct Physical Changes Due to Mining) and Table 2.2 (Comparison of Alternatives, Effects by Resource/Issue) in the FEIS. The tables show the effects of the Selected Alternative relative to the other evaluated alternatives.

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A. Achievement of the Forest Plan Goals and Objectives

The Manti-La Sal National Forest Land and Resource Management Plan (Forest Plan) identifies goals for the management of the Forest. Goals are concise statements describing a desired condition to be achieved some time in the future. Progress is made toward achieving the goals, and their corresponding desired conditions, through implementation of site-specific projects. Projects are designed to achieve specific goals and move toward desired conditions.

B. Meeting the Purpose and Need of the Proposal

The purpose of offering the tract for competitive leasing is to provide an opportunity to develop mineable Federal coal reserves by underground methods. This coal is needed for the generation of electricity, other industrial uses, and to provide economic returns to the National, State and local economies. If the tract were not leased within the approximate proposed time frame, it is likely that the mineable Federal coal reserves in the project area would be bypassed and not mined in the foreseeable future.

The purpose of Canyon Fuel's application is to obtain the right to mine known Federal coal reserves in the Flat Canyon Tract, immediately to the west of the current permit area for their Skyline Mine. If Canyon Fuel is the successful bidder, they would extend their underground coal workings to the west into the Flat Canyon Tract and beyond into private (fee) coal reserves. This would allow the life of the Skyline Mine to be extended and provide the most efficient mining scenario for available reserves. In addition, mining in the tract would provide needed coal production time to allow potential development of the Winter Quarters Lease (UTU-67939) north of the current permit area without interruption of longwall production mining and associated employment.

My decision would allow production of up to 28 million tons of coal and potentially extend the life of the Skyline mine by up 7 years based on an annual production rate of 4 million tons. This is consistent with Canyon Fuel's current plans for mining the Tract with available mining equipment and would provide more longwall production time than needed to develop underground access to the Winter Quarters Lease (UTU-67939) (3 to 4 years) for future mining.

C. Forest Plan Goals, Objectives, and Standards

Leaseable Minerals

A review of the Forest Plan showed that the proposed lease tract area is available for further consideration for coal leasing through application of the Unsuitability Criteria (43 CFR 3464) and an appropriate environmental analysis. (Letter to the Utah State Director of BLM from the Forest Supervisor, Manti-La Sal National Forest 2820-4, January 21, 2000). The Tract lies within the Huntington Canyon-Gentry Mountain coal Multiple-Use Evaluation Area (Forest Plan, pg. C-8). Issues and concerns that must be evaluated for tracts in this area include water quality, traffic, visual quality, and recreation. No areas of the Tract were determined to be unsuitable (FEIS, Appendix F) and the specified issues were evaluated in the FEIS.

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Forest Plan, Page III-35, Minerals Management Leaseable (01) "Negative recommendations, denials, or consent for leasing, permitting, or licensing will be based on site specific environmental assessments using appropriate standards and guidelines. Stipulations for these activities should minimize and/or mitigate effects or conflicts with other resource uses and should return disturbed lands to conditions compatible with the emphasis of the management unit or adjacent management unit."

My decision conforms with this direction. An FEIS was completed for the proposal and I have decided to consent to leasing subject to Special Coal Lease Stipulations prescribed in the Forest Plan, needed to mitigate the effects of leasing/mining consistent with management emphasis for the affected management units. The lease stipulations in combination with Federal Regulations for permitting coal mine operations (30 CFR 700 to end) and the Utah Coal Rules provide for management consistent with emphasis for individual Forest Plan Management Units.

Forest Plan direction for specific management units is address as follows:

RNG (Range) Management Unit

Minerals Management General (Forest Plan, pg. III-66)

01 "Provide appropriate mitigation measures to assure continued livestock access and use".

It was determined in the FEIS (pg. 2-8) that there would be negligible effects to livestock access and use and this was dismissed as an issue.

02 "Those authorized to conduct developments will be required to replace losses through appropriate mitigations, where a site-specific development adversely affects long-term production or management."

Special Coal Lease Stipulation #13 requires protection, restoration, or replacement of owned or permitted surface improvements.

DRS (Developed Recreation Sites) Management Unit

Minerals Management General and Minerals Management Leaseable (Forest Plan, pg. III-50)

01 "Manage mineral activities to be compatible with recreation uses and visual quality objectives."
01 "Allow mineral leasing where it is determined that stipulated methods of development and extraction will not adversely affect recreation values to any significant degree."

Flat Canyon Campground is the only DRS Management Unit in the Project Area. It could be closed for one summer use season with additional time needed for repairs due to potential damages from subsidence and safety concerns regarding use of associated facilities during active subsidence. If mined under and subsided during the non-use winter season, it might not be necessary to close it during the following summer-use season unless extensive repairs are necessary. The lessee/operator would monitor the facilities for damages and would be required to make repairs as necessary. The campground would be reopened once utility systems (water/waste water) can safely be operated. During any

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necessary closure, recreation use would be displaced to other available facilities in the area. In addition, the loss or recreation use would be mitigated as required in Attachment 2.

Boulger Reservoir is a popular summer season fishing location, however it was not designated as a DRS Management Unit in the Forest Plan. This facility could be closed and drained for up to 7 years due to potential subsidence damages and safety concerns unless reconstructed to be able to withstand subsidence without significant damage. The latter is an option only if the lessee/operator can demonstrate to the Forest Service and State of Utah that damages would not occur and the Dam could continue to function in a safe manner. The lessee/operator will be required to provide other fishing opportunities to mitigate or offset the effects. If the Dam is breached or damaged, the lessee/operator will be required to reconstruct the Dam to current State standards, dredge the reservoir, and replace/repair the fish ladder following completion of subsidence.

TBR (Timber) Management Unit

There are no specific requirements for mineral activities in TBR areas (Forest Plan, pg. III-68). No effects from subsidence are expected. Cutting of timber would be avoided when planning exploration and vent shafts. If merchantable timber is cut, the lessee/operator would be required to pay the fair market value for the trees (Special Coal Lease Stipulation #11. Reclamation would be conducted in a manner consistent with management unit objectives.

WPE (Watershed Protection/Improvement) Management Unit

Minerals Management General (Forest Plan, pg. III-79)

01 "Restore structural watershed improvements impacted by minerals activities where appropriate."

No effects to this area are expected. If effects should occur, the lessee/operator would be required to protect, restore, or replace any owned or permitted surface improvements. To provide for continuance of current land uses (Special Coal Lease Stipulation #13).

RPN (Riparian) Management Units

The goals of management are (Forest Plan, pg. III-69) to "(1) maintain water flows to provide free and unbound water within the soil needed to create the distinct vegetative community, (2) provide healthy self-perpetuating plant communities, (3) meet water quality standards, (4) provide habitats for viable populations of wildlife and fish, (5) provide stable stream channels and still water body shorelines, and (6) restore riparian habitats that have been lost through the downcutting of stream channels and wet meadows. The aquatic ecosystem may contain fisheries, habitat improvements, and channel stabilizing facilities that maintain or improve wildlife or fish habitat requirements."

Wildlife Habitat Improvement and Maintenance (Forest Plan, pg. III-70)

01 "Provide habitat diversity through vegetation treatments, and/or structural developments in conjunction with other resource activities, designed to maintain or improve wildlife or fisheries habitat".

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02 "Provide habitat for viable populations of native vertebrate species of fish and wildlife within existing ranges."
03 "Maintain current fish habitat inventory in cooperation with State wildlife agencies."
04 "Provide instream flows to support a sustained yield of natural fisheries resources."

Minerals Management General (Forest Plan, pg. III-72

01 "Avoid and mitigate detrimental disturbance to the riparian area by mineral activities. Initiate timely and effective rehabilitation of disturbed sites."
02 "Where possible, locate mineral activities outside the riparian unit."
03 "Design and locate settling ponds to prevent washout during high water. Locate settling ponds outside of the active channel. Restore channel changes to hydraulic geometry standards for each stream type."

This general direction can be met under the Selected Alternative. By limiting the amount of subsidence of perennial drainages, I believe that the effects can be managed to a level that can maintain viable populations of fish, macroinvertebrates, and other aquatic organisms. Required monitoring would provide information regarding the location and magnitude of effects needing mitigation. Required rehabilitation of affected areas would restore conditions needed to maintain viable populations over the long-term.

Land Uses

Boulger Reservoir and the Flat Canyon Campground are discussed above.

Consultation with the Bureau of Reclamation has determined that there would be no conflicts with the Bureau of Reclamation Withdrawal (personal communication with Bruce Snyder, Bureau of Reclamation, December 19, 2001).

Project scoping (telephone notes, project file) indicated that the private landowners are generally in favor of mining even though some damages to surface facilities are expected from subsidence. Under the Federal Mining Regulations and Utah Coal Rules, the operator would be required to coordinate with surface landowners and repair damages.

Pre-mining land uses would remain the same after mining is completed. As discussed above for specific Forest Plan Management Units, management direction can be met.

D. Response to Issues Raised

The following discussions explain how I considered the FEIS issues in making my decisions. The discussions are presented by resource issues as described in Chapter 2, pages 2-3 through 2-8, and Chapter 4 of the FEIS:

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Structures and Facilities

- *Mining-induced subsidence and seismicity could damage the Boulger Dam (including the fish ladder) and Reservoir (Significant Issue).*

  This facility could be closed for up to 7 years due to potential damages from mining-induced seismicity and subsidence and safety concerns or potentially reconstructed prior to mining such that the Dam would withstand seismicity/subsidence without significant damage. See discussion under DRS Management Units above.

  I believe that this is an acceptable effect because of the short-term of lost use and the net benefit to recreation uses (including reconstruction/improvement of the dam and improvements to adjacent facilities) that would occur after mining is completed. To offset increased use in other facilities, the lessee/operator would be required to conduct some improvements of these facilities. In addition, Boulger Reservoir is collecting sediment and as a result, degradation of the quality of facility for recreation fishing quality is occurring. Once mining and subsidence are completed and mining is sufficiently distant to prevent continued damages, reconstruction of the Dam to current State standards and dredging of the reservoir would result in a higher quality facility and improved fishing/recreation quality.

- *Mining-induced subsidence could damage State Highway 264 (Significant Issue) and Forest Roads (Non-Significant Issue).*

  The potential damages to these facilities would be reduced by limiting subsidence to that which would occur from one seam of full-extraction mining. The effects would be minor, similar to that which occurred in the existing Skyline Mine Permit Area, and rapidly/easily repaired by the lessee/operator as required under the Federal Mining Regulations, Utah Coal Rules, and Special Coal Lease Stipulations.

- *Extension of the mine life would increase the length of time that mining related traffic volumes would occur on State Highways (Non-Significant Issue).*

  Existing traffic levels would be extended by up to 7 years. The traffic levels are well within design capabilities. Increased long-term traffic would be negligible, except for an unknown amount of increase related to increased recreation use. Traffic increases relative to anticipated coal exploration and construction of the vent shafts would be short-term (2 seasons) involving an increase of approximately 42 trips per day. Cumulative increases considering other activities and pipeline construction activities (50 trips per day for one season) would also be short-term and can be effectively mitigated by use of flaggers and signs. Some delays in traffic can be expected, but would be minimized by proper planning required to allow traffic passage.

- *Mining-induced subsidence and seismicity could damage facilities at the Flat Canyon Campground (Significant Issue).*

  Under the Selected Alternative, the potential loss of use would be reduced to one summer season of

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use with additional time for repair. Special Coal Lease Stipulations would require the lessee/operator to monitor the facilities for damage and make prompt repairs such that the campground can be reopened as soon as possible. By closing the campground during active subsidence, safety concerns would be avoided. The cost of facility repairs would be borne by the lessee/operator and not the public.

- *Mining-induced subsidence could damage recreation cabins and/or camp facilities and roads on adjacent private lands that are mined as a result of leasing the Flat Canyon Tract (Non-Significant Issue).*

  Project scoping indicated that the private landowners are generally in favor of mining even though some damages to surface facilities are expected from subsidence. Under the Federal Mining Regulations and Utah Coal Rules, the operator would be required to coordinate with surface landowners, repair damages, and compensate owners for any lost use.

Surface and Ground Water

- *Prolonged and increased discharge of mine water into Eccles Creek could change water quality in Eccles Creek, other downstream drainages, and Scofield Reservoir. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).*

  The mine water discharge point is below the Forest Boundary in Eccles Creek. An increase in mine water discharge to Eccles Creek has already occurred over the last year. The increase was from less than 1,000 gpm to approximately 15,000 gpm. As discussed in the FEIS stream morphology changes have already occurred and will continue for at least 2 more years regardless of my decision to consent to leasing of the Flat Canyon Tract.

  The quality of discharge water has improved over the last year due to higher quantities of ground water encountered in Mine #3, decreased dwell time in underground workings, and installation of a sand filtration system for Mine #1 discharge. Quality of discharge water is expected to continue to improve over existing discharges.

  A potential increase of 7,000 gpm of mine water discharge is possible as a result of mining the Flat Canyon Tract and adjacent private lands. If discharged to Eccles Creek, significant effects to the morphology of Eccles Creek and Mud Creek below the Forest boundary could occur. However, these effects can be mitigated by balancing discharge between Eccles Creek and a potential new discharge point in Electric Lake if a UPDES permit is issued Canyon Fuel by the Utah Division of Water Quality. In addition, Canyon Fuel is conducting a study to determine how much flow Eccles Creek and Mud Creek can accommodate without significant damages. Discharge above a potential threshold would be piped directly to Scofield Reservoir, bypassing the stream channels (personal communications with Chris Hansen, Canyon Fuel, December 20, 2001). The pipe could be buried under already disturbed areas such as the roadways minimizing additional surface disturbance and environmental effects.

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- *A new mine water discharge point at the north end of Electric Lake would involve changing all or some of the discharge from Eccles Creek in the Price River Watershed to the Huntington Canyon Watershed. This could decrease flow in the Price River Watershed and increase flow in the Huntington Canyon Watershed (Significant Issue).*

  This issue was identified due to potential loss of pre-January 2001 flows of less than 1,000 gpm to Scofield Reservoir if the discharge were shifted to Electric Lake. Due to the increased flows over the last year, level of concern regarding this issue has decreased. It is highly unlikely that all of the mine water discharge would be shifted from Eccles Creek to Electric Lake due to the high total volumes. It is predicted that an additional 7,000 gpm of mine water discharge could be required as a result of mining the Flat Canyon Tract. The current proposal involves decreasing flow to Eccles Creek from 15,000 gpm to 10,000 gpm and discharge of approximately 12,000 gpm to Electric Lake. It appears likely that the State of Utah could issue a UPDES discharge permit to Canyon Fuel to discharge mine water to Electric Lake. This would allow the above scenario to occur. In addition, Canyon Fuel would have the ability to adjust discharge volumes to the two watersheds as needed to accommodate needs of the water users. Officials of both Water Districts have made it clear to the Forest Service and regulatory agencies that they are anxious to maximize flow to the respective reservoirs (Quarterly Meetings Hosted by the Manti-La Sal National Forest).

- *Changing some or all of the mine water discharge from Eccles Creek to Electric Lake could change water quality in the receiving streams/water bodies (Significant Issue).*

  No increases in sediment are likely in Electric Lake because mine water and ground water discharge would be directly to the reservoir, bypassing Upper Huntington Creek. Adverse effects to Huntington Creek below the dam are not expected due to operation of the dam and controlled release to Huntington Creek based on precipitation cycles and seasonal runoff.

  Due to the large quantity of ground water and increased discharge of ground water and mine water in Mine #3, the quality of water discharged from the Skyline Mine has improved (EarthFax, Skyline Mine Discharge Evaluation, 2001). In addition, Canyon Fuel has increased their pumping capacities and have decreased dwell time of mine water in the mine workings causing additional increases in the quality of mine water (Chapter 4, Section 4.1.4). A sand filtration treatment system has been installed at the mine water discharge point in Eccles Canyon. All water except for discharge from abandoned workings in Mine #3 is treated through this system (between 80 and 90% of water discharged). The remaining 10-20% is discharged from the Mine #3 abandoned workings (personal communications with Chris Hansen, Canyon Fuel, December 21, 2001). By mixing these waters, quality requirements can be maintained. Based on recent analyses conducted by EarthFax (Skyline Mine Discharge Evaluation, 2001) and water quality data submitted to the Forest Service by Canyon Fuel for September, October, and November 2001 (project file) and mixing models prepared by EarthFax (December 17, 2001 Addendum to Skyline Mine Discharge Evaluation, project file), parameters of concern that include total dissolved solids, phenol, and phosphorous have decreased to low levels consistent with the receiving waters. Water quality meets State of Utah Beneficial Use Standards and water quality is generally consistent with quality of the receiving waters. Under

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normal operations, no adverse effects to water quality of the receiving streams and reservoirs are expected. Under requirements of a UPDES permit and Special Coal Lease Stipulations monitoring sufficient to detect increases in concentrations of selected parameters would be required and the lessee/operator would be required to treat discharge waters as needed to maintain water quality standards. Canyon Fuel proposes to monitor discharge water by automated methods and divert water that does not meet standards to the underground mine workings until standards can be met. Water from the two mine levels (Mines #1 and #3), new inflows, and mine water stored in the underground workings would be mixed during discharge to maintain water quality.

- *Subsidence of perennial streams and the Boulger Dam/Reservoir could intercept flowing/impounded water and divert it underground, changing the hydrology (Significant Issue).*

  It has been determined in the FEIS, Section 4.1.4 and 4.1.5 that diversion of surface and ground water from subsidence is not likely and that any effects would be temporary and negligible under Alternative B'. The Selected Alternative decreases any potential even further by limiting the amount of subsidence that could occur beneath perennial streams.

- *Subsidence could change the flow of springs and seeps, affecting the flow of springs and their receiving streams. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).*

  As discussed in the FEIS, Sections 4.1.4 and 4.1.5, the potential for loss of flow at springs is negligible under Alternative B' and therefore under the Selected Alternative. The potential for shifting of spring emergence locations is very low and confined to areas with shallow overburden. Overburden in the project area is 600 feet and greater, therefore the potential for this to occur is very remote. Under the Selected Alternative the amount of expected subsidence is decreased and the potential for spring water diversion is further reduced.

- *Interception of ground water in underground mine workings and subsequent discharge to Eccles Creek (Existing NPDES Permit) could cause diversions of surface and ground water from the Huntington Canyon Drainage to the Price River Drainage. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Significant Issue).*

  This issue was identified due to concerns of the local water users that ground water intercepted in the underground mine workings beneath the Huntington Canyon Watershed is being discharged and diverted to Eccles Creek in the Price River Watershed. As discussed in Section 4.1.5, the ground water encountered in the mines is ancient water that does not likely emerge as surface water to the Huntington Canyon Watershed. In addition, approximately 3,000 gpm of ground water is currently being discharged to Electric Lake from the James Canyon wells and approximately half of the water encountered in the mine could likely be discharged to Electric Lake, mitigating this concern.

- *Equipment and materials spilled, used, and/or abandoned in underground mine workings could change ground water quality and any connected surface water sources. This could affect agricultural, domestic, and industrial water supplies as well as ecosystems (Non-Significant Issue).*

  As discussed in the FEIS, Sections 4.1.4 and 4.1.5 the potential for contamination of surface waters

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is very unlikely due to requirements that the lessee/operator obtain approval from the regulatory agencies to abandon equipment underground and that evidence must be provided to demonstrate that safety issues prevent removal or that there would be no connection between the ground water and surface waters. Operators are required to remove all fluids, batteries, etc. prior to abandoning any approved equipment underground, unless safety hazards prevent removal. In the Flat Canyon Tract and project area it is unlikely that there is any connection between ancient waters encountered in the coal seams and the surface environment because of the depth of the coal seams and related underground workings. Overburden depths range from 600 feet to well over 2,000 feet. The coal seams dip to the west and do not crop out west of the mine area.

Vegetation

- *Subsidence and other mining-caused changes to surface and ground water could affect vegetation, especially riparian vegetation/wetlands (Significant Issue).*

  As discussed in the FEIS, Sections 4.1.4, 4.1.5, and 4.1.6 it is not likely that spring flow and associated wetlands would be affected. It is possible, but very unlikely that spring locations could shift due to subsidence and that the associated riparian vegetation communities would be affected. Under the Selected Alternative, the potential for this to occur would be further reduced due to limitation of subsidence to that expected for a single seam of full-extraction mining.

  In regard to riparian communities associated with perennial streams, see Wildlife below.

- *Construction of a pipeline and/or roads in or across riparian areas and/or wetlands could destroy vegetation and related habitat and increase downstream sediment (Non-Significant Issue).*

  Riparian areas would be avoided for construction of coal drilling pads and roads, but some stream crossings for access are anticipated. Streams would be crossed using bottomless pipe arches or bridges to minimize the disturbance to the stream channels, however it would be necessary to disturb some riparian areas adjacent to the streams. Perpendicular or near perpendicular crossings would be required to reduce disturbance. The disturbances would be temporary, lasting only one or two seasons. Reclamation of the disturbed area using riparian species would be required. Due to the small area (length of stream affected would be less than 30 feet for any individual road) relative to the adjacent stream channel lengths, re-vegetation with suitable species should be successful within 3-5 years.

Wildlife

- *Exploration drilling, construction of mine vent holes, and reclamation activities could temporarily disrupt use of summer habitat by terrestrial species (Non-Significant Issue).*

  As discussed in the FEIS, Section 4.1.7 the construction activities associated with coal exploration drilling and construction of vent shafts are short-term. Avoidance would last only as long as the activities. Prompt reclamation following completion of operations would replace lost vegetation within 3-5 years. Less than one acre would be disturbed long-term for the two vent shafts. Since no fans will be installed, there would be no long-term noise that would displace use.

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- *Any changes in stream gradient/morphology, water flow, and quality in perennial drainages, Boulger Reservoir, or riparian vegetation/wetlands could affect habitat for terrestrial and aquatic species. Includes changes in morphology due to flow changes and subsidence (Significant Issue).*

The Forest Plan direction includes the following (pg. III-31, 02), "Give preferential consideration to riparian area dependent resources in cases of irresolvable resource conflicts" and (pg. III-22, 08) "Manage waters capable of supporting self-sustaining fish populations to provide for those populations". Plan standards include the following (pg. III-36, 01,d, (5)), "Coal leases may be denied or limited by special stipulations where operations would result in unacceptable or unmitigable impact on wildlife or fisheries" and "Proposed management activities which may cause unfavorable conditions in existing fisheries will include mitigation measures".

Under Alternatives B' and the Selected Alternative perennial streams would be subsided. Stream morphology changes to drainages with average gradients greater than 5% such as Swens and Little Swens Canyons would react to subsidence similar to Burnout Canyon where the subsidence study determined that effects were not significant. For drainages with less than 5% average gradient there is no direct empirical evidence regarding potential effects. The Selected Alternative would reduce the amount of anticipated subsidence from up to 13 feet for Alternative B' to less than 7 feet (NorWest, 2000, Technical Report on Geology, Mining, Subsidence, and Seismicity, Table 5.2). Maximum surface slope change anticipated for one seam of mining over a single abutment or single fire barrier would be less than 1.0% (NorWest, 2000, Technical Report on Geology, Mining, Subsidence, and Seismicity, Tables 5.2 and 5.3, FEIS, Section 4.1.2, Table 4.1) as opposed to 3% over stacked abutments with two overlapping seams of full-extraction mining.

The perennial stream reaches of greatest concern are Boulger Creek and Flat Canyon due to their relatively flat stream gradients of less than 3%. In Flat Canyon the upper reaches above Flat Canyon Campground the stream gradient averages 0.93% and the maximum slope change is calculated at approximately 0.6%. East of Flat Canyon Campground the stream gradient increases to approximately 3%. In Boulger Creek the flattest gradient area is below the forks and above Boulger Reservoir where the average gradient is approximately 1.7%. The channel below the reservoir steepens as it cuts through the glacial moraine. The forks have a steeper gradient ranging from 3.0% to 7.5%. Considering the potential slope change, the anticipated subsidence should not cause a negative gradient over any extended stream reaches considering the average stream gradients. There is however potential for negative gradients to occur over short segments where the gradient is less than 1% as occurred in Burnout Creek (Utah Division of Oil, Gas and Mining, Letter to File Dated September 15, 2000, Subsidence in Burnout and James Canyons, Canyon Fuel Company, Skyline Mine, ACT/007/005, project file). As documented in this report, it was determined by the fisheries biologists in attendance that the pool had no adverse effects to aquatic habitat, the subsidence has had little or no effect on stream morphology, and that the creek is in good condition. The most likely scenario is that the percentage of pools in the streams would increase. Stream channel morphology could change as described in the FEIS, Section 4.1.7 and increased meandering is expected to a reduced extent. Since there would be only a single seam of full-extraction mining under the drainages and a single episode of subsidence, the stream channels would stabilize sooner than under Alternative B'.

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With required intensive monitoring of the channels and mitigations I believe that the effects to aquatic habitat can be mitigated to be consistent with Forest Plan standards for management of aquatic habitat. Attachment 2 contains a list of monitoring and mitigations to be incorporated as requirements for approval of the mine permit during the permit review and approval process. Special Coal Lease Stipulations #3 and #7 require baseline and operational monitoring sufficient to determine the progressive and final effects to the topographic surface, surface and ground water, and vegetation. The Federal Coal Mining Regulations (30 CFR 700 to end) and Utah Coal Rules provide authority to require mitigations needed to maintain land uses.

- *Changes to flow in drainages and points of mine water discharge would affect aquatic wildlife species and habitat (Significant Issue).*

The quality of water currently being discharged to Electric Lake from the James Canyon wells is approximately the same as the quality of water in upper Huntington Creek just above the reservoir. If a UPDES permit is issued by the Utah Division of Water Quality for discharge of mine water to James Canyon, monitoring would be required and limits to the quality of water that can be discharged would be set as requirements of the permit based on the quality of water in Upper Huntington Creek and/or Electric Lake. Discharge would be directly to Electric Lake so no effects would occur to Upper Huntington Creek. Discharge water must meet these quality standards. If monitoring shows exceedances, water would be discharged to mine sump areas, treated, or to Eccles Creek until water quality compliance is restored. Adverse effects to Electric Lake or Huntington Creek below the dam are not anticipated.

Recreation

- *Damage to recreation facilities and temporary closures (Boulger Dam/Reservoir, Flat Canyon Campground, Roads) could cause, displacement of recreation use to other areas, and/or loss of use during repairs/replacement and closure (Significant Issue).*

The potential lost use of the Flat Canyon Campground would be reduced to approximately one season of use and time needed for repairs. In addition, the potential for lost use of Boulger Reservoir would be reduced to up to 7 years. This is acceptable from a recreation perspective since there would be an overall net benefit to recreation opportunities within a seven year period or less. Improvement of adjacent recreation facilities would be required of the lessee/operator such that they could accommodate displaced use and Boulger Reservoir would be improved resulting in improved quality of the facility and the recreation fishing experience.

- *Subsidence could cause surface disruption and seismic events that could cause safety hazards and disrupt the recreation experience (Non-Significant Issue).*

By closing Flat Canyon Campground and Boulger Reservoir over the short-term during active subsidence, the potential safety risks are eliminated. Prior to approval of mining by the regulatory authorities the lessee/operator is required to cooperate with private landowners regarding potential risks to facilities. The lessee/operator will be responsible for repairs and/or reimbursement of land and facility owners for damages and potential lost use of facilities during active subsidence and repairs.

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- *Traffic and heavy equipment operation related to exploration drilling and drilling/construction of mine vent holes could temporarily disrupt dispersed recreation (Non-Significant Issue).*

  Traffic levels are expected to remain within design capabilities even with the extended period of mine traffic. Cumulative traffic levels associated with coal exploration, construction of the vent shafts, and pipeline construction are also expected to remain with design standards but could result in traffic delays at the SR-264, Monument Peak Road (FR50018). Required flaggers and warning signs would mitigate this short-term effect.

Visual Quality

- *Equipment and ground disturbance related to drilling exploration holes, construction of ventilation shafts, and reclamation would temporarily (construction phase) decrease visual quality (Non-Significant Issue).*

  Visual quality objectives would be met and effects to visual quality are short-term.

- *Ventilation shaft facilities, access roads, and any visible emissions (water vapor) would decrease visual quality for the life of the facilities (Non-Significant Issue).*

  Visual quality objectives for the disturbed area would be met. The access roads and portions of the vent shaft pads would be reclaimed and revegetated, minimizing visibility. Neither facility would be evident to traffic on SR-264.

Transportation

- *Extension of the mine life would increase the length of time that mining-related traffic volumes would occur on State Highways (non-significant Issue).*

  Under the Selected Alternative existing traffic volumes related to mine operations would be extended for up to 7 years. Cumulative anticipated traffic levels during this time are expected to remain with design standards for SR-264 and SR-31. Short-term increases in traffic for projects such as coal exploration drilling, pipeline construction, and timber harvesting on private lands could cause short-term exceedances, but safety would be assured by requiring flaggers, warning signs, and restrictions on road use during high use periods such as holiday weekends and the opening weekends of the big game rifle hunting seasons.

Cultural and Historic Resources

- *Construction of surface facilities and mining-induced subsidence could damage cultural resources.*

  No effects to cultural resources are anticipated. Potential effects to historic resources on private lands would be mitigated in accordance with the National Historic Preservation Act in consultation with the State Historical Preservation Office.

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Paleontological Resources

- *Underground mining, subsidence, and construction of surface facilities could damage paleontological resources.*

  No effects to significant paleontological resources are expected. Prior to conducting surface operations and disturbance surveys are required. If significant paleontological resources were discovered they would be avoided or recovered.

  Paleontological resources in the coal seams and mine roof could be destroyed during the mining process but these resources typically have limited scientific value. In the Federal Regulations contained in 36 CFR 261.2 pertaining to prohibitions on uses of National Forest System lands, paleontological resources are defined as "any evidence of fossilized remains of multicellular invertebrate and vertebrate animals and multicellular plants, including imprints thereof. Organic remains primarily collected for use as fuel such as coal and oil are Paleontological Resources, but are excluded from prohibitions under the rule". Therefore, fossils contained in coal seams and mined in the recovery of coal reserves are not protected under the rule.

Socio-economics

- *Leasing of the tract would extend the life of the Skyline Mine, provide an important energy resource, and result in social and economic benefits. If the mine closes, there could be a loss of jobs and socioeconomic benefits (Significant Issue).*

  The mine life could be extended by up to 7 years. The 220 jobs at the Skyline Mine and undetermined number of support service jobs related to Skyline Mine would be extended for this period of time.

  The recoverable reserves are estimated at approximately 28 million tons at a total value of approximately $476 million. Royalties would be approximately $38 million. It is likely the Canyon Fuel will bid on the tract and meet fair market value. An undetermined amount of bonus bid money would be received in addition to royalties.

IV. PUBLIC INVOLVEMENT

The Forest Service and BLM initiated scoping (30 day comment period) by publication of a Notice of Intent to Prepare an EIS in the *Federal Register* on March 17, 2000. A legal notice informing the public of the intent to evaluate the Flat Canyon Coal Lease Tract, prepare an EIS, and requesting issues and concerns, were published in the *Sun Advocate* Newspaper (publication of record) and the *Emery County Progress* (supplemental publication) on March 14, 2000. The legal notice was also published in the *Mt. Pleasant Pyramid* on March 15, 2000. A letter was sent to 100 agencies, individuals, and organizations on March 13, 2000 briefly explaining the proposed action and requesting comments regarding issues and concerns. The comment period ended at the close of business on April 18, 2000. The project was listed on the Forest Internet website and Quarterly Schedule of Proposed Actions. In addition, the proposed

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project was explained to local resource user organizations at the quarterly water users meetings and Emery County Public Lands Council meetings.

A letter was sent to the owners of private lands within and adjacent to the project area on October 30, 2000 informing them of the project and requesting comments followed by phone calls. Only one letter of response was received from the LDS Church asking for some additional information that was provided by telephone. The conversations with landowners divulged that they generally wanted to see the Federal and private lands mined. Some were concerned about potential damages to buildings from subsidence but felt that any necessary repairs would be made by the mining operator. At least two of the landowners were concerned about potential effects to springs within and adjacent to their property. One landowner was concerned about potential lowering of the private roads that cross Flat Canyon due to subsidence and that it would be difficult to relocate them because of the wetlands issue.

Nine letters and two phone calls were received in response to scoping. The Interdisciplinary Team (IDT) evaluated comments and identified the proposed issues based on the comments and concerns identified by participating agencies. The issues were approved by the agency responsible officials on June 8, 2000.

The Draft EIS was released for a 45-day public review in May 2001. The 45-day review period started on May 19, 2001, the day after the Environmental Protection Agency published the Notice of Availability in the *Federal Register* (Vol. 66, No. 97/Friday, May 18, 2001/Notices). The comment period ended at close of business on the 45th day, July 2, 2001. On May 8, 2001, copies of the DEIS were sent to individuals, agencies, and companies who responded to scoping, all agencies with direct interest or authority regarding the proposed action, and anyone who requested a copy for review prior to the date of the letter. Additional copies were provided to those requesting a copy for review after the letter was sent. Notices of Availability were published in the *Sun Advocate* Newspaper (publication of record) and the *Emery County Progress* (supplemental publication) on May 15, 2001. The Notice of Availability was also published in the *Mt. Pleasant Pyramid,* on May 16, 2001. Approximately 120 copies of the DEIS were distributed as described above. Comments and responses regarding the adequacy of the DEIS are contained in Chapter 5 of the FEIS.

The FEIS and this ROD were sent to individuals and organizations listed in Attachment 4. Additional copies will be made available upon request.

V. ALTERNATIVES CONSIDERED

A. Alternatives Considered in Detail, But Not Selected

Alternatives were developed to address the significant issues associated with the project and to meet the requirements of NEPA. The alternatives addressed cover both ends of the spectrum regarding the possibilities for leasing/mining. Alternative A (No Action) presents the effects of not leasing the Tract. Alternative B, at the other end of the spectrum is a leasing scenario with no special stipulations, representing the full-mining scenario where mining would be conducted to maximize efficiency and coal recovery without specific measures to protect surface resources. Alternative B' (B Prime) is a derivative of B that would result in the same mining scenario without restrictions to prevent subsidence of sensitive

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resource areas, but differs in that it includes Special Coal Lease Stipulations (SCLS) that would require specific monitoring and mitigations in the event that specific effects occur. Alternative C lies in between, representing a leasing scenario where SCLSs would be included in the lease and subsidence of sensitive resources and facilities/structures would not be allowed regardless of the potential level of effects to them. To provide information to the public and decision makers, so that combinations of these alternatives can be considered, each of the sensitive resources and structures/facilities are addressed individually in the analysis. All of the following alternatives were considered in the EIS.

ALTERNATIVE A, NO ACTION - The no action alternative provides a baseline for estimating the effects of the action alternatives. Under this alternative the lease tract would not be offered for leasing and there would be no mining.

ALTERNATIVE B, OFFER THE TRACT FOR LEASING AS DELINEATED/WITHOUT SPECIAL LEASE STIPULATIONS - Under this alternative the tract would be offered for competitive leasing, as delineated by the Tract Delineation Team, with BLM standard lease terms and conditions only, as displayed in Appendix B. No special coal lease stipulations would be included in the lease to be offered. Longwall (full-extraction) mining would be allowed throughout the tract resulting in subsidence of perennial drainages, Boulger Dam and Reservoir, Flat Canyon Campground, State Route 264 (other than along Upper Huntington Creek), and structures on private lands within the project area. It would be analyzed as the basis for comparison with other action alternatives that would include special stipulations needed to protect non-mineral resources and uses.

This alternative does not specifically meet Forest Plan requirements because it does not include any of the 17 Special Coal Lease Stipulations (SCLSs) prescribed for coal leases on National Forest System lands, on an as needed basis (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4). Special stipulations were not included for the purpose of disclosing the effects of leasing without special stipulations.

ALTERNATIVE B' (B PRIME), OFFER THE TRACT AS DELINEATED WITH SPECIAL COAL LEASE STIPULATIONS BUT WITHOUT RESTRICTIONS ON MINING THAT WOULD CAUSE SUBSIDENCE OF SENSITIVE SURFACE RESOURCES - Under this alternative, the tract would be offered for competitive leasing, as delineated, with BLM standard lease terms and conditions and special stipulations to protect non-mineral resources and uses. Special coal lease stipulations for this alternative are included in Appendix C. The mining scenario would be the same as Alternative B, without restrictions on subsiding sensitive resources, but would include lease stipulations that require mitigation of effects. In some cases, the opportunity exists to include similar requirements in the mine permit during the mining plan review and permitting process. For the purposes if this analysis, it is assumed that similar measures not specifically required by law or regulation would not be applied.

This Alternative B' would be consistent with Forest Plan direction (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4).

ALTERNATIVE C, OFFER THE TRACT FOR LEASING AS DELINEATED/WITH SPECIAL LEASE STIPULATIONS (Do Not Allow Subsidence of Perennial Drainages, Boulger Dam and Reservoir, or Flat Canyon Campground) - Under this alternative, the tract would be offered for

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competitive leasing, as delineated, with BLM standard lease terms and conditions and special stipulations to protect non-mineral resources and uses. Special coal lease stipulations for this alternative are included in Appendix C. Subsidence of perennial drainages, Boulger Dam and Reservoir, State Route 264, and Flat Canyon Campground would not be allowed. Subsidence of structures on private lands within the project area could occur, if the lessee/operator obtains permission from private coal estate owner(s), under agreement with the private surface estate owner(s). This alternative would be consistent with Forest Plan direction (Forest Plan, 1986, as amended, General Direction, Page III-35 and Appendix B, Pages B-2 through B-4).

OTHER ACTION ALTERNATIVES – Alternatives B and C define the least and most restrictive action alternatives regarding leasing/mining and resource protection. Other alternatives were considered in the decisions, as needed, to address significant social and environmental issues or opportunities. In formulating other alternatives for consideration in the EIS, the Forest Service and BLM looked at the tract boundary and potential restrictions on underground mining and surface occupancy needed to protect non-mineral resources and uses. Sensitive resource areas were specifically and individually evaluated under Alternatives B and C such that the effects can be adequately considered and disclosed if the decisions involve a combination of the evaluated alternatives. The Selected Alternative, which is essentially a combination of Alternatives B' and C, was based on this concept.

VI. Findings Required by Other Laws and Regulations

After consideration of the discussion of environmental consequences (FEIS, Chapter Four), I have determined that the Selected Alternative (a combination of Alternatives B' and C with modifications) is consistent with other laws and regulations, as outlined in the FEIS.

A. Consistency with Forest Plan Direction

Regulations and Requirements - All resource plans are to be consistent with the Forest Plan [16 U.S.C. 1604 (i)]. The Forest Plan guides all natural resource management activities [36 Code of Federal Regulations (CFR) 219.1 (b)]. All administrative activities affecting the National Forest must be based on the Forest Plan [36 CFR 219.10 (e)].

The Forest Plan was approved on November 5, 1986. The FEIS for the South Manti Timber Salvage tiers to the Forest Plan. The Forest Plan provides for the overall guidance for management activities by specifying goals and objectives, desired future conditions, management direction, and standards and guidelines.

The features of the Selected Alternative have been evaluated for consistency with the Forest Plan and I have determined that the Selected Alternative is in compliance with the Forest Plan. No Forest Plan amendments will be needed to implement this project.

B. Consistency with the National Forest Management Act

The Selected Alternative is consistent with the National Forest Management Act (NFMA) of 1976 in meeting the management requirements detailed in implementing regulations of 36 CFR 219.27. The

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Special Coal Lease Stipulations provide for protection of soil, water, air, wildlife, fishery resources, and other multiple uses.

C. Consistency with Other Laws and Regulations

Clean Water Act - The Clean Water Act requires each state to implement its own water quality standards. The State of Utah's Water Quality Antidegradation Policy requires maintenance of water quality to protect existing instream beneficial uses on streams designated as Category 1 High Quality Waters. All surface waters geographically located within the outer boundaries of the Manti-La Sal National Forest, whether on private or public lands are designated as High Quality Waters (Category 1). Water quality is to be maintained with little or no degradation. New point source discharges are prohibited; nonpoint sources will be controlled to the extent feasible through implementation of Best Management Practices (BMP's) or regulatory programs (Utah Division of Water Quality 1997). The State of Utah and the Forest Service have agreed through a 1993 Memorandum of Understanding to use Forest Plan Standards and Guidelines, and the Forest Service Handbook (FSH) 2509.22 Soil and Water Conservation Practices (SWCP's) as the BMP's. The use of SWCP's as BMP's meet the water quality protection elements of Utah's Nonpoint Source Management Plan.

The Beneficial uses and high quality water in the streams in the project area would be maintained during and following project implementation through proper implementation of BMP's and Project Design Features.

On November 30, 2001 the Utah Water Quality Board changed the designation of Electric Lake from High Quality Water - Category 1 (no new point source discharges allowed) to High Quality Water - Category 2 (new discharge allowed if there is no degradation of water quality). This was in response to a request by Canyon Fuel for this reclassification in anticipation of obtaining the Flat Canyon Tract and their proposal to discharge a portion of water entering the mine to Electric Lake.

Executive Order 11990 of May, 1977 - This requires the Forest Service to take action to minimize destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. In compliance with this order, Forest Service direction requires that an analysis be completed to determine whether adverse impacts would result.

Wetlands in the project area are associated with perennial streams and their headwaters. The Selected Alternative would be compliant with Executive Order 11990. Some changes to stream morphology are anticipated from subsidence. Detailed monitoring would be conducted and the lessee/operator will be required to mitigate potential effects. No loss of flow contributing to these areas is anticipated.

Executive Order 11988 of May, 1997 - This order requires the Forest Service to provide leadership and to take action to (1) minimize adverse impacts associated with occupancy and modification of floodplains and reduce risks of flood loss, (2) minimize impacts of floods on human safety, health, and welfare, and (3) restore and preserve the natural and beneficial values served by flood plains. In compliance with this order, the Forest Service requires an analysis be completed to determine the significance of proposed actions in terms of flood plains.

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Some changes to stream morphology are anticipated from subsidence. Detailed monitoring would be conducted and the lessee/operator will be required to mitigate potential effects. No loss of flow contributing to these areas is anticipated. Therefore, the Selected Alternative will be in compliance with Executive Order 11988.

Endangered Species Act of 1973, as Amended - Based upon the effects analysis in Chapter Four, the Biological Assessment (project file) and concurrence with the US Fish and Wildlife Service, it has been determined that there would be no adverse effects to populations of threatened, endangered, or proposed wildlife, fish, or plant species relative to the Selected Alternative.

Migratory Bird Treat Act of 1918 - The Selected Alternative will retain viable populations of native species.

American Antiquities Act of 1906 and Historic Preservation Act of 1966 - Based upon the effects analysis in Chapter Four and the Memorandum of Understanding with the Utah State Historic Preservation, it has been determined that there will be no measurable effects to any Historic Properties relative to the Selected Alternative. Any cultural properties discovered during project activities will be avoided, protected, or mitigated (see Special Coal Lease Stipulations, Attachment 1 and the FEIS, Unsuitability Analysis, Appendix F).

Clean Air Act, as Amended in 1977 - Based upon the effects analysis in Chapter Four, it has been determined that there will be no measurable effects to air quality and that all alternatives would comply with State air quality requirements and the Clean Air Act.

Civil Rights - Based upon comments received during scoping and the comment period for the DEIS, no conflicts have been identified with other Federal, State, or local agencies or with Native Americans, other minorities, women, or civil rights of any United States citizen.

Secretary of Agriculture Memorandum, 1827 - The Selected Alternative is in conformance for prime farmland, rangeland, and forestland.

Energy - The Selected Alternative would not have unusual energy requirements and would meet the intent of the Presidents Energy Policy.

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." - This order requires the Forest Service to make achieving environmental justice part of its mission by identifying and addressing as appropriate, disproportionately high and adverse health effects, of its programs, policies, and activities on minority populations and low-income populations in the United States and territorial possessions. In compliance with this executive order, the Manti-La Sal National Forest, through intensive scoping and public involvement attempted to identify interested and affected parties, including minority and low-income populations for this project. The Forest defined a range of alternatives to be evaluated and analyzed the consequences of the alternatives on the quality of human environment. A comment period was held for 45 days for the DEIS following the U.S. Environmental Protection Agency's publication of the Notice of Availability in the Federal Register.

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The land described in this analysis is managed by the USDA Forest Service as the Manti-La Sal National Forest. The adjacent private lands in the project areas are managed by the private landowners. Consultation with the landowners has been conducted. The decision for this document will not amend or preclude any existing private or treaty rights in the project area. No minority or low-income populations were identified during the pubic involvement within communities near or immediately surrounding the South Manti project area.

VII. ENVIRONMENTALLY PREFERRED ALTERNATIVE

Regulations implementing the National Environmental Policy Act (NEPA) require agencies to specify "the alternative or alternatives which were considered to be environmentally preferable" [40 CFR 1505.2(b)]. Forest Service policy further defines the "environmentally preferable alternative" as "an alternative that meets the goals of Section 101 of the NEPA." (FSH 1909.15). Section 101 of the NEPA describes national environmental policy, calling on federal, state, and local governments and the public to "create and maintain conditions under which man and nature can exist in productive harmony." Section 101 further defines this policy in six broad goals, to:

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;

(3) attain the widest range of beneficial uses of the environment without degradation, risk to health, or safety, or other undesirable and unintended consequences;

(4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and a variety of individual choice;

(5) achieve a balance between population and resource use which permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

From the perspective of causing the least amount of change to the natural environment, Alternative A (No Action) would be preferable. Considering a combination of all of the items described above, I believe that Alternative C best meets the goals of Section 101, and is therefore the environmentally preferable alternative for this proposed federal action. However, Alternative C has a high potential to render the coal reserves not mineable from an economic perspective and the related adverse socioeconomic effects would be significant. In addition, it does not provide the best balance between socioeconomic benefits and effects to the natural environment. Therefore, I did not select it.

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VIII. IMPLEMENTATION DATE

This project cannot be implemented until 15 days after the resolution of any appeal. If no appeal is received, the project may be implemented five days after the end of the appeal period.

IX. ADMINISTRATIVE REVIEW

This decision is subject to appeal pursuant to 36 CFR 215.7. Any written appeal must be postmarked or received by the Appeal Deciding Officer within 45 days of the publication of a legal notice in the *Sun Advocate*. The Appeal Deciding Officer is: Regional Forester, Intermountain Region, 324-25th Street, Ogden, UT 84401. Appeals must meet the content requirements of 36 CFR 215.14.

This decision is subject to appeal pursuant to 36 CFR 251.82. Notice of appeal must be postmarked or received by the Appeal Reviewing Officer within 45 days of the date of this decision. A notice of appeal, including the reasons for appeal, must be filed with the Regional Forester, Intermountain Region, Federal Building, 324-25th Street, Ogden, Utah 84401. A copy of the notice of appeal must be filed simultaneously with Elaine J. Zieroth, Forest Supervisor, 599 West Price River Drive, Price, Utah 84501. Appeals must meet the content requirements of 36 CFR 251.90.

For further information, contact Carter Reed or Aaron Howe, Manti-La Sal National Forest, 599 West Price River Drive, Price, Utah 84501, or phone (435) 637-2817.

Elaine J. Zieroth

ELAINE J. ZIEROTH
Forest Supervisor

January 3, 2002
Date

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ATTACHMENT 1
SPECIAL COAL LEASE STIPULATIONS

Federal Regulations 43 CFR 3400 pertaining to Coal Management make provisions for the Surface Management Agency, the surface of which is under the jurisdiction of any Federal agency other than the Department of Interior, to consent to leasing and to prescribe conditions to insure the use and protection of the lands. All or part of this lease contain lands the surface of which are managed by the United States Department of Agriculture, Forest Service, Manti-La Sal National Forest.

The following stipulations pertain to the Lessee responsibility for mining operations on the lease area and on adjacent areas as may be specifically designated on National Forest System lands.

Stipulation #1
Before undertaking activities that may disturb the surface of previously undisturbed leased lands, the Lessee may be required to conduct a cultural resource inventory and a paleontological appraisal of the areas to be disturbed. These studies shall be conducted by qualified professional cultural resource specialists or qualified paleontologists, as appropriate, and a report prepared itemizing the findings. A plan will then be submitted making recommendations for the protection of, or measures to be taken to mitigate impacts for identified cultural or paleontological resources.

If cultural resources or paleontological remains (fossils) of significant scientific interest are discovered during operations under this lease, the Lessee prior to disturbance shall immediately bring them to the attention of the appropriate authority. Paleontological remains of significant scientific interest do not include leaves, ferns or dinosaur tracks commonly encountered during underground mining operations.

The cost of conducting the inventory, preparing reports, and carrying out mitigating measures shall be borne by the Lessee.

Stipulation #2
If there is reason to believe that Threatened or Endangered (T&E) species of plants or animals, or migratory bird species of high Federal interest occur in the area, the Lessee shall be required to conduct an intensive field inventory of the area to be disturbed and/or impacted. The inventory shall be conducted by a qualified specialist and a report of findings will be prepared. A plan will be prepared making recommendations for the protection of these species or action necessary to mitigate the disturbance.

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The cost of conducting the inventory, preparing reports and carrying out mitigating measures shall be borne by the Lessee.

Stipulation #3
The Lessee shall be required to perform a study to secure adequate baseline data to quantify the existing surface resources on and adjacent to the lease area. Existing data may be used if such data are adequate for the intended purposes. The study shall be adequate to locate, quantify, and demonstrate the interrelationship of the geology, topography, surface and ground water hydrology, vegetation and wildlife. Baseline data will be established so that future programs of observation can be incorporated at regular intervals for comparison.

Stipulation #4
Powerlines used in conjunction with the mining of coal from this lease shall be constructed so as to provide adequate protection for raptors and other large birds. When feasible, powerlines will be located at least 100 yards from public roads.

Stipulation #5
The limited area available for mine facilities at the coal outcrop, steep topography, adverse winter weather, and physical limitations on the size and design of access roads, are factors that will determine the ultimate size of the surface area utilized for the mine. A site-specific environmental analysis will be prepared for each new mine site development and for major improvements to existing developments to examine alternatives and mitigate conflicts.

Stipulation #6
Consideration will be given to site selection to reduce adverse visual impacts. Where alternative sites are available, and each alternative is technically feasible, the alternative involving the least damage to the scenery and other resources shall be selected. Permanent structures and facilities will be designed, and screening techniques employed to reduce visual impacts and, where possible, achieve a final landscape compatible with the natural surroundings. The creation of unusual, objectionable, or unnatural landforms and vegetative landscape features will be avoided.

Stipulation #7
The Lessee shall be required to establish a monitoring system to locate, measure and quantify the progressive and final effects of underground mining activities on the topographic surface, underground and surface hydrology and vegetation. The monitoring system shall utilize techniques that will provide a continuing record of change over time and an analytical method for location and measurement of a number of points over the lease area. The monitoring shall incorporate and be an extension of the baseline data.

Stipulation #8
The Lessee shall provide for the suppression and control of fugitive dust on haul roads and at coal handling and storage facilities. On Forest Development Roads (FDR), Lessees may perform their share of road maintenance by a commensurate share

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agreement if a significant degree of traffic is generated that is not related to their activities.

Stipulation #9
Except at specifically approved locations, underground mining operations shall be conducted in such a manner so as to prevent surface subsidence that would: (1) cause the creation of hazardous conditions such as potential escarpment failure and landslides, (2) cause damage to existing surface structures, and (3) damage or alter the flow of perennial streams. The Lessee shall provide specific measures for the protection of escarpments, and determine corrective measures to assure that hazardous conditions are not created.

Limited subsidence zones consisting of perennial streams in the lease, Boulger Reservoir/Dam, SR-264, and Flat Canyon Campground are specifically approved for subsidence resulting from a single-seam of full-extraction mining. The limited-subsidence zones, where subsidence from a second overlapping seam of full-extraction mining is not approved, will be determined based on the typical angle-of-draw for past operations in the Skyline Mine Permit Area (23 degrees). "Angle-of-draw" is defined in the FEIS (pg. 4-7). The angle-of-draw will be applied to perennial stream buffer zones that include the natural floodplain and alluvium in perennial drainages, bounded by the first major slope break in the associated canyons. For structures, it will be applied to an area delineated by a 50-foot radius or distance from the major structures that could sustain damage.

Stipulation #10
In order to avoid surface disturbance on steep canyon slopes and to preclude the need for surface access, all surface breakouts for ventilation tunnels shall be constructed from inside the mine, except at specific approved locations.

Stipulation #11
If removal of timber is required for clearing of construction sites, etc., such timber shall be removed in accordance with the regulations of the surface management agency.

Stipulation #12
The coal contained within, and authorized for mining under this lease shall be extracted only by underground mining methods.

Stipulation #13
Existing Forest Service owned or permitted surface improvements will need to be protected, restored, or replaced to provide for the continuance of current land uses.

Stipulation #14
In order to protect big-game wintering areas, elk calving and deer fawning areas, sagegrouse strutting areas, and other key wildlife habitat and/or activities, specific surface uses outside the mine development area may be curtailed during specified periods of the year.

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Stipulation #15
Support facilities, structures, equipment, and similar developments will be removed from the lease area within two years after the final termination of use of such facilities. This provision shall apply unless the requirement of Section 10 of the lease form is applicable. Disturbed areas and those areas previously occupied by such facilities will be stabilized and rehabilitated, drainages re-established, and the areas returned to a premining land use.

Stipulation #16
The Lessee, at the conclusion of the mining operation, or at other times as surface disturbance related to mining may occur, will replace all damaged, disturbed or displaced corner monuments (section corners, 1/4 corners, etc.), their accessories and appendages (witness trees, bearing trees, etc.), or restore them to their original condition and location, or at other locations that meet the requirements of the rectangular surveying system. This work shall be conducted at the expense of the Lessee, by a professional land surveyor registered in the State of Utah, and to the standards and guidelines found in the Manual of Surveying Instructions, United States Department of the Interior.

Stipulation #17
The Lessees, at their expense, will be responsible to replace any surface and/or developed groundwater sources identified for protection, that may be lost or adversely affected by mining operations, with water from an alternate source in sufficient quantity and quality to maintain existing riparian habitat, fishery habitat, livestock and wildlife use, or other land uses (authorized by 36 CFR 251).

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Stipulation #18

STIPULATION FOR LANDS OF THE NATIONAL FOREST SYSTEM
UNDER JURISDICTION OF
THE DEPARTMENT OF AGRICULTURE

The licensee/permittee/lessee must comply with all the rules and regulations of the Secretary of Agriculture set forth at Title 36, Chapter II, of the Code of Federal Regulations governing the use and management of the National Forest System (NFS) when not inconsistent with the rights granted by the Secretary of the Interior in the license/permit/lease. The Secretary of Agriculture's rules and regulations must be complied with for (1) all use and occupancy of the NFS prior to approval of a permit/operation plan by the Secretary of Interior, (2) uses of all existing improvements, such as Forest Development Roads, within and outside the area licensed, permitted or leased by the Secretary of Interior, and (3) use and occupancy of the NFS not authorized by a permit/operating plan approved by the Secretary of the Interior.

All matters related to this stipulation are to be addressed to:

Forest Supervisor
Manti-La Sal National Forest
599 West Price River Drive
Price, Utah 84501

Telephone Number: 801-637-2817

who is the authorized representative of the Secretary of Agriculture

_____
Signature
Licensee/Permittee/Lessee

Stipulation #19
ABANDONMENT OF EQUIPMENT:
The lessee/operator is responsible for compliance and reporting regarding toxic and hazardous material and substances under Federal Law and all associated amendments and regulations for the handling of such materials on the land surface and in underground mine workings.

The lessee/operator must remove mine equipment and materials not needed for continued operations, roof support and mine safety from underground workings prior to abandonment of mine sections. Exceptions can be approved by the Authorized Officer (BLM) in consultation with the surface management agency. Any on-site disposal of non-coal waste must comply with 30CFR § 817.89 and must be approved by the

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regulatory authority responsible for the enforcement of the Surface Mining Control and Reclamation Act (30 U.S.C. 1201, et seq.). Creation of a situation that would prevent removal of such material and equipment by retreat or abandonment of mine sections, without prior authorization would be considered noncompliance with lease terms and conditions and subject to appropriate penalties under the lease.

All safe and accessible areas shall be inspected prior to being sealed. The lessee shall notify the Authorized Officer in writing 30 days prior to the sealing of any areas in the mine and state the reason for closure. Prior to seals being put into place, the lessee shall inspect the area and certify through documentation any equipment/machinery, hazardous substances, and used oil that is intended to be left underground. The Authorized Officer may participate in this inspection. The purpose of this inspection will be: (1) to provide documentation for compliance with 42 U.S.C. 9620 section 120 (h) and State Management Rule R-315-15, and to assure that certification will be meaningful at the time of lease relinquishment, (2) to document the inspection with a mine map showing location of equipment/machinery (model, type of fluid, amount remaining, batteries, etc.) that is proposed to be left underground. In addition, these items will be photographed at the lessee's expense and shall be submitted to the Authorized Officer as part of the certification.

WASTE CERTIFICATION:
The lessee shall provide on a yearly basis and prior to lease relinquishment, certification to the lessor that, based upon a complete search of all the operator's records for the mine and upon their knowledge of past operations, there has been no hazardous substances defined as per (40 CFR 302.4) or used oil as per Utah State Management Rule R-315-15, deposited within the lease, either on the surface or underground, or that all remedial action necessary has been taken to protect human health and the environment with respect to any such substances remaining on the property. The back-up documentation to be provided shall be described by the lessor prior to the first certification and shall include all documentation applicable to the Emergency Planning and Community Right-to-know Act (EPCRA, Public Law 99-499), Title III of the Superfund Amendments and Reauthorization Act of 1986 or equivalent.

Stipulation #20
Notwithstanding the approval of a resource recovery and protection plan by the BLM, lessor reserves the right to seek damages against the operator/lessee in the event (1) the operator/lessee fails to achieve maximum economic recovery [as defined at 43 CFR § 3480.0-5(21] of the recoverable coal reserves or (2) the operator/lessee is determined to have caused a wasting of recoverable coal reserves. Damages shall be measured on the basis of the royalty that would have been payable on the wasted or unrecovered coal.

The parties recognize that under an approved R2P2, conditions may require a modification by the operator/lessee of that plan. In the event a coal bed or portion thereof is not to be mined or is rendered unminable by the operation, the operator shall submit appropriate justification to obtain approval by the Authorized Officer to leave such reserves unmined. Upon approval by the Authorized Officer, such coal beds or portions

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thereof shall not be subject to damages as described above. Further, nothing in this section shall prevent the operator/lessee from exercising its right to relinquish all or portion of the lease as authorized by statute and regulation.

In the event the Authorized Officer determines that the R2P2 as approved will not attain MER as the result of changed conditions, the Authorized Officer will give proper notice to the operator/lessee as required under applicable regulations. The Authorized Officer will order a modification if necessary, identifying additional reserves to be mined in order to attain MER. Upon a final administrative or judicial ruling upholding such an ordered modification, any reserves left unmined (wasted) under that plan will be subject to damages as described in the first paragraph under this section.

Subject to the right to appeal hereinafter set forth, payment of the value of the royalty on such unmined recoverable coal reserves shall become due and payable upon determination by the Authorized Officer that the coal reserves have been rendered unminable or at such time that the lessee has demonstrated an unwillingness to extract the coal.

The BLM may enforce this provision either by issuing a written decision requiring payment of the MMS demand for such royalties, or by issuing a notice of non-compliance. A decision or notice of non-compliance issued by the lessor that payment is due under this stipulation is appealable as allowed by law.

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ATTACHMENT 2

MONITORING AND MITIGATION MEASURES TO BE INCORPORATED AS APPROPRIATE AS CONDITIONS OF CONSENT TO MINE PERMIT ISSUANCE FOR MINING IN THE FLAT CANYON TRACT

Monitoring

Forest Service Stipulations #3 and #7 require establishment of a scientific baseline against which to monitor possible effects of subsidence. Note that establishing a baseline is not a one-year enterprise; typically three to five years is the minimum and five to seven is frequently needed to reliably assess human-induced change beyond natural variability. A baseline inventory and subsequent monitoring should include the following:

- Valley and stream morphology – annual topographically controlled, low-elevation aerial photography plus stream hydraulic surveys (longitudinal profile, cross-sections, channel bed/bank material)
- Precipitation – continuously operated recording gages
- Valley groundwater levels, stream and spring discharge quantity – continuously operated recording gages
- Valley groundwater, stream, and spring chemistry – periodic grab samples
- Valley groundwater, stream, and spring temperature - continuously operated data recorders at selected sites
- Fish habitat – annual detailed mapping of habitat units
- Fish and macroinvertebrate populations – annual population sampling in representative sections of each stream reach and Electric Lake
- Wetlands (flora) – mapping and characterization, including pollen columns at selected sites, plus detailed inventory and monitoring of plant species and distribution in wetlands associated with springs and seeps
- Wetlands (fauna) – periodic surveys for dependent species, including amphibians and aquatic organisms

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Mitigation/Rehabilitation

The information developed from the baseline inventories will establish the range of "normal" conditions. As appropriate this information will be supplemented by research findings or off-site information. Changes identified through monitoring which exceed this "normal" range will require remedial/restorative actions by the mining company.

Surface Water

Enrichment of Electric Lake/change in trophic state from mine water discharge – Installation and operation of aerators at one or more locations. Aeration is generally effective in offsetting eutrophication effects.

Thinning of ice on Electric Lake around mine discharge point – Installation of warning signs. The effectiveness of warning signs for this situation is unknown.

Vegetation

Loss of streamside riparian vegetation due to stream channel adjustments – See the Aquatic Wildlife section.

Aquatic Wildlife

Subsidence-caused pooling and subsequent breaching, lateral migration of stream channel, stream channel entrenchment, and sediment accumulation – These and associated secondary effects like loss of streamside vegetation and aquatic habitat features are usually mitigated with an integrated package of treatments. Put another way, individual areas may be temporarily stabilized, but long-term restoration will be more effective if combined with other treatments in a stream reach. Treatments, in varying combinations, may include the following:

- Construction and vegetation of realigned stream channel segments;
- Construction of one or more sediment basins at the breached Boulger Reservoir site;
- Temporary breaching of subsidence-caused pools;
- Construction of in-channel grade controls;
- Structures to recreate specific habitat features, such as wetted secondary channels or pool with effective flow-through velocities;
- Riparian plantings to stabilize stream banks; or
- Placement of riprap or brush-layered riprap, or fascine construction to stabilize stream banks.

Designs and measures will be based on available information and technical reports.

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Recreation

Boulger Reservoir Dam - Reconstruct the dam to current State standards after determining that subsidence is complete. Dredge the reservoir to increase the life and enhance fishing quality. Water-right adjustment(s) associated with draining, filling, pool enlargement will be at the expense of the lessee/operator. Repair/replace the fish ladder structure, sidewalks, foot bridge, and vault toilet as needed to return them to serviceability.

Loss of Boulger Reservoir recreation use - Replacement/enhancement of recreational fishing opportunities. Measures considered could include the following, depending on available opportunities:

- Obtain lands or public easements (in the name of the United States) along existing reservoirs within the vicinity of the project area to provide continued flat water fishery opportunities to National Forest users.

- Purchasing water rights in adjacent reservoirs to establish a conservation pool to ensure that water is not drawn down beyond a threshold needed to ensure over-winter survival of trout.

Flat Canyon Campground - Improvement/enhancement of camping opportunities, measures considered could include:

- Improvement of dispersed recreation sites in Boulger and adjacent tributary canyons, including roads.

- Gravel parking pads and access roads.

- Purchase/placement of fire rings and tables.

- Post and pole fencing of closed dispersed recreation areas, as necessary.

- Purchase/placement of 3-4 vault toilets.

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ATTACHMENT 3

EXPANDED AND CORRECTED TABLES 2.1 AND 2.2 FROM FEIS, CHAPTER 2, SECTIONS 2.8 AND 2.9

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ATTACHMENT 3

Table 2.1, Comparison of Alternatives, Direct Physical Changes Due to Mining (Corrected/Expanded)

PHYSICAL CHANGE	ALTERNATIVES			
	Alternative A	Alternatives B and B'	Alternative C	Selected Alternative
MINING				
General	No mining of Federal or non-Federal coal in project area.	Two overlapping seams of full-extraction mining (longwall and room-and-pillar) in majority of project area. One seam full-extraction mining in other areas where both seams not mineable. Full-support mining in peripheral areas of both seams needed to access and develop full-extraction areas. 36 million tons recoverable. Extend mine life 9 to 12 years..	Same as Alternatives B and B', except no full-extraction mining under perennial streams, SR-264, Flat Canyon Campground, and Boulger Reservoir/Dam. Only full-support room-and-pillar mining in protected areas. (no restriction under Cunningham Drainage) 18 to 20 million tons recoverable. Extend mine life by 5 to 7 years. The potential of receiving bids on the tract is reduced.	Same as Alternatives B and B', except only one seam of full-extraction mining under perennial streams, SR-264, Flat Canyon Campground, and Boulger Reservoir/Dam. Two overlapping seams of full-extraction mining in remaining areas. (no restriction under Cunningham Drainage) Approximately 28 million tons recoverable. Extend mine life up to 7 years.
Mine Discharge Water	No change. Discharge recently increased from less than 1,000 gpm to 15,000 gpm.	Possibility of changing the mine water discharge location from Eccles Creek to Electric Lake. Discharge could increase an additional 7,000 gpm over the 15,000 gpm for Alternative A for a total of 22,000 gpm.	Same as Alternatives B and B' Same as Alternatives B and B'	Same as Alternatives B and B' Same as Alternatives B and B'
Vent Shafts	No effect	Two air vent shafts with temporary access roads. Temporary disturbance of 2.9 acres (2.0 acres for pads and 0.92 acres for access roads). Possibility of pumping mine water discharge from Swens Canyon Shaft to Electric Lake requiring new buried pipeline from shaft along Swens Canyon Road and SR-264.	Same as Alternative B and B'	Same as Alternative B and B'
Exploration Holes	No effect	About 10 additional boreholes with temporary surface disturbance of 9.2 acres (4.6 acres for pads and 4.6 acres for access roads)	Same as Alternatives B and B'	Same as Alternatives B and B'

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Table 2.1, Comparison of Alternatives, Direct Physical Changes Due to Mining (Corrected/Expanded)

PHYSICAL CHANGE	ALTERNATIVES			
	Alternative A	Alternatives B and B'	Alternative C	Selected Alternative
SUBSIDENCE				
Longwall and Room-and-Pillar Mining (other than full-support mains).	No effect	Longwall subsidence of 2 to 13 ft, generally with flexure of ground surface producing localized slope changes of up to 3% and tension fractures in zones of high differential subsidence expected to be less than 1% of the mined area.	Same as Alternatives B and B' in areas where longwall extraction is allowed and no impact in areas with full-support mining. Area of differential subsidence would be increased as compared to Alternatives B and B' because full-extraction mining would be split into three blocks separated by subsidence protection zones.	Same as Alternatives B and B' in areas outside of limited-subsidence areas. In limited-subsidence areas, subsidence would be less than 7 feet with slope change of less than 1% and tension zones of high differential subsidence expected to be less than 1% of mined area. None of the high differential subsidence areas would be under perennial stream channels. Differential subsidence areas under perennial stream channels would be moderate to low.
Full-support mains	Same as Alternatives B and B' since mains under Upper Huntington Creek could still be driven to access coal reserves in existing permit area.	Full-support mains would be driven across/under Upper Huntington Creek to access the Flat Canyon Tract project area then south under the west slope of Upper Huntington Canyon to set up longwall panels.	Same as Alternatives B and B'.	Same as Alternatives B and B'.
		Full-support mains are designed to be stable and prevent caving and subsidence. Geotechnical design/models show safety factors in excess of 1.74 (1.0 considered stable). Empirical data from existing mines shows mains to be stable for at least 70 years and predictions indicate that they would be stable over 200 years.	Same as Alternatives B and B'.	Same as Alternatives B and B'.
	Same as Alternatives B and B'.	In unlikely event that pillars fail, they would fail over hundreds to thousands of years. Maximum subsidence, if pillars fail over large area, would be 4.7 ft, considering two seams of stacked mains.	Same as Alternatives B and B'.	Same as Alternatives B and B'.

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Table 2.1, Comparison of Alternatives, Direct Physical Changes Due to Mining (Corrected/Expanded)

PHYSICAL CHANGE	ALTERNATIVES			
	Alternative A	**Alternatives B and B'**	**Alternative C**	**Selected Alternative**
Natural Slopes	Subsidence in existing permit area has not caused slope instability or movement of naturally unstable areas.	No accelerated slope instability expected.	Same as Alternatives B and B'.	Same as Alternatives B and B'.
SEISMICITY				
General	No mining-induced seismic events generated from mining in project area. Seismic events from mining in adjacent area would continue. Maximum Credible Event (MCE) of Richter 3.45 at a rate of one event with magnitude greater than 2 every 5 days.	Longwall mining induced seismicity expected with increased potential at depths below 1500 ft. Maximum Credible Event (MCE) of Richter 3.45. Frequency of events over extended mine life expected to be about one event with magnitude greater than 2 every 5 days. Human response to ground vibrations from seismicity is expected to result in events being distinctly felt by campers, forest visitors and cabin dwellers about once every 5 days within 3,500 ft. of longwall mining areas.	Same as Alternatives B and B' but the length of time that mining could continue and the associated seismic events could occur is shortened to 5-7 years.	Same as Alternatives B and B', but length of time that mining could continue and the associated seismic events could occur is shortened to up to 7 years.
Natural Slopes	Same as Alternatives B and B'	No effect. Vibration levels are too low for potential impact to slope stability. Confirmed by no evidence of slope failure due to past mining at Skyline Mine.	Same as Alternatives B and B'	Same as Alternatives B and B'.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
FACILITIES					
Boulger Dam and Reservoir (Subsidence Pt. 6)					
Subsidence damage	No effect	Subsidence of up to 13 feet with high to very high differential subsidence. Dam could fail with downstream effects and potential hazard.	Subsidence of up to 13 feet with high to very high differential subsidence. Dam would be intentionally breached to prevent downstream effects and hazard.	No effect from subsidence.	Same as Alternative B' except that subsidence limited to less than 7 feet with moderate to low differential subsidence. Dam would be intentially breached to prevent downstream effects and hazard.
Seismicity damage	No effect	Based on the MCE, the dam would experience greater than 0.1g if the event occurs within 5,500 ft., and could fail with downstream effects and potential hazards.	Same as Alternative B, except downstream effects and associated hazard would be eliminated by taking the dam out of service prior to mining.	Same as Alternative B'.	Same as Alternative B'.
Lost use	No effect	Dam would be out of service for up to 12 years. Damage estimated at about $390,000.	Dam would be taken out of service for up to 12 years, then repaired and improved by the lessee/operator at a cost of about $390,000.	Same as Alternative B', except the dam could be out of service for 5 to 7 years.	Same as Alternative B' except dam could be out of service for up to 7 years.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Highway SR 264 (Subsidence Pts. 5 and 6)					
Subsidence damage	No effect	Longwall mining subsidence of 2 to 13 ft., with the possibility of minor cracking of surface in some isolated areas. Two major culverts could be damaged. Damage estimated at $52,000.	Subsidence and damage to the road are the same as Alternative B. SCLS #13 would require monitoring and repair by lessee/operator. Total cost estimated at $52,000. Repairs could include filling cracks and grading in some areas with resurfacing of road and replacement of culverts, but without long-term effects.	No effect. No longwall mining within the subsidence angle-of-draw. Projected full support pillars would not cause subsidence. No cracks expected.	Same as Alternative B' except that subsidence would be less than 7 feet and the potential for cracks and needed repairs would be reduced.
Safety hazard	No effect	Safety hazard exists without close monitoring and immediate repairs.	Safety hazard effectively avoided by monitoring and immediate repairs.	No effect	Same as Alternative B'.
Seismicity damage	No effect	No effects from mining-induced seismicity.	No effects from mining-induced seismicity.	No effects from mining-induced seismicity.	No effects from mining-induced seismicity.
Unpaved Roads (FS and pvt.)					
Subsidence damage	No effect	Small cracks 2 inches or less expected in tensile zones. Larger cracks are possible but not likely.	Subsidence and damage same as Alternative B.	Same as Alternative B.	Same as Alternative B.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Safety hazard	No effect	Minor safety risk to motorists.	Monitoring required. Some repair work required in tensile zones to fill cracks and maintain slopes and drainage with temporary safety measures required. Cost of repair estimated at less than $10,000.	Same as Alternative B'.	Same as Alternative B'.
Seismicity damage	No effect	No effect from seismicity.	No effect from seismicity.	No effect from seismicity.	No effect from seismicity.
Flat Canyon Campground (Subsidence Pts. 5, 6, and 8)					
Subsidence damage	No effect	Longwall mining subsidence of 2 to 13 ft. with very low to moderate differential subsidence. Minor cracking of surface expected in some areas. Water tank, water pipelines, tables, toilets, septic tank/drain field, spring collection system, and retaining wall could be damaged. Minor cracking of roads could occur. Damage costs are estimated at $150,000 by the Forest Service.	Same as Alternative B except that SCLS #13 would require monitoring and repair by the lessee/operator. Repair costs are estimated at $150,000.	No effect. Protected with no subsidence of the structures allowed. No possibility of cracks or subsidence damage to facilities provided pillar dimensions are adequate.	Same as Alternative B' except subsidence would be less than 7 feet. Potential damage reduced.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Seismicity damage	No effect	Longwall mining induced seismicity has the potential to vibrate structures once every 5 days at a Peak Particle Velocity (PPV) of over 1 in/sec within a range of 3,500 ft. from mining areas. Some minor cosmetic damage may result with a very low possibility of structural damage to buildings for infrequent larger events. No damage to the water system is expected. Some effects to recreation use at this facility are expected. See Recreation.	Same as Alternative B, except that lessee/operator would be required to monitor and repair damage. Some effects to recreation use at this facility are expected. See Recreation.	Same as Alternative B'. Some effects to recreation use at this facility are expected. See Recreation.	Same as Alternative B'. Some effects to recreation use at this facility are expected. See Recreation.
Flat Canyon Cabins (Subsidence Pt. 5) Subsidence damage	No effect	Longwall mining subsidence of 2 to 4 ft., with very low to low differential subsidence. Potential for tensile strain and induced slope changes with the possibility of cracks. Lost use of facilities during active subsidence. Cost of repairs could reach $360,000.	Same as Alternative B. Cabins, land surface, and are in private ownership. It is assumed that monitoring and repairs would be agreed upon by coal operator and owners as required under state law.	Most cabins protected due to no longwall mining allowed for protection of perennial drainage. Two cabins north of canyon may be subject to tensile strains at edge of stacked pillars with some mitigation required. Repair requirements are same as Alternatives B'.	Same as Alternative B'.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Seismicity damage	No effect	Longwall mining induced seismicity has the potential to vibrate structures once every 5 days. Some minor cosmetic damage may result with a very low possibility of structural damage to buildings for infrequent larger events. No damage to the water systems is expected.	Same as Alternative B.	Same as Alternatives B and B'.	Same as Alternative B and B'.
Swens Canyon Cabins (Subsidence Pt. 3)					
Subsidence Damage	No effect	Longwall mining subsidence of 4 to 10 ft. with very low to high differential subsidence. Pillars at edge of longwall area could result in higher tensile strains with the possibility of damage and lost use during active subsidence. Estimated repair cost included with Flat Canyon cabins above.	Same as Alternative B. Cabins, land surface, and coal estates are in private ownership. It is assumed that monitoring and repairs would be agreed upon by coal operator and owners as required under state law.	Similar to Alternative B, but could be located above pillars giving rise to greater tensile zone and greater potential for damage.	Similar to Alternative B', but potential for damage reduced by limiting subsidence to less than 7 feet.
Seismicity damage	No effect	Same as discussion for Flat Canyon cabins.	Same as discussion for Flat Canyon cabins.	Same as Alternatives B and B'.	Same as Alternatives B and B'.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Hunt Dam and Reservoir					
Subsidence damage	No effect	No effect from subsidence. Closest mining and subsidence would be over 1,000 ft. distance.	Same as Alternative B.	Same as Alternatives B.	Same as Alternatives B.
Seismicity damage	No effect. Nearest mining is more than 5,500 ft. away.	Mining-induced seismicity could damage the dam. If the MCE of magnitude 3.45 occurs within 5,500 ft. the dam would experience greater than 0.1g. It could potentially be taken out of service during active mining within 5,500 ft. resulting in a loss of use. If damaged, repairs would be required. Cost could reach $390,000. It is assumed that an agreement would be reached between the lessee/operator and private landowner to prevent downstream effects and make repairs.	Same as Alternative B.	Same as Alternatives B.	Same as Alternatives B.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
SURFACE WATER					
Prolonged and increased mine water discharge to Eccles Creek and Scofield Reservoir	Discharge increased from less than 1,000 gpm to 10,000-15,000 gpm after August 2001. Could stop in 2003 if mine closes.	If Electric Lake UPDES Permit obtained, discharge to Eccles Creek would continue at approx. 10,000 gpm. No change from Alternative A, except discharge prolonged 9-12 years. If Electric Lake UPDES Permit Denied, mine water discharge and flow to Eccles Creek could increase by 7,000 gpm to a maximum of 22,000 gpm and last an additional 9-12 years.	Same as Alternative B.	Same as Alternatives B and B' except that mine water discharge could occur for a shorter time (extended mine life of 5 to 7 years).	Same as Alternatives B and B' except that mine water discharge could occur for a shorter time (extended mine life of up to 7 years).
	Chemical quality generally consistent with beneficial use standards, occasional exceedance of phenol, total phosphorous, and TDS.	Chemical quality remain generally the same and could improve. Phosphorous loading to Scofield Reservoir possible but not likely due to recent decreased phosphorous levels of discharge waters and improved management.	Same as Alternative B.	Same as Alternative B', but for a shorter time (5-7 years).	Same as Alternative B', but for a shorter time (up to 7 years).

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
	Significant erosion of Mud Creek channel and resulting sediment increases to Scofield Reservoir. Piping of some discharge directly to Scofield Reservoir could reduce effects.	If Electric Lake UPDES Permit obtained, stream morphology effects to Eccles and Mud Creeks same as Alternative A. If Electric Lake UPDES Permit Denied, erosion of Mud Creek and sediment transport to Scofield Reservoir would increase relative to Alternative A. Piping of some discharge directly to Scofield Reservoir could reduce effects.	Same as Alternative B. Same as Alternative B.	Same as Alternative B', but for a shorter time (5-7 years). Same as Alternative B', but for a shorter time (5-7 years).	Same as Alternative B', but for a shorter time (up to 7 years). Same as Alternative B', but for a shorter time (up to 7 years).
A new mine water discharge point in Electric Lake, Changing some or all of the mine water discharge from Eccles Creek to Electric Lake. Decrease flow in Price River Watershed and increase flow in Huntington Canyon Watershed.	Flow Current discharge to Eccles Creek is 10,000 to 15,000 gpm. Current ground water discharge from James Canyon wells to Electric Lake is 2,000-4,000 gpm. Expected to stabilize at 5,000 gpm. Expected to continue to 2003.	Flow If Electric Lake UPDES Permit issued, 12,000 mine water discharged to Electric Lake for 9-12 years. Increase of 19,350 ac-ft annual increase representing 33% of Electric Lake capacity. If Electric Lake UPDES denied, no change to Electric Lake but flow to Eccles Creek increased by 7,000-12,000 gpm for 9-12 years for a total of 22,000 gpm. Increase of 12,000 gpm is 19,350 ac-ft annually, representing 26% of Scofield Reservoir capacity. Under either scenario, discharge to Eccles Creek would remain above pre-August 2001 flows.	Flow Same as Alternative B.	Flow Same as Alternative B', except that discharge would occur for a shorter time (5-7 years)..	Flow Same as Alternative B', except that discharge would occur for a shorter time (up to 7 years)..

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Change water quality in receiving streams.	Quality Negligible change to Electric Lake since ground water discharged is very good quality.	Quality Possible, but unlikely, increase in phosphorous in Electric Lake. Possible, but unlikely, accelerated eutrophication. Water temperature increase at discharge outlet.	Quality Same as Alternative B, but some mitigations potentially required if eutrophication occurs.	Quality Same as Alternative B', but for a shorter time (5-7 years).	Quality Same as Alternative B', but for a shorter time (up to 7 years).
Subsidence of perennial streams and Boulger Res. could intercept water and divert it underground.	No effect	No loss of water expected due to deep overburden and sealing characteristics of clay in shales. If it should occur, state appropriated waters would be replaced by the lessee/operator's expense.	Same as Alternative B, except that SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems.	No effect because subsidence would be prevented except for the Cunningham Drainage. No loss of water expected due to deep overburden and sealing characteristics of clay in shales. In the event that loss occurs due to mining, SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems.	Same as Alternative B'.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
GROUND WATER					
Subsidence could change flow of springs/seeps, affecting flow of springs and receiving streams. Also water rights.	No effect	Spring locations could shift, though unlikely, and no loss of water expected due to sealing characteristics of clay in shales. Lessee/operator required to replace state appropriated water if affected. No loss of water related to water rights anticipated.	Same as Alternative B except that SCLS #17 would require replacement of all waters identified for protection including unappropriated water needed for ecosystems. Same as Alternative B.	Same as Alternative B', except that fewer springs would be subjected to subsidence. Same as Alternatives B and B'.	Same as Alternative B', except less subsidence and potential for springs to shift. Same as Alternatives B and B'.
Interception of mine water and discharge to Eccles Creek diverts water from Huntington Canyon drainage to Price River drainage (Transmountain Diversion)	No effect	Deep aquifers associated with channel sands are discontinuous. Ground water and mine water tested at 4,000 to over 10,000 years old and transmissivity of rock layers (vertical and horizontal) is extremely slow, so any effect would not be quantifiable or perceptible. Ground/mine water too deep to be issuing to Huntington Creek Watershed. Negligible effect.	Same as Alternative B.	Same as Alternatives B and B'.	Same as Alternatives B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Water Quality Effects from Equipment Left Underground	No effect	Local ground water quality could be degraded by oils and other fluids (battery acid, transmission oil, diesel fuel, lubricants, etc.) if leaked underground and slow corrosion/oxidation of metals left underground. See mine water discharge in Surface Water Section. Connection with surface waters is very slow and unlikely, therefore effects are expected to be negligible.	Same as Alternative B, but SCLS #19 would require removal of equipment unless specifically approved. Less potential for contamination because equipment and materials left underground would be limited to inert materials, corrosion/oxidation resistant metals, and non-polluting fluids.	Same as Alternative B'.	Same as Alternative B'.
VEGETATION					
Disturbance from Surface Facilities	No effect	Temporary (3-5 yrs.) removal of 2.9 acres of vegetation for vent shafts and 9.2 acres for exploration drill holes. Long-term (12-15 years) loss of vegetation affected for vent shafts of less than 1 acre.	Same as Alternative B.	Same as Alternatives B and B', except long-term loss of vegetation at vent shafts reduced to 5-7 years.	Same as Alternatives B and B', except long-term loss of vegetation at vent shafts reduced to up to 7 years.
Subsidence disturbance.	No effect	Changes in stream morphology in Swens Canyon, Little Swens Canyon, Boulger Canyon, and Flat Canyon could result in loss of streambank riparian vegetation from scouring. Increase in pond areas could increase riparian over the long-term after all subsidence is complete (increased land/water contact area).	Same effects as Alternative B but SCLS #3 and #7 require vegetation baseline information and monitoring necessary to quantify changes.	No effect	Similar to B' except that the potential for vegetation loss is reduced by limiting subsidence to less than 7 feet. Intensive monitoring would occur and lessee/operator required to mitigate effects by completing stream channel rehabilitation and stabilization measures and planting riparian vegetation.

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RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
	No effect	Spring locations could shift causing associated localized riparian vegetation to shift. Temporary loss during adjustment.	Same as Alternative B, except SCLS #3 and #7 would require vegetation baseline information and monitoring necessary to quantify changes.	Same as Alternative B', but fewer springs subjected to subsidence.	Same as Alternative B' but potential for effects reduced by limiting subsidence to less than 7 feet.
Increased discharge to Eccles Creek if Electric Lake UPDES Permit not issued.	No Effect	Increase of discharge to Eccles Creek from 10,000 -15,000 gpm to 22,000 gpm. Could increase headcutting in Eccles and Mud Creeks. This could cause loss of riparian vegetation for many years, until channels stabilize and vegetation recovers. Could be reduced by piping some discharge directly to Scofield Reservoir.	Same as Alternative B.	Same as Alternatives B and B', but for less time (5-7 years).	Same as Alternatives B and B', but for less time (up to 7 years).
Threatened, Endangered, and Sensitive Species	No effect	No effect	No effect	No effect	No effect
WILDLIFE					
Terrestrial					
Disturbance from Surface Facilities	No effect	Short-term loss of habitat for exploratory drilling and construction/drilling of vent shafts due to avoidance. Sensitive bird species (individuals) could be affected during nesting season, causing abandonment.	Same as Alternative B, except SCLS #14 reduces effects to sensitive species and species of high interest by imposing appropriate timing restrictions on construction and drilling operations. Does not affect operation of vent holes, once constructed.	Same as Alternative B'.	Same as Alternative B'.

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RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Subsidence/Seismicity	No effect	No effect	No effect	No effect	No effect
Aquatic					
Disturbance from Surface Facilities	No effect	Crossing Boulger Canyon and Swens Canyon could add minor amounts of sediment to creeks. Use of bridges or bottomless arches would reduce streambed disturbance, therefore negligible effect to habitat.	Same as Alternative B.	Same as Alternatives B and B'.	Same as Alternatives B and B'.

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Subsidence caused changes in stream gradient/morphology/flow/quality could affect habitat.	No effect	Stream morphology changes and sediment additions in streams could decrease habitat quality and productivity for aquatic species in perennial drainages with gradients of 5% or less including the majority of Boulger Creek, (4.0 miles), lower portions of Swens (0.5 mile) and Little Swens (0.5 mile) Canyons, and in Flat Canyon (1.5 miles). Individuals affected but population viability not lost. Recovery could take 10-30 years after subsidence. No flow changes expected (see Surface and Ground Water).	Same effects as Alternative B, but SCLS #3 and #7 would require monitoring to quantify effects to habitat and aquatic species and potentially require measures to mitigate effects. Measures would only partially decrease effects.	No effect except for Cunningham Drainage. Negligible effects because stream gradient is steeper than 5% (similar to Burnout Canyon).	Same as B' except that the magnitude of effects reduced by limiting subsidence to less than 7 feet and slope change to less than 1%.
	No effect	Macroinvertebrate indices could fall below Forest Plan Standards for 10-30 years.	Macroinvertebrate indices could fall below Forest Plan Standards but probably for less time than Alternative B due to mitigation measures.	No effect	Macroinvertebrate indices could decrease but Forest Plan Standards likely maintained through intensive monitoring and stream rehabilitation measures
Seismicity	No effect	No effect	No effect	No effect	No effect

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RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Mine Water Discharge	Increased discharge to Eccles Creek and Scofield Reservoir from less than 1,000 gpm to 10,000 to 15,000 gpm could cause decrease in aquatic habitat anticipated. Piping of some discharge directly to Scofield Reservoir could reduce effects.	Mine water discharge increased by 9-12 years.	Same as Alternative B.	Same as Alternatives B, but mine water discharge would occur for a shorter time (5-7 years).	Same as Alternatives B, but mine water discharge would occur for a shorter time (up to 7 years).
		Discharge to Eccles Creek could increase to 22,000 gpm if Electric Lake UPDES Permit not approved. Changes to stream morphology and riparian vegetation in Eccles and Mud Creeks could cause habitat degradation for many years. Quality changes expected to be negligible. Effects could be reduced by piping some discharge directly to Scofield Reservoir.	Same as Alternative B.	Same as Alternative B, but for shorter time.	Same as Alternative B, but for shorter time.
		If discharge to Electric Lake approved, effects to Eccles Creek and Scofield Reservoir same as Alternative A.	Same as Alternative B.	Same as Alternative B, but for shorter time.	Same as Alternative B, but for shorter time.
		If discharge to Electric Lake is approved, degradation of water quality from mine water discharge could occur due to phosphorous and associated eutrophication, but not likely due to recent improved quality of discharge water and improved management.	Same as Alternative B, except that monitoring and mitigations could reduce effects..	Same as Alternative B', except that discharge would occur for shorter time (5-7 years).	Same as Alternative B', except that discharge would occur for shorter time (up to 7 years).

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RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Threatened, Endangered, and Sensitive Species	No effect	Negligible effects	Negligible effects	Negligible effects	Negligible effects
RECREATION					
Disturbance from Surface Facilities	No effect	Single-season degradation of recreation experience in Boulger Canyon and Swens Canyons during construction of vent shafts. One to two season degradation of recreation experience for coal drilling in any specific area.	Same as Alternative B. Same as Alternative B.	Same as Alternatives B and B'. Same as Alternative B and B'.	Same as Alternatives B and B'. Same as Alternative B and B'.

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RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Subsidence					
Boulger Reservoir	No effect	Long-term (up to 12 years) loss/displacement of fishing opportunity (5,000 RVDs/year and total of 60,000 RVDs) due to potential damage to dam. Failure of dam could cause a safety hazard to fishermen and sightseers in the stream channel downstream. Increased fishing pressure on Beaver Dams Reservoir, Gooseberry Reservoir, and Electric Lake.	Same as Alternative B except the safety hazard would be avoided by requiring the dam to be breached prior to mining.	No effect	Same as Alternative B' except loss/displacement of recreation opportunities for less than 7 years. Improvement of adjacent facilities would partially offset loss of recreation opportunity and mitigate increased use.
Flat Canyon Campground	No effect	See the facilities section for description of damages. Loss of one season of use for each of the two seams for a total of two seasons of lost use (3,000 RVDs/season for a total of 6,000 RVDs). Potential safety hazard to people using the facilities.	Same as Alternative B, except safety hazard would be avoided by closing campground during active subsidence.	No effect	Same as Alternative B' except lost use for 1 season plus time for repairs. Increased use of adjacent facilities mitigated by required improvements.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Seismicity					
Boulger Reservoir	No effect	Dam could be damaged by seismicity (see Facilities). Long-term (up to 12 years) loss/displacement of fishing opportunity (5,000 RVDs/year and total of 60,000 RVDs). Potential safety hazard to fishermen and sightseers in channel downstream. Increased fishing pressure on Beaver Dams Reservoir, Gooseberry Reservoir, and Electric Lake.	Same as Alternative B, except safety hazard avoided by requiring dam to be breached prior to mining.	Same as Alternative B', except lost use reduced to 5-7 years..	Same as Alternative B', except lost use up to 7 years. Required mitigations would offset lost use and mitigate increased use of other adjacent facilities.
Flat Canyon Campground	No effect	Some minor potential for damage (see Facilities) that could cause a low safety hazard.	Safety hazard avoided because campground closed due to subsidence concerns. Campground closed for two seasons (see subsidence above).	No effect.	Same as Alternative B', but campground closed for 1 season and time for repairs. Lost use mitigated by required measures.
Dispersed recreation	Events greater than magnitude 2 could be perceived once every 5 days within 3,500 ft. of existing permit area.	Human response to ground vibrations from seismicity is expected to result in events being distinctly felt by campers, forest visitors and cabin dwellers about once every 5 days within 3,500 ft. of longwall mining areas. Events could occur for 9-12 years.	Same as Alternative B.	Same as Alternative B' but length of time that events could occur and be felt is decreased to 5-7 years.	Same as Alternative B' but length of time that events could occur and be felt is decreased to up to 7 years.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
VISUAL QUALITY					
Disturbance from Surface Facilities	No effect	Consistent with Visual Quality Objectives. Drilling operations for coal exploration and vent shafts would be visible along SR-264 for one season for each specific hole/vent. Vent shafts in Swens and Boulger Canyons would be visible over the long-term (12 years) from the immediate vicinity. Both screened from view from SR-264. Water vapor plumes would be visible from SR-264 and SR-31 on infrequent occasions. Drained Boulger Reservoir could be a visual detraction to visitors along SR-264 (12 years).	Same as Alternative B. Same as Alternative B. Same as Alternative B.	Same as Alternatives B and B'. Same as Alternative B and B' but for less time (5-7 years). Same as Alternatives B and B' but for less time (5-7 years).	Same as Alternatives B and B'. Same as Alternative B and B' but for less time (up to 7 years). Same as Alternatives B and B' but for less time (up to 7 years).
TRANSPORTATION					
Extended Mine Life	No effect	Existing mine related traffic on SR-264 and SR-31 (total of about 56 cars/trucks per day) would be extended for another 9-12 years.	Same as Alternative B.	Same as Alternatives B and B' except traffic use would be extended by 5-7 years.	Same as Alternatives B and B' except traffic use would be extended by up to 7 years.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Disturbance from Surface Facilities	No effect	Addition of drilling traffic for two – three seasons (one season for individual vents/hole) on SR-264, SR-31, private roads, and Forest Development Roads.	Same as Alternative B.	Same as Alternatives B and B'.	Same as Alternatives B and B'.
Subsidence	No effect	Minor cracks could occur on SR-264 that would need repairs.	Same as Alternative B. SCLS #13 would require monitoring and repair of cracks by lessee/operator to avoid hazards.	No effect	Same as Alternative B', except less subsidence and decreased potential for cracks.
		Larger cracks are expected on Forest Development roads and private roads on ridge tops that could present short-term hazard.	Same as Alternative B. SCLS #13 would require monitoring and repair of cracks by lessee/operator to avoid hazards.	Same as Alternative B', except fewer roads would be subjected to subsidence.	Same as Alternative B', except fewer roads would be subjected to subsidence.
		Private roads that cross Flat Canyon Creek could be flooded requiring work to raise running surface to above water levels.	Same as Alternative B.	No effect.	Same as Alternative B, except less subsidence and reduced potential for effects.
Seismicity	No effect	No effect.	No effect.	No effect.	No effect.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
SOCIO-ECONOMIC					
Lease Bonus Bid	No Bonus Bid	Bonus Bid	Bonus Bid.	Bonus bid but less than Alternatives B and B'. Potential for receiving bids is reduced.	Bonus bid expected to be less than Alternative B' but more than C. Probability of receiving bid is high.
Life of Mine, Employment, and Support Services Jobs Extended	No extension. Loss of 220 jobs in 2003. This does not consider the potential for mining U-67939.	Mine life including 220 jobs extended up to 12 years.	Same as Alternative B.	Mine life including 220 jobs extended 5 to 7 years, but potential for receiving bids reduced.	Mine life including 220 jobs extended up to 7 years.
Coal Production	None	36 million tons	Same as Alternative B.	18-20 million tons	Approx. 28 million tons.
Value of Coal Recovered	None	$612 million	Same as Alternative B.	$306 - $340 million	Approx. $476 million.
Royalties	None	$49 million	Same as Alternative B.	$24 - $27 million	Approx. $38 million.
CULTURAL AND HISTORIC RESOURCES					
Disturbance from Surface Facilities	No effect.	Site surveys required and sites would be avoided or recovered on Fed. lands. Sites on private lands subject to landowner discretion.	Same as Alternative B.	Same as Alternatives B and B'.	Same as Alternatives B and B'.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	Selected Alternative
Subsidence	No effect.	Site surveys required and sites on Federal lands would be protected, repaired or recovered. Disposition of sites on private lands subject to discretion of landowner.	Same as Alternative B. SCLS #1 serves as a notice to lessee that surveys and protection required on Federal lands.	No effect. Structures located in subsidence protection zones. For other sites, Same as Alternative B'.	Same as Alternative B', except potential for damage reduced.
		Historic log structures not likely damaged. Rock foundations could be cracked.	Same as Alternative B. Federal sites protected, repaired, or recovered.	Same As Alternative B'.	Same As Alternative B', except potential for damage reduced.
		Historic roads and trails not likely affected.	Same as Alternative B.	Same as Alternative B'.	Same as Alternative B'.
		Lithic scatters not likely affected.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
Seismicity	No effect.	No effect.	No effect.	No effect.	No effect.
PALEONTOLOGICAL RESOURCES					
Mining	No effect	Some dinosaur footprints, bone fragments, and vegetation imprints with low scientific value destroyed in the underground coal seam during mining.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
Disturbance from Surface Facilities	No effect	Surveys would be conducted and sites would be avoided or recovered.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.

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Table 2.2, Comparison of Alternatives, Effects by Resource/Issue (Corrected/Expanded)

RESOURCE/ ISSUE	ALTERNATIVES				
	A	B	B'	C	**Selected Alternative**
Subsidence	No effect	No effect to buried dinosaur fossils. Pleistocene mammal fossils buried in glacial materials could be displaced by subsidence. Not likely that bones would be broken.	Same as Alternative B.	No effect to buried dinosaur fossils. Very low potential for displacement of Pleistocene mammal fossils because high occurrence potential areas lie within subsidence protection zones.	Same as Alternative B.
Seismicity	No effect.	No effect.	No effect.	No effect.	No effect.

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ATTACHMENT 4
FEIS/ROD Mailing List

Copies of the FEIS and ROD were sent directly to agencies, organizations, and individuals listed below. Copies are also available upon request

Director, Planning and Review Advisory Council on Historic Preservation 1100 Pennsylvania Ave., NW, Suite 809 Washington, DC 20004	Deputy Director USDA APHIS PPD/EAD 4700 River Rd. Unit 149 Riverdale, MD 20737-1238
Policy and Planning Division Office of Civil Rights U.S. Department of Agriculture Washington, DC 20250	Natural Resources Conservation Service National Environmental Coordinator U.S. Department of Agriculture 1400 Independence Ave., SW Washington, DC 20250
USDA, National Agricultural Library Head, Acquisitions & Serials Branch 10301 Baltimore Blvd. Rm. 002 Beltsville, Maryland 20705 **3 copies**	Bureau of Land Management Utah State Office P.O. Box 45155 Salt Lake City, 84145-0155
National Marine Fisheries Service Habitat Conservationists Division Northwest Region 7600 Sand Point Way NE BIN C15700, Building 1 Seattle, WA 98155-0070	U.S. Army Engr. Northwestern Division 220 N.W. 8th Avenue Portland, OR 97209-3589
Director, Office of Environmental Compliance U.S. Department of Energy 1000 Independence Ave., SW Mail Code EH-22, Rm. 3G092 Washington, DC 20585 **3 copies**	Region VIII Environmental Protection Agency EIS Review Coordinator 1 Denver Place, Suite 500 999 18th St. Denver, CO 80202 **5 copies**
Environmental Officer U.S. Department of Housing & Urban Development 633 17th Street Denver, CO 80202	Director, Office of Environmental Policy and Compliance U.S. Department of Interior Main Interior Bldg., MS-2340 1849 C Street, NW Washington, DC 20240 **9 copies**
Chief, Energy and Environment Interstate Commerce Commission Rm. 3219 Washington, DC 20423	Intermountain Region National Park Service 12795 Alameda Parkway Lakewood, CO 80225

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Assistant Secretary for Policy Environmental Division (P-14), Rm. 9217 400 7th Street, SW Washington, DC 20593	Northwest Mountain Region Regional Administrator Federal Aviation Administration 1601 Lind Avenue, SW Renton, WA 98055-4056
Western Region, Regional Administrator Federal Highway Administration 201 Mission St., Suite 2100 San Francisco, CA 94105	Office of Transportation and Regulatory Affairs Federal Railroad Administration Environmental Division, P-14 400 7th Street, SW Washington, DC 20590
Research and Special Program Administration Federal Railroad Administration 400 7th Street, SW Washington, DC 20590	Floyd McMullen Office of Surface Mining 1999 Broadway, Suite 3320 Denver, Colorado 80202 **2 copies**
Carl Winters Canyon Fuel Company, LLC HC 35, Box 380 Helper, Utah 84526	Laura Lindley Bjork, Lindley, Danielson & Baker, P.C. Attourneys at Law 1600 Stout Street, Suite 1400 Denver, Colorado 80202
Mark Belles	Brian Trapnell
Carl Adams Utah Division of Water Quality P.O. Box 144870 Salt Lake City, Utah 84118-4870	Elmer Fellis
JD (Jeff) McKenzie, PE The Church of Jesus Christ of Latter-day Saints Natural Resource Section Twelfth Floor East, Room 1229 50 East North Temple Street Salt Lake City, Utah 84150-0001	Ken Bench
Butch Wilcox Mayor of Elmo P.O. Box 22 Elmo, Utah 84521	Ross Cox
Eddie Cox Sanpete County Commission Chair Sanpete County Courthouse 160 North Main Manti, Utah 84642	Lee Cox

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Reed Harris Field Supervisor United States Department of the Interior Fish and Wildlife Service Utah Field Office Lincoln Plaza 145 East 1300 South, Suite 404 Salt Lake City, Utah 84115	Newell Dee Cox
Conrad Houser NorWest Mine Services, Inc. 136 East South Temple, 12th Floor Salt Lake City, Utah 84111	C.C. Dixon Trustee
Mark Page Regional Engineer State of Utah Department of Natural Resources Division of Water Rights Southeastern Area 453 South Carbon Avenue P.O. Box 718 Price, Utah 84501-0718	Kelly Payne NorWest Mine Services, Inc. 136 East South Temple, 12th Floor Salt Lake City, Utah 84111
Jack Stoyanoff Manager N.E.W.U.A North Emery Water Users Association 1325 North Highway 155 Box 129 Cleveland, Utah 84518 435-653-2649	Erik Petersen Petersen Hydrologic 2695 North 600 East Lehi, Utah 84043

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John Carter President Willow Creek Ecology P.O. Box 280, Mendon, Utah 84325	Robert Jewkes
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Jack Rogers LASR Geo Consulting 50 E. 970 N. Castle Dale, Utah 84513	Darrell Leamaster Castle Valley Special Services District P.O. Box 877 Castle Dale, Utah 84513
Jay Mark Humphrey Emery Water Conservancy District 50 E. 100 S. P.O. Box 998 Castle Dale, Utah 84513	Jeff Richens Price Water Improvement District 265 Fairgrounds Road Price, Utah 84501
Varden Wilson Huntington-Cleveland Irrigation Company P.O. Box 327 Huntington, Utah 84528	Kleston Laws Utah Department of Transportation Rt. #3 Box 75C5 940 S. Carbon Avenue Price, Utah 84501
Mary Ann Wright Utah Department of Natural Resources Division of Oil, Gas and Mining 1594 West North Temple, Suite 1210 P.O. Box 145801 Salt Lake City, Utah 84114-5801	Carbon County Commissioners Carbon County Courthouse 120 E. Main Price, Utah 84501
Emery County Commissioners P.O. Box 629 Castle Dale, Utah 84513	Utah County Commissioners 100 E. Center Street Provo, Utah 84601
Juab County Commissioners 146 North Main Nephi, Utah 84648	Mayor of Scofield Scofield Town Scofield Rt. Helper, Utah 84526

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Val Payne Emery County Public Lands Council P.O. Box 1298 75 E. Main Castle Dale, Utah 84513	Charles A. Calhoun U.S. Bureau of Reclamation Upper Colorado Regional Office 125 South State, Room 6107 Salt Lake City, Utah 84138
Price River Water Users 90 N. 100 E. Price, Utah 84501	US Environmental Protection Agency Office of Federal Activities Mail Code 2252-A, Room 7241 Ariel Rios Building (South Oval Lobby) 1200 Pennsylvania Avenue, NW Washington, DC 20004 **5 copies**

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Forest Service

Manti-La Sal National Forest

Supervisor's Office
599 West Price River Drive
Price, UT 84501
Phone # (435) 637-2817
Fax # (435) 637-4940

File Code: 1950, 2820 **Date:** February 1, 2013

Subject: Supplemental Information Report: Flat Canyon Coal Least Tract FEIS

To: Project File

Introduction

Pursuant to 40 CFR 1502.9 (c), Forest Service Manual 1950, and procedures in Forest Service Handbook 1909.15, Section 18.1, an inter-disciplinary team (ID Team) evaluated whether or not there is significant new information or if there are changed circumstances relating to the environmental impacts of the Record of Decision (ROD) for the Flat Canyon Coal Lease Tract (UTU-77114) Final Environmental Impact Statement (FEIS). Members of the ID Team include Forest Hydrologist (Jan Curtis-Tollestrup), Wildlife Biologist (Jeff Jewkes), and Environmental Coordinator (Nate Lewis). This Supplemental Information Report (SIR) documents the ID Team's evaluation.

Background Information on the Flat Canyon Coal Lease Tract FEIS and ROD

On January 3, 2002, the Forest Supervisor of the Manti-La Sal National Forest signed a ROD for the Flat Canyon Coal Lease Tract FEIS consenting to the leasing of the Flat Canyon Lease By Application (LBA). Shortly thereafter, the proponent, Arch Coal, asked that the project be put on hold indefinitely. As a result, the decision was never implemented and a letter of consent was never transmitted to the BLM by the Regional Forester as required by Forest Service Manual (Sec. 2822.04c).

After receiving a request from Arch Coal expressing renewed interest in the project and the 2002 decision, the BLM sent a letter on June 14, 2012 to the Forest Service inquiring about the status of the Forest Service's consent to leasing of the tract. The decision was made in the 2002 ROD to consent to leasing and the effects were disclosed in the FEIS. However, since the environmental analysis is over ten years old, before we send a letter of consent to leasing of the tract to the BLM, we need to evaluate whether or not there is significant new information or if there are changed circumstances that would warrant a supplemental environmental analysis.

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Policy for New Information or Changed Circumstances

CEQ NEPA requirements (40 CFR 1502.9(c)) and Forest Service NEPA implementing procedures (FSH 1909.15, Section 18) require that if new information or changed circumstances relating to the environmental impacts of a proposed action come to the attention of the responsible official after a decision has been made and prior to completion of the approved program or project, the responsible official should review the information carefully to determine its importance. In this review, consideration is given to whether or not the new information or

changed circumstances are within the scope and range of effects considered in the original analysis. If, after an interdisciplinary review and consideration of new information the Responsible Official determines that it falls within the scope and range of effects considered in the original analysis, then a correction, supplement, or revision to an environmental document is not necessary and implementation would continue. Conversely, a supplement or revision to an EIS would be needed if the interdisciplinary review of new information or changed circumstances indicates that changes in the EIS are needed to address environmental concerns not previously disclosed that have a bearing on the action or its impacts. If it is determined that a supplement or revision to the EIS and/or ROD are required, project implementation would remain on hold until the supplementation process is completed.

This SIR is not a NEPA document and therefore cannot be used to fulfill the requirements for a revised or supplemental EIS. This SIR simply documents the interdisciplinary review and the Responsible official's determination as to whether a correction, supplement, or revision of environmental documents is necessary. This SIR will serve as the documentation of the results of the interdisciplinary review and Responsible Official's determination.

The 2002 Decision of the Selected Alternative.

The following decision was made in the 2002 ROD:

> "After careful review of the public comments, the analysis disclosed in the FEIS, and project file, I have decided to select a combination of Alternative B' and C. My decision is hereafter referred to as the "Selected Alternative". The Selected Alternative closely resembles Alternative B' except that (similar to C) there would be a limit on the amount of subsidence that could occur beneath perennial streams, Boulger Dam and Reservoir, State Route 264, and Flat Canyon Campground on National Forest System lands within the project area. Therefore, I consent to leasing and subsidence of the Flat Canyon Tract, with Forest Service and BLM Special Coal Lease Stipulations (Attachment 1) but subsidence of the areas noted above would be limited to that which would occur from a single seam of full extraction mining. This would allow development in two overlapping seams with full-extraction in one seam and only full-support (no subsidence) mining in the second seam within the limited subsidence zones. It would also provide for two overlapping seams of full-extraction mining outside of the limited subsidence zones. The limited-subsidence areas would be established as discussed in Special Coal Lease Stipulation #9 (Attachment 1). In addition, detailed and comprehensive monitoring of the effects of mining would be required in Forest Service consent/concurrence to approval of the mining and Reclamation Plan (MRP) and Mine Permit to be issued by the Department of Interior. The lessee/operator would also be required to promptly commence and complete measures specified to mitigate effects. Attachment 2 is a list of monitoring and mitigation requirements that will be incorporated during the MRP and Mine Permit review and approval process."

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New Information/Changed Circumstances from the 2002 Record of Decision (ROD), Environmental Impact Statement (EIS), and Biological Evaluation.

The following items have been identified as potentially having changed circumstances and have been evaluated as follows:

Inventoried Roadless Areas (IRAs) and Draft Unroaded/Undeveloped Areas – At the completion of the 2002 FEIS and ROD, the Roadless Area Conservation Rule of 2001 was already in place, but there were no Inventoried Roadless Areas (IRAs) located within the project area so an analysis of impacts to IRAs was unnecessary. These circumstances have not changed. Although an inventory of draft unroaded undeveloped areas were created after the 2002 FEIS and ROD as part of the LRMP revision pursuant to NFMA implementation regulations in 36 CFR 219.7, there are no draft unroaded undeveloped areas located within the project area. (See Appendix A: IRAs and Draft Unroaded Undeveloped Areas Near Flat Canyon Coal Least Tract Map). Therefore, there is no new information or additional analysis needed regarding impacts to IRAs or draft unroaded/undeveloped areas.

Surface Water – After reviewing *Section 3.1.5 Surface Water* and *Section 3.1.6 Ground Water* in the FEIS and the *Technical Report Surface Water and Groundwater Resources in the Flat Canyon Area (2000)* by Norwest Mine Services, Inc., the Forest Hydrologist determined that the 2002 ROD and FEIS are still consistent with the Forest Plan and its amendments, but impacts to drinking water source protection areas for surface water have not been analyzed within the Flat Canyon Coal Lease Tract. (See Appendix B for full Hydrologist Report.) Drinking water source protection for surface water is required by the Utah Drinking Water Board under Utah Rule R309-605. Huntington Creek is identified as a Zone 2 drinking water protection area and the remainder of the project area is a Zone 4 protection area (lowest risk). (See Appendix B – Map 1 Drinking Water Protection Zones for Surface Water.) In the mine plan permitting process we expect mitigation measures needed to protect these drinking water protection zones would be addressed to ensure compliance with Special Coal Lease Stipulations #9 and #17 of the 2002 ROD.

> **"Stipulation #9** – Except at specifically approved locations, underground mining operations shall be conducted in such a manner so as to prevent surface subsidence that would: (1) cause the creation of hazardous conditions such as potential escarpment failure and landslides, (2) cause damage to existing surface structures, and (3) damage or alter the flow of perennial streams. The Lessee shall provide specific measures for the protection of escarpments, and determine corrective measures to assure that hazardous conditions are not created."
>
> **"Stipulation #17** – The Lessees, at their expense, will be responsible to replace any surface and/or developed groundwater sources identified for protection, that may be lost or adversely affected by mining operations, with water from an alternate source in sufficient quantity and quality to maintain existing riparian habitat, fishery habitat, livestock and wildlife use, or other land uses (authorized by 36 CFR 251)."

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Ground Water – The FEIS and 2002 ROD do not identify any drinking water source protection areas for ground water. Sometime around the time the ROD was signed, the State of Utah

identified ground water protection zones within and adjacent to the Flat Canyon Coal Lease Tract. (See Appendix B – Map 2 Drinking Water Protection Zones for Ground Water.) Drinking water source protection for ground water is required by the Utah Drinking Water Board under Utah Rule R309-600. The MIA Shalom Recreation Camp is located adjacent to the project area and relies upon many springs as the source of their drinking water. Zone 1 and Zone 2 protection areas surround these springs. Flat Canyon Campground is also adjacent to the project area and relies upon two springs for drinking water. Zone T2 and Zone T4 protection areas surround these springs. In the mine plan permitting process we expect mitigation measures needed to protect these drinking water protection zones would be addressed to ensure compliance with State requirements. This would be consistent with Special Coal Lease Stipulations #17 of the 2002 ROD.

Hydrologic Data – Baseline hydrologic data for the FEIS was collected from 1997 through 2000 during a wet cycle *[Figure 3.1 Palmer Hydrologic Drought Index (PHDI) for Utah Division 5, Technical Report Surface Water and Groundwater Resources in the Flat Canyon Area, 2000]*. Because the baseline data is over twelve years old, it needs to be validated showing that it represents current conditions and/or updated as part of the permitting process in order to comply with Utah State Law. Long-term data sets are important to assess climatic change (e.g., dry periods versus wet periods) and the impacts of mining on steam and spring flows. Adequate baseline data and continual monitoring is required under Special Coal Lease Stipulation #3 and Stipulation #7 which were attached to and made part of the 2002 decision. Continual monitoring is also necessary to show regular intervals for comparison and trend analysis.

> **"Stipulation #3 –** The Lessee shall be required to perform a study to secure adequate baseline data to quantify the existing surface resources on and adjacent to the lease area. Existing data may be used if such data are adequate for the intended purposes. The study shall be adequate to locate, quantify, and demonstrate the interrelationship of the geology, topography, surface and ground water hydrology, vegetation and wildlife. Baseline data will be established so that future programs of observation can be incorporated at regular intervals for comparison."
>
> **"Stipulation #7 –** The Lessee shall be required to establish a monitoring system to located, meaure and quantify the progressive and final effects of underground mining activities on the topographic surface, underground and surface hydrology and vegetation. The monitoring system shall utilize techniques that will provide a continuing record of change over time and an analytical method for location and measurement of a number of points over the lease area. The monitoring shall incorporate and be an extension of the baseline data."

Federally Listed Species (Threatened, Endangered, Proposed, and Candidate) – After reviewing *Section 3.1.8 Wildlife* in the FEIS and the BA/BE the Wildlife Biologist determined that there are three candidate species that have been added to the U.S. Fish and Wildlife Service (USFWS) County List that were not addressed in the 2002 FEIS. These species are the greater sage grouse, least chub, and the western yellow-billed cuckoo. These species were identified in the addendum BA/BE but do not need to be analyzed further because there is no suitable habitat for these species within the Flat Canyon Coal Lease Tract. Should this circumstance change, Threatened

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and Endangered Species are further protected by Special Coal Lease Stipulations required by the 2002 ROD:

> **"Stipulation #2** – If there is reason to believe that Threatened or Endangered (T&E) species of plants or animals, or migratory bird species of high Federal interest occur in the area, the Lessee shall be required to conduct an intensive field inventory of the area to be disturbed and/or impacted. The inventory shall be conducted by a qualified specialist and a report of findings will be prepared. A plan will be prepared making recommendations of the protection of these species or action necessary to mitigate the disturbance."

Forest Sensitive Species – There are five species that have been added to the Intermountain Regional Forester's List of sensitive plant, wildlife, and fish species that were not addressed in the 2002 FEIS. These species are bighorn sheep, greater sage grouse, western yellow-billed cuckoo, southern leatherside chub, and western boreal toad. Western boreal toad is the only species to have suitable habitat within the Flat Canyon Coal Lease Tract and was analyzed in the 2012 addendum to the BA/BE. The analysis in the FEIS regarding amphibians was thorough and does not need to be changed based on any new information. Therefore, although the listing of Boreal Toad as forest sensitive species is new information, it falls within the scope and range of effects considered in the original analysis, so additional analysis in a supplemental EIS is unnecessary.

Macroinvertebrates – After reviewing *Section 3.1.8 Wildlife* in the FEIS the Wildlife Biologist and Fisheries Biologist determined that the effects analysis regarding macroinvertebrates is still valid; however, the Forest Plan was amended in 2006 to update the protocols used to collect macroinvertebrate data and to change the method used to analyze the data. The 2006 amendment did not alter the language regarding macroinvertebrate monitoring as an optional technique for selected projects. The Manti-La Sal National Forest will continue monitoring aquatic habitat using macroinvertebrate sampling, but change the type of appraisal method used. The methodology is similar to that being used by the Utah Division of Water Quality for macroinvertebrate monitoring. This information was captured in the 2012 addendum to the Flat Canyon Coal Lease Tract Wildlife Report. Macroinvertebrate monitoring is also required of the proponent by the Conditions of Consent to Mine Permit Issuance in the 2002 ROD (Attachment #2). This monitoring will further assess human induced change beyond natural availability. Therefore, no additional analysis is needed.

Air Quality – After the 2002 decision was made, the EPA provided new information about air quality. The EPA classifies areas that meet federal ambient air quality standards as being in attainment, while areas not meeting standards are classified as being in nonattainment. The list of nonattainment areas was most recently updated on December 14, 2012, but none of the counties (e.g., Carbon, Emery, or Sanpete Counties) surrounding the Flat Canyon project area and Skyline Mine were identified by the EPA as nonattainment areas for any of the criteria pollutants including ozone with respect to the 2008 ozone standard (http://www.epa.gov/oaqps001/greenbk/ancl.html).

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The FEIS did discuss the effects of air quality from operations at the Skyline Mine Portal and loadout facilities in *Section 2.4 Issues Identified But Not Carried Through The Analysis*, and concludes:

> "Emissions at the Skyline Mine facilities currently meet air quality standards and the Permit-to-Construct issued by the Utah Department of Air Quality. The proposed action would not lead to additional emissions but would extend the life of operations. It is not expected that operations would lead to any violations of the Clean Air Act" (FEIS, 2-11).

The air quality permit is primarily concerned with dust deriving from how much coal is moved on the surface of the mine in a given year, and that will not change if this decision is implemented. There were no new surface activities connected to the conceptual mine plan scenario anyway. Therefore, any new concerns over air quality fall within the scope and range of effects considered in the original FEIS analysis, so additional analysis in a supplemental EIS is unnecessary.

Climate Change – After the 2002 decision was made, new information has come out about climate change. According to the U.S. Global Change Research Program (2009), global warming is unequivocal, and the global warming that has occurred over the past 50 years is primarily human-caused. Standardized protocols designed to measure factors that may contribute to climate change, and to quantify climatic impacts, are presently unavailable. As a consequence, impact assessment of specific impacts related to anthropogenic activities on global climate change cannot be accurately estimated. Moreover, specific levels of significance have not yet been established by regulatory agencies. Therefore, climate change disclosure for the purpose of this SIR is limited to accounting for greenhouse gas (GHG) emissions changes resulting from the combustion of fossil fuels that would contribute incrementally to climate change. (Source: http://globalchange.gov/what-we-do/assessment/previous-assessments/global-climate-change-impacts-in-the-us-2009).

The question of what researchers have found regarding coal combustion as a significant source of CO2, a greenhouse gas contributing to global warming, was addressed in the FEIS in *Section 2.4 Issues Identified But Not Carried Through The Analysis*, and concludes:

> "In regard to global climate change, scientists have debated the potential effects for the last decade and studies with conflicting conclusions continue to be published. According to the US Environmental Protection Agency (http://www.epa.gov/globalwarming/uncertainties.html) it is known that human activities are adding greenhouse gasses to the atmosphere, and that these gasses tend to warm the earth. However it is not known to what degree human-generated greenhouse gasses are responsible for the global warming trend. This is because other factors, natural and human, affect the earth's temperature. Scientific understanding of factors such as natural climatic variations, changes in the sun's energy, and the cooling effects of pollutant aerosols are not well understood. There is scientific uncertainty regarding how much warming would occur, how fast warming would occur and what the potential adverse and beneficial effects would be. It is beyond the scope of this document to predict what potential effects burning of the coal from the project area for generation of electricity would have on the global climate. The local coal fired power plants will continue to burn

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coal at the current or increased rate regardless where the coal comes from. If not mined from the project area, coal would be imported from other areas with potentially greater effects due to burning of lower quality coals" (FEIS, 2-10).

The FEIS also addressed the impact on climate change of burning fossil fuels such as coal from the Flat Canyon lease:

> "The quality of the coal in the Flat Canyon Tract is low in ash and sulfur (i.e. compliance coal). These coals are desirable for power plants because they produce very few particulates, relatively little sulfur dioxide, and decrease the potential for acid rain relative to other coals. Coal in the tract contains less than 0.5 percent sulfur. It is reasonably foreseeable that the coal would be burned to produce electricity at power plants in Utah and western Nevada. Emissions at these plants are reduced by scrubber technology and are regulated through air quality standards. If Flat Canyon Tract coal is not mined and burned, coal from other sources with higher potential for producing pollutants would most likely be purchased and burned in these or other plants. The issues of climate changes and global warming from combustion of fossil fuels are considered beyond the scope of this analysis" (FEIS, 2-10 to 2-11).

Effects from fossil fuel GHGs may not be measurable for decades or centuries and modeling is very expensive and relies on assumptions. Predicting the degree of impact any single emitter of GHGs may have on global climate change, or on the changes to biotic and abiotic systems that accompany climate change, is not possible at this time. As such, the controversy is to what extent GHG emissions resulting from continued mining may contribute to global climate change, as well as, the accompanying changes to natural systems cannot be quantified or predicted at this time. Therefore, the effects of this decision on climate change were addressed in the original FEIS analysis, so there is no need for additional analysis in a supplemental EIS.

Overall Conclusion and Responsible Official Determination Concerning New Information/Changed Circumstances

I have reviewed the new information and have considered this information within the overall context of the project analysis and decision. This analysis complies with 40 CFR 1502.9 (c), and the Forest Service Handbook 1909.15, Section 18.1, "Review and Documentation of New Information Received after a Decision Has Been Made." Based on the above summaries and conclusions, I have determined that the new information described above does not constitute "significant new circumstances or information relevant to environmental concerns and bearing" on decisions documented in the January 3, 2002 Record of Decision for the Flat Canyon Coal Lease Tract, or the effects disclosed in the associated Environmental Impact Statement. I find the new information and its effects to be within the context of the project's environmental analysis and decision, based on the following rationale: The Environmental Coordinator, Forest Hydrologist, and Wildlife Biologist determined that a consent to leasing the Flat Canyon Federal Coal Lease Tract is still within the parameters of the original decision, any of this new information would not have new or different effects on the natural resources from those described in the original EIS. Prior to the commencement of mining activities and through the mine plan permitting process, any mitigation measures needed for the protection of the drinking water source protection zones for both surface and ground water will be addressed as required by

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Special Coal Lease Stipulations #9 and #17 of the 2002 ROD. In addition, through the mine plan permitting process the hydrologic baseline data will be validated for current conditions or updated to comply with Utah State Law as required by Special Coal Lease Stipulation #3 and #7 of the ROD.

Considering the above rationale, I believe the analysis in the FEIS adequately displayed the effects of the selected alternative on the environment. None of the new information demonstrates that the project will affect the quality of the human environment in a significant manner or to a significant extent that is not already considered in the underlying documents. I find that the new information and its effects would be within the context of the project's ROD. Therefore, I find no need to correct, supplement, or revise the EIS or the January 3, 2002 decision. Consent to leasing the Flat Canyon Federal Coal Lease Tract with special coal lease stipulations in place is consistent with Forest Plan objectives for the affected area. Implementation of the project may proceed. All elements of the original ROD remain in effect and unchanged. The findings in this Supplemental Information Report (SIR) are not appealable under the Forest Service appeal regulations.

This SIR, when signed, is to be retained in the project record.

___/s/ Allen Rowley_____ __February 1, 2013_

ALLEN ROWLEY
Acting Forest Supervisor
Manti-La Sal National Forest

Date

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USDA United States Department of Agriculture | Forest Service | Manti-La Sal National Forest

Supervisor's Office
599 West Price River Drive
Price, UT 84501
Phone # (435) 637-2817
Fax # (435) 637-4940

BLM - UT - 950
2013 FEB 14 PM 2:06

File Code: 2820
Date: February 4, 2013

Mr. Kent Hoffman
Deputy State Director
BLM State Office
440 West, 200 South, Suite 500
PO Box 45155
Salt Lake City, UT 84145-0155

Dear Mr. Hoffman,

On January 3, 2002, the Forest Supervisor of the Manti-La Sal National Forest signed the Record of Decision (ROD) for the Flat Canyon Coal Lease Tract FEIS consenting to the leasing of the Flat Canyon Lease (UTU-77114) (Attachment 1). Shortly thereafter, the proponent Arch Coal asked that the project be put on hold indefinitely. As a result, the decision was never implemented and a letter of consent was never transmitted to the BLM as required by Forest Service Manual (Sec. 2822.04c). After receiving a request from Arch Coal expressing interest in the project, the BLM sent a letter on June 14, 2012, to the Forest Service inquiring about the status of the Forest Service's consent to leasing of the tract. Because the environmental analysis for this proposed action was over ten years old, I needed to evaluate whether or not there was new information or if there are changed circumstances that would warrant a supplemental environmental analysis consistent with CEQ NEPA requirements (40 CFR 1502.9(c)) and Forest Service NEPA implementing procedures (FSH 1909.15, Section 18). In response to the request, an internal review was conducted and a Supplemental Information Report (SIR) was prepared by an inter-disciplinary team (ID Team) (Attachment 2).

Based on the summaries and conclusions of the SIR, I have determined that the information described within the attached reports and documentation does not constitute "significant new circumstances or information relevant to environmental concerns and bearing" on decisions documented in the January 3, 2002, Record of Decision for the Flat Canyon Coal Lease Tract, or the effects disclosed in the associated Environmental Impact Statement. Of note, the ROD identifies and requires monitoring and mitigation measures be incorporated as appropriate in the mine permit if a leasing decision is made by BLM. Also, the 2002 ROD does not identify any drinking water source protection areas for ground water even though there are some that are located within and adjacent to the Flat Canyon Coal Lease Tract. (See SIR – Map 2 Drinking Water Protection Zones for Ground Water.) Drinking water source protection for ground water is required by the Utah Drinking Water Board under Utah Rule R309-600. The MIA Shalom Recreation Camp is located adjacent to the project area and relies upon many springs as the source of their drinking water. Zone 1 and Zone 2 protection areas surround these springs. Flat Canyon Campground is also adjacent to the project area and relies upon two springs for drinking water. Zone T2 and Zone T4 protection areas surround these springs. To be consistent with State requirements, mitigation measures are needed to protect these drinking water protection zones and should be addressed in the mine plan permitting process and are required by Special Coal Lease Stipulations #17 of the 2002 ROD.

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Therefore, this letter is my consent to the Bureau of Land Management (BLM) Utah State Office to implement the Flat Canyon Coal Lease Tract (UTU-77114). Please include stipulations identified in the decision (ROD Attachment 1) into the proposed lease.

Should you have additional clarification, please contact Nate Lewis at 435-636-3550 or Tom Lloyd at 435-636-3596.

Sincerely,

ALLEN ROWLEY
Acting Forest Supervisor

Enclosures

cc: Patricia Clabaugh, Field Office Manager, BLM Price Field Office, 125 South 600 West, Price, Utah, 84501

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Skyline Mine Flat Canyon Coal Lease Tract
Mining Plan Modification
Finding of No Significant Impact
April 2017

Prepared in Cooperation with the Bureau of Land Management, US Forest Service, and Utah Division of Oil, Gas and Mining

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United States Department of the Interior
Office of Surface Mining Reclamation and Enforcement
Program Support Division
1999 Broadway, Suite 3320 Denver, CO 80202
PH: 303-293-5000 FAX: 303-293-5032

Introduction

The Office of Surface Mining and Reclamation Enforcement (OSMRE) has completed the environmental review of the Skyline Mine Flat Canyon Coal Lease Tract Mining Plan Modification proposal under the National Environmental Policy Act (NEPA).

Canyon Fuel Company has operated the Skyline Mine since 1981 under Utah Division of Oil, Gas and Mining (DOGM) Permit C0070005. Skyline is an underground coal mine located near Helper, Utah. The Flat Canyon Federal Coal Lease Tract UTU-77114 is in Sanpete County, Utah. Private coal resources located in Sanpete and Emery Counties are directly adjacent to the Flat Canyon Federal Coal Lease Tract UTU-77114 and would be mined via access through the lease.

On February 27, 2015, Canyon Fuel Company, LLC submitted a significant revision to the Utah DOGM. The Utah DOGM is reviewing Skyline Mine's permit amendment, and will submit the Canyon Fuel Company permit application package (PAP) for the mining plan modification to the OSMRE for review, in accordance with its responsibilities under the federal Surface Mining Control and Reclamation Act of 1977 (SMCRA).

The U.S. Forest Service, Manti-La Sal National Forest, and the BLM Utah State Office, with OSMRE as a cooperating agency, completed a Final Environmental Impact Statement (FEIS) reviewing the impacts of the federal coal leasing action (US Forest Service, 2002a), the BLM also signed a Record of Decision (ROD) (BLM, 2002) to offer the lease for sale, and the Forest Service issued a ROD in 2002 (US Forest Service, 2002b) consenting to the leasing action proposed by the BLM.

Canyon Fuel Company subsequently requested that the sale of the lease be delayed. On June 21, 2012, Canyon Fuel Company requested to reinitiate the lease sale. Because the NEPA review was more than 10 years old, in compliance with the U.S. Forest Service Handbook 1909.15, the Manti-La Sal National Forest reviewed the project and completed a supplemental information report (SIR) (US Forest Service, 2013), which identified the changed conditions and confirmed the Forest Service consent to lease decision. The Forest Service issued a consent letter on February 4, 2015. The BLM also completed a Determination of NEPA Adequacy (BLM, 2015a) under BLM Handbook 1700-1, confirming the 2002 NEPA decision. The lease was auctioned in July 2015.

The OSMRE is required to evaluate the PAP before Canyon Fuel Company may conduct underground mining and reclamation operations to develop the Flat Canyon Federal Coal Lease Tract UTU-77114. OSMRE is the agency responsible for making a recommendation to the ASLM to approve, disapprove, or approve with conditions the proposed mining plan modification. The ASLM will decide whether the mining plan modification is approved, disapproved, or approved with conditions. The OSMRE has prepared an Environmental Assessment (EA) based on the previously completed EIS, Supplemental Information Report, and Determination of NEPA Adequacy and reached a Finding of No Significant Impact (FONSI).

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In conducting the EA, the OSMRE reviewed the environmental impacts of the Proposed Action (approving a mining plan modification that would authorize mining activities to produce up to 8

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million tons per year of coal from Flat Canyon Federal Coal Lease Tract UTU-77114) and the No Action (disapprove the mining plan modification).

Statement of Environmental Significance

Pursuant to 30 CFR Part 746, OSMRE is recommending selection and approval of the Proposed Action. The undersigned person has determined that approval of a federal mining plan modification authorizing the continuation of mining operations to recover the federal coal for approximately 9 to 12 years of Flat Canyon Federal Coal Lease Tract UTU-77114 with no additional surface disturbance would not have a significant impact on the quality of the human environment under section 102(2)(C) of the NEPA, 42 USC 4332(2)(C); therefore, an EIS is not required.

Reasons for a Finding of No Significant Impact

OSMRE must make a recommendation to the Assistant Secretary of Land and Minerals Management (ASLM) on a decision to approve, disapprove, or approve the mining plan modification with conditions. OSMRE's purpose and need for the Proposed Action is to meet the requirements of 30 CFR Part 746 to review the PAP. OSMRE is the lead Federal agency responsible for development of the EA because it has the decision-making authority regarding a recommendation for the proposed mining plan modification under the Mineral Leasing Act of 1920. As such, this EA follows the regulations and guidance for implementing NEPA from the Council on Environmental Quality, the Department of the Interior, and OSMRE.

The Proposed Action would modify the mining plan to authorize mining a probable maximum of approximately 42 million tons of federal coal at a maximum rate of up to 8 million tons per year (a limit established in the air permit Approval Order DAQE-AN0092007-03 issued by the Utah Department of Environmental Quality, Division of Air Quality). No additional surface disturbance is planned. The Proposed Action and adjacent private coal (a probable maximum of 5 million tons) would extend the mining at Skyline for approximately 9 to 12 years, based on an average annual production of 4.5 million tons.

Under the No Action Alternative, the mining decision document would not be prepared by OSMRE and therefore ASLM would not approve the mining plan modification. Although DOGM has already approved the permit revision associated with the Proposed Action, without ASLM approval, DOGM's permit would revert to the previous permit.

The Federal coal reserves in the Flat Canyon Federal Coal Lease Tract UTU-77114 would not be recovered and underground mining would continue until available coal reserves are mined out in 2018. Reclamation would last two years after closure and continue until Canyon Fuel Company's obligations for reclamation under SMCRA and the Federal lease terms were met.

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The attached EA considers a reasonable range of alternatives and in conjunction with the previously completed NEPA reviews, discloses the potential environmental effects. These reviews provide sufficient evidence and support for a FONSI.

The EA was prepared by a third-party consulting firm at the direction of OSMRE. During the development of the EA, OSMRE independently reviewed the document to ensure compliance with

43 CFR Part 46, Subpart D and all Council of Environmental Quality regulations implementing NEPA (40 CFR 1500-1508), and other program requirements. This independent review included OSMRE's evaluation of all environmental issues analyzed in the EA, including those identified in comments received from the public during scoping. OSMRE takes full responsibility for the accuracy, scope, and the content of this document.

The undersigned has determined that the public involvement requirements of NEPA have been met. OSMRE conducted public outreach and received comments from October 13 through November 19, 2015. The draft EA and FONSI were made public on June 28, 2016 for a 30-day public comment period.

This finding is based on determining the significance as defined by the context and intensity found in 40 CFR 1508.27 of effects from the Proposed Action.

a) Context. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.

The proposed action would meet demand for coal and continue mine operations through at least 2028 by:

- Securing a federal mining plan modification approval authorizing mining of leased federal coal; and,
- Continuing to mine (3 to 4.5 million tons of coal per year), process, and ship (via rail and truck) coal to customers in need of coal.

Under the No Action Alternative, mining would continue until 2018. The effects of both the Proposed Action and No Action have been analyzed at the local and regional scale.

b) Intensity. This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity.

The 10 Significance Criteria in the federal regulations at 40 CFR 1508.27 have been considered in evaluating the severity of impacts.

1. Impacts that may be both beneficial and adverse.

Beneficial and adverse impacts from the Proposed Action are described in the attached EA. There are no ground disturbing activities associated with the Proposed Action therefore there would be minor, negligible or no impact to cultural resources, vegetation, or soils (EA Table 4). Particulate matter, hazardous air pollutants, and greenhouse gas emissions would remain at current levels for the duration of the additional life of the mine and within the permitted limits; therefore, direct impacts would be negligible and adverse (EA Section 4.3.1). The contribution to greenhouse gas emissions

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compared to Utah totals would be negligible. It is unknown where the coal would be consumed, the greenhouse gas emissions from the maximum 4.5 million tons of coal mined at Skyline Mine indirect impacts are considered negligible and adverse (EA Section 4.3.1). The direct and indirect impacts on topography, geology, water resources (surface water, groundwater, surface water and groundwater quality, and mine dewatering and discharges), and greater sage-grouse are considered minor, negligible or no impact.

Stipulations included in the lease reduce potential short-term and long-term impacts to topography, air quality, water resources, vegetation, fish and wildlife, threatened and endangered species, cultural resources, visual resources, and soils (EA Section 2.2.13). Additionally, the air permit (DAQE-AN0092007-03) includes measures to reduce impacts on air quality (EA Section 2.3.13), and the Utah Pollution Discharge Eliminating System permit includes requirements to reduce the impacts on surface and groundwater (EA Section 2.2.13).

The Proposed Action would result in minor beneficial economic impacts. There would be an extension of employment for approximately 320 employees in Carbon County for up to 12 years (EA Section 4.4). The No Action would have major adverse social and economic impacts with the loss of employment and revenue.

None of the environmental effects from the Proposed Action discussed in the EA are considered to be significant.

2. The degree to which the Proposed Action affects public health or safety.

Effects from the Proposed Action that could affect health and safety are traffic, air quality, water quality, and noise. Impacts on Transportation and Access were analyzed in the 2002 EIS (see Table 3 in the EA). Air and water impacts of the Proposed Action are discussed in the EA in sections 4.3.1 and 4.6.1, respectively. Impacts on air quality are negligible (see 1 above). The direct and indirect impacts on water would be minor to no impact and short term. Underground mining would not produce noise effects (Table 4 in the EA).

3. Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farm lands, wetlands, wild and scenic rivers, or ecologically critical areas.

There are no park lands, prime farmlands, wild and scenic rivers, wetlands, or ecologically critical areas within the Project Area (Table 1 in the EA). There are no wilderness areas within or near the Project Area. Inventories of historic or cultural resources have been completed, which identified two potentially eligible historic sites in the Project Area. The 2002 Record of Decision determined there were little potential impacts from subsidence. The Utah State Historical Preservation Office concurred with the determination that there would be no adverse effects.

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4. The degree to which the impacts on the quality of the human environment are likely to be highly controversial.

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As a factor for determining within the meaning of 40 CFR 1508.27(b)(4)—whether or not to prepare a detailed environmental impact statement—"controversy" is not equated with "the existence of opposition to a use." *Northwest Environmental Defense Center v. Bonneville Power Administration*,

117 F.3d 1520, 1536 (9th Cir. 1997). The term 'highly controversial' refers to instances in which "a substantial dispute exists as to the size, nature, or effect of the major federal action rather than the mere existence of opposition to a use" *Hells Canyon Preservation Council v. Jacoby*, 9 F.Supp.2d 1216, 1242 (D. Or. 1998).

The EA has analyzed the direct and indirect effects on and from climate change and determined the effects to be negligible. The analysis complied with CEQ's guidance on when and how to consider the effects of greenhouse gas (GHG) emissions and climate change in the NEPA process, in both the guidance's draft (published Dec 2014) and final (published Dec 2016) iterations. Executive Order 13783, signed 28 March 2017, rescinded the final CEQ guidance. Therefore OSMRE edited the discussion of climate change in the final EA to remove references to the CEQ guidance; however these edits made no substantive difference to the methodology used to examine the direct or indirect effects of the emissions under each alternative or to our conclusions on the resulting potential for climate change impacts.

Approvals of federal mining plans and mining plan modifications have been made for the Skyline Mine since 1981. The design features and reclamation plan would reduce the effects on the environment; or, in some cases, would improve the current condition (e.g., soils, vegetation, and wildlife habitat (EA Section 2.2.13).

5. The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

There are no direct, indirect, or cumulative effects on the human environment under the Proposed Action that are highly uncertain or involve unique or unknown risks. OSMRE has experience implementing similar actions in similar areas.

6. The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principal about future consideration.

This decision is not precedent setting. The issues considered in the EA were developed by the interdisciplinary team within the context of past, present, and reasonably foreseeable actions. Significant cumulative impacts are not anticipated.

7. Whether the action is related to other actions with individually insignificant but cumulatively significant impacts – which include connected actions regardless of land ownership.

The interdisciplinary team evaluated the possible issues in context of past, present, and reasonably foreseeable actions, including the Skyline Mine operation and other mining operations, the transport of coal from the mine, the combustion of that coal, and ranching, recreation and other mines in the cumulative effects analysis area. The indirect greenhouse gas emissions from coal combustion mined annually from the Skyline Mine were disclosed in the EA (Section 4.3.1). There were no significant cumulative effects identified (EA Section 5.2.2.1).

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8. The degree to which the action may adversely affect districts, sites, highways, structures, or other objects listed in or eligible for listing in the National Register of

Historic Places (NRHP) or may cause loss or destruction of significant scientific, cultural, or historical resources.

The Project Area was surveyed for cultural and historic resources. The 2002 Record of Decision determined there was little potential impact from subsidence. The Utah State Historical Preservation Office concurred with the determination that there would be no adverse effects.

9. The degree to which an action may adversely affect a threatened or endangered species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

There would be no impacts on listed species because habitat does not exist in the Project Area (EA Section 3.1). Downstream effects on listed fish would not occur because there would be minor to negligible, short-term impacts on water quality or volume (Section 4.5.1).

10. Whether the action threatens a violation of a federal, state, local, or tribal law, regulation, or policy imposed for the protection of the environment, where non-federal requirements are consistent with federal requirements.

The Proposed Action would not violate any known Federal, state, local, or tribal law or requirement imposed for the protection of the environment. During the public and agency involvement for this EA, state, local, and tribal interests were given the opportunity to participate in the environmental analysis process as well as cooperating agencies, BLM, USFS, and Utah DOGM. Tribal consultation with the Hopi, Southern Ute, and Santa Clara Pueblo is ongoing. The Proposed Action is consistent with applicable plans, policies, and programs.

M. Calle 4/27/2017

Marcelo Calle, Manager
Program Support Division
Western Region
OSMRE

Date

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LEGEND

1 Lodestar Energy, Inc.
2 Alpine Board of Education
3 Robert Radakovich, Trust
4 Central Utah Telephone, Inc.
5 Church of Jesus Christ of LDS
6 Hellenic Church
7 Lutheran High School
8 David G. & Renee L. Cunningham
9 D. Euray Allred & Madelyn E. Allred Trust
10 Canyon Fuel Company, LLC
11 Max A. Blackham & Paul E. Jacob
12 Milton A. Oman, LTD
13 Koula Marakis, Trust: George E. & Helen Liodakis & Liodakis Ranch, LLC
14 E. George Telonis, et. al.
15 J. Mark & James C. Jacob
16 Della L. & Hilda M. Madsen
17 Robert & E. Radakovich
18 J. Mark & Terri T. Jacob
19 Clan Stilson & Ted Miller
20 Louis & Anna Kosec
21 Jack & Sei Otani
22 John R. & Lillie E. Woolsey
23 Max A. & Mary Lou Blackham
24 Mary L. Seamons
25 Lafe & Joyce Parrish
26 Calvin J. Jacob Trust, et. al.
27 Dennis & Kary Law & Lafe & Joyce Parrish
28 Carl B. & Grace M. Clegg, et. al.
29 Carbon County School District
30 Robert J. & Evelyn R. Hilton Trust
31 Utahna Pace Jones, Trust
32 Arthur J. Anderson
33 Questar Pipeline Company
34 United States of America
35 Gordon R. & Wendy Nichol
36 Fred & Sheila Jensen
37 Town of Schofield
38 William A. & Mattie Cornaby
39 Utah Power and Light
40 Sterling Robert Boren, et. al.
41 Hyrum & Elaine Reich Trust
42 Clan Stilson, et. al.
43 Jack & Sei Otani & Steven K. Tanner
44 Paul E. Jacob Trust
45 Kenneth & Geneva Olsen
46 Paul Barton & Margie & Calvin Jacob
47 Boyd L. & Caleen Marsing
48 Craig N. & Elizabeth Teerlink Trust
49 Douglass L. & Jolene Hale
50 Steven R. Adams, et. al.
51 Brent Leon Bawden, et. al.
52 R.W. Jr. & Caren C. Jensen Trust, et. al.
53 Chadette B. & Kim J. Sorensen
54 Robert J. & Evelyn R. Hilton
55 Gary D. & Joann Smith Trust
56 Paul E. Jacob Trust
57 Schofield Reservoir Special Services District
58 Clear Creek Home Association
59 John Dehass Trust
60 Albert B. & April S. Cornaby
61 James & Lana Billingsley
62 Jeff & Beverly Memmott et. al.
63 Mike & Harvey Carso, Jim Davis
64 Mike H. Carso
65 Glade W. Mower
66 G.W. Mower Family Partnership LTD.
67 J.O. Tracy et. al. & David G. & Renee L. Cunningham
68 L.A. Peterson et. al.
69 Price Water Conservation District
70 Collard Family Trust
71 Gooseberry Estates
72 D. & L. Evans Starhaven Partnership
73 C.K. Cox Family Corp.
74 Shirley Cox Trust
75 Cox Inc.
76 W.E. Cox
77 Elmer N. Fillis
78 E. Odell Cox
79 Dee Cox
80 Rex Hansen
81 Dwight W. Peterson
82 Leif M. Greco etux. J.T. et. al.
83 Margaret B. Bench
84 Anna Marie Kellet
85 Peterson Enterprises et. al.
86 Roy F Hatch (Four Seasons)
87 Terry R. Cox et. al.
88 G. Wayne Mower et. al.
89 Leslie Scott Watson et. al.
90 Sandra Lynn Shelly et. al.
91 Jeffrey V. Jensen et. al.
92 Kenneth R. Bench
93 Richard S. Christensen Trustee
94 Dodge Enterprises Inc.
95 Neal Rosenbaum et. al.
96 Bateman Dynasty L.C.
97 Brian Trapnell Trustee
98 Merril Gappmayeer Trustee
99 DKL, LLC
100 State of Utah
101 Carbon County Recreation Trans. Spec. Service Dist.
A Duvel's Inc.
B Rudman Land and Livestock, LLC
C Bryan and Susan Allred
D Lazy CP LTD Partnership

OWNERSHIP BOUNDARY

2000' 0' 1000' 2000'

CONTOUR INTERVAL: 80 Feet

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

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RECEIVED
MAY 09 2017
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Date	No.	REVISIONS	DR./CK.
AUG 02	1		VSM
MAY 07	2		BR/GG
Dec 09	3	MODIFIED PERMIT BOUNDARY AND ADDED WQVF LAND OWNERSHIP	AB/GG
JULY 10	4	REMOVED PERMIT BOUNTARY, ADDED LOCATION NOTE	JH/GG
AUG 10	5	REMOVED WQVF LAND OWNERSHIP	AB/GG
JUNE 16	6	Modified ownership adjacent to Flat Canyon Lease; #'s 70, 92, 99	GG/GG

LAND OWNERSHIP

Canyon Fuel Company, LLC
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463
Skyline Mines

SCALE: 1" = 2000' | DATE: 7-1-2002 | CK.BY:VSB | REVISION: 6
DWG. NO.: 1.6-1 | DR.BY:CDH
CAD FILE: 1.6-1REV6 | 12-30-16

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T 12 S
T 13 S

T 13 S
T 14 S

SCOFIELD RESERVOIR

SCOFIELD LAKE STATE RECREATION AREA

Scofield

GRANGER RIDGE

WINTER QUARTERS RIDGE

Winter Quarters Canyon

Woods Canyon

Bobs Canyon

Box Canyon

Huntington Canyon

Eccles Canyon

Broads Canyon

Sheep Canyon

Boulger Canyon

Clear Creek Canyon

Gooseberry Campground

Beaver Dam Reservoir

Gooseberry Reservoir

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

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LICENSED PROFESSIONAL GEOLOGIST
GREGG GALECKI
5248584
STATE OF UTAH
5.5.17

LEGEND

1 Gooseberry Enterprises, Inc.
2 50% Mason 50% Peterson Ent.
3 Collard Family Trust, Leased to CFC
4 Carbon County (Leased to Canyon Fuel Co., LLC)
5 Church of Jesus Christ of LDS
6 State of Utah
7 U-7714, State of Utah
8 Utah Power & Light
9 Chevron
10 75% L. Uhl 25% Mave H. & Harvey R. Carson & Jim Davis
11 C.K. Cox Family Corp.
12 E. Odell Cox
13 Dee Cox
14 Elmer N. Fillis
15 Cox Inc.
16 Leif M. Greco
17 Dwight W. Peterson
18 Robert S. Hansen
19 W. Chad Cox Family Inc.
20 Margaret B. Bench
21 Anna Marie Kellett
22 DKL, LLC
23 T. & L. Tracey & D. & R. Cunningham
24 United States of America
25 Arkland
26 C & B Energy (Leased to Canyon Fuel Co., LLC)
27 Jeffery V. Jensen et. al.
28 Shirley Cox Trust
29 Kenneth R. Bench
30 Roy F. Hatch (Four Seasons)
31 Terry R. Cox et. al.
32 G. Wayne Mower et. al.
33 Leslie Scott Watson et. al.
34 Sandra Lynn Shelly et. al.
35 Jeffery V. Jensen et. al.
36 Energy Fuels (Leased to Canyon Fuel Co., LLC)
37 Canyon Fuel Company, LLC

COAL OWNERSHIP BOUNDARY

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

2000' 0' 1000' 2000'

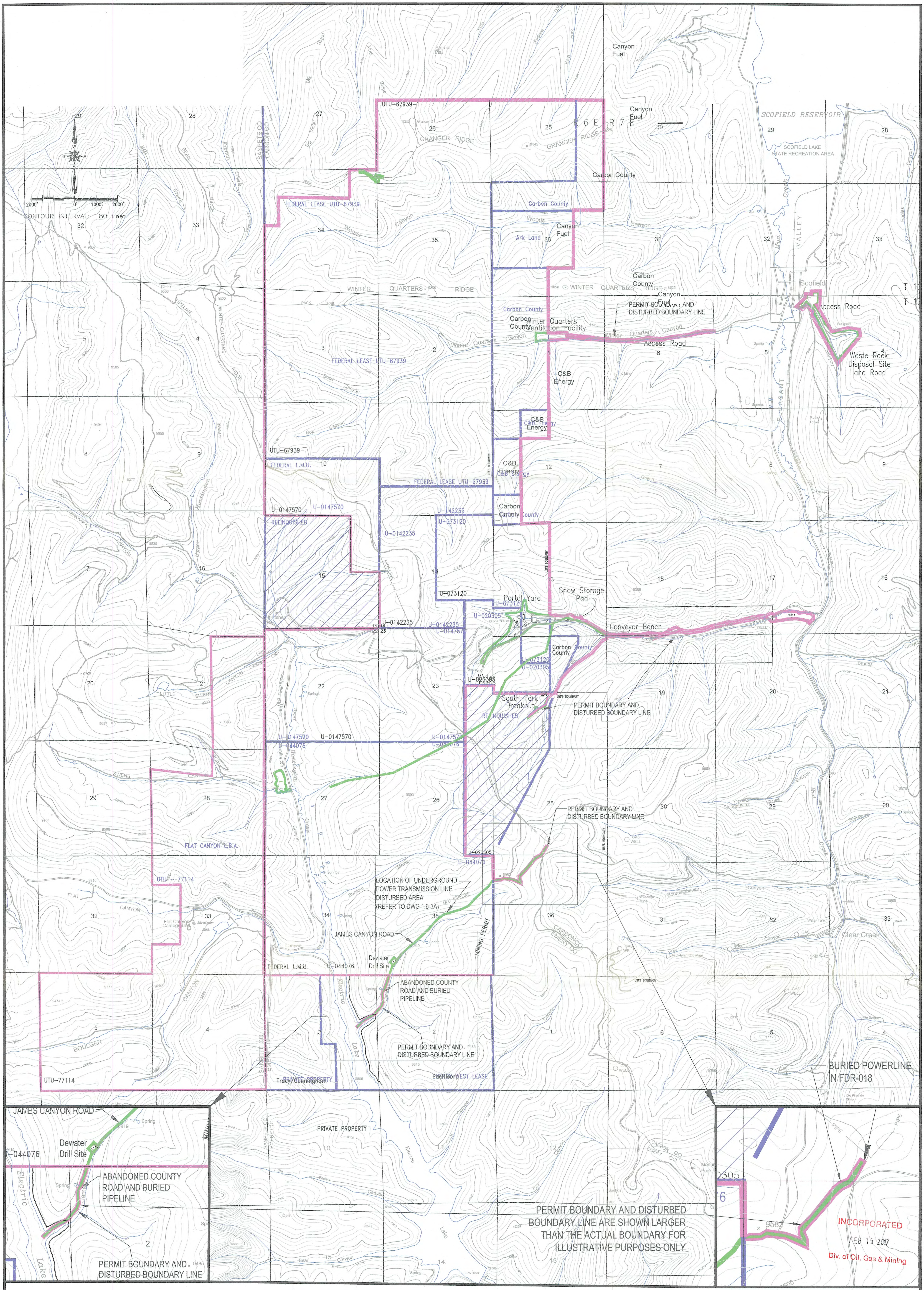
CONTOUR INTERVAL: 80 Feet

DATE	No.	REVISIONS	DR.	CHKD.
AUG 02	1			VSM
OCT. 02	2			VSM
NOV 02	3			VSM
OCT 07	4	Modified Permit Boundary (IBC & WASTE ROCK), Corrected Carbon Co. ownership/modified legend	BR	GG
DEC 09	5	MODIFIED PERMIT BOUNDARY	AB	GG
JULY 10	6	REMOVED PERMIT BOUNDAY, ADDED LOCATION NOTE	JH	GG
Oct 12	7	Changed Hanson Natural Resources to Canyon Fuel Company, LLC in Legend – #37	GG	GG
JUNE 16	8	Modified ownership adjacent to Flat Canyon lease; #'s 22, 29, 30; removed UTU-77114 lease line	GG	GG

Coal Ownership

Canyon Fuel Company, LLC
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463
Skyline Mines

SCALE: 1" = 2000'	DATE: 2/20/01	CK.BY:C. HANSEN	REVISION: 8
DWG. NO.: 1.6-2		DR.BY:JLP	12-30-16
CAD FILE: 1.6-2REVB			



ADJACENT AREA SITE DESCRIPTION:
Active Lease Areas, Permit Boundary, and 1/2 Mile beyond Waste Rock Disposal Site

13,525 ACRES SITE PERMIT BOUNDARY

PERMIT AREA	SITE DESCRIPTION
13.86	RAIL LOADOUT
42.55	PORTAL YARD
0.60	WATER TANKS & WELL PADS
0.96	SOUTH FORK PORTALS
14.18	CONVEYOR BENCH
32.48	WASTE ROCK DISPOSAL SITE
7.93	WINTER QUARTERS VENTILATION FACILITY
4.90	WINTER QUARTERS ROAD (not reclaimed)
1.60	JAMES CANYON BURIED PIPELINE
0.30	JAMES CANYON BURIED POWER LINE
2.95	JAMES CANYON WATER WELLS AND ROAD
3.00	NOG Bleeder Shaft
14.50	Swens Shaft and Power line (powe line not reclaimed)
139.81	

LEASE ACREAGE WITHIN ADJACENT AREA

FEDERAL COAL	ACREAGE	NON-FEDERAL COAL	ACREAGE
U-0147570	1532.70	C&B COAL	120.00
U-0142235	520.0	CARBON COUNTY	811.25
U-073120	557.22	ARK LAND COMPANY	240.00
U-044076	2489.32	Cunningham / Tracy	346.68
U-020305	279.40	TOTAL	1,517.93
UTU-67939	4061.52		
UTU-771114	2692.16		
TOTAL	12,132.32		

NOT ALL ACREAGE FOR EACH LEASE IS WITHIN THE PERMIT BOUNDARY, REFER TO PART 1, TABLE 1.114.

LEGEND

ADJACENT AREA: Areas Authorized for Coal Mining and Reclamation Activities (SEE CHIA FOR HYDROLOGIC ADJACENT AREA)

PERMIT BOUNDARY

LEASE BOUNDARY

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

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DIV. OF OIL, GAS & MINING

DATE	No.	REVISIONS	DR. / CHKD.
AUG 02	1		/VSM
NOV 02	2		/VSM
JUNE 07	3	MODIFIED PERMIT BOUNDARY (IBC & WASTE ROCK) SKYLINE MINES PERMIT AREA, LEASE AREAS.	BR /GG
MAR 2010	4	ADDED ADJACENT AREA, MODIFIED PERMIT AND LEASE BOUNDARIES	AB /GG
JUL 2010	5	ADDED WINTER QUARTERS ACCESS ROAD	AB /GG
AUG 2010	6	MODIFIED ADJACENT AREA	AB /GG
OCT 2012	7	Modified Adjacent Area with Lease Mod. and Relinquishments	GG /GG
July 2014	8	Corrected permit boundary to include water line from Tanks	GG /GG
April 2015	9	Added the NOG shaft pad	TE /GG
May 2016	10	Added Swens shaft pad and power line	JA /GG
Dec. 2016	11	Added Flat Canyon Lease – UTU-77114	JA /GG

SKYLINE MINE PERMIT AREA

Canyon Fuel Company, LLC
Skyline Mines
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463

SCALE: 1" = 2000' | DATE: 9/24/01 | CK.BY: G. Galecki
DWG. NO.: 1.6-3 | DR.BY: JCA
CAD FILE: 1.6-3REV11
REVISION: 11
12-30-16

LOA SEAM PLYS

- LOA7
- LOA5
- LOA3
- LOA1
- FC5
- FC3
- FC1

FC SEAM PLYS

PARTINGS

LEGEND

99-33-1 — DRILL HOLE

12 — ISOPACH CONTOUR

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

NOTES:

1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH - M96147

0 2000' 4000'

N

DATE	No.	REVISIONS	BY / CHKD
DEC 09	1	MODIFIED PERMIT BOUNDARY	AB / GG
JULY 10	2	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JH / GG
Dec 16	3	UPDATED SEAM ISOPACH	BB / GG

LICENSED PROFESSIONAL GEOLOGIST — STATE OF UTAH — GREGG GALECKI 5248584 — 5-5-17

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INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

SKYLINE MINE
LOWER O'CONNER "A" / FLAT CANYON
SEAM ISOPACH

Canyon Fuel Company, LLC
Skyline Mines

SCALE: 1" = 2000'	DATE: 6/11/07	CK.BY: G. GALECKI	REVISION: 3
DWG. NO.: 2.2.7-1		DR.BY: P. JENSEN	12-30-16
FILE: 2.2.7-1REV3			

LEGEND

2000' — 500 ISOPACH OVERBURDEN

1400 — 100 ISOPACH OVERBURDEN

⊕ 98-2-3c — DRILL HOLE

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

LICENSED PROFESSIONAL GEOLOGIST
GREGG GALECKI
5248584
5.5.17.
STATE OF UTAH

2000' 0' 1000' 2000'

CONTOUR INTERVAL: 80 Feet

DATE	No.	REVISIONS	DR./CHKD.
JUNE 07	1	MODIFIED PERMIT BOUNDARY (IBC & WASTE ROCK)	BR / GG
DEC 09	2	MODIFIED PERMIT BOUNDARY	AB / GG
JULY 10	3	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JH/GG
DEC 16	4	UPDATED OVERBURDEN ISOPACH	BB/GG

Overburden Isopach Map
Lower O'connor 'B' Seam

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INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

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Canyon Fuel Company, LLC
Skyline Mines
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463

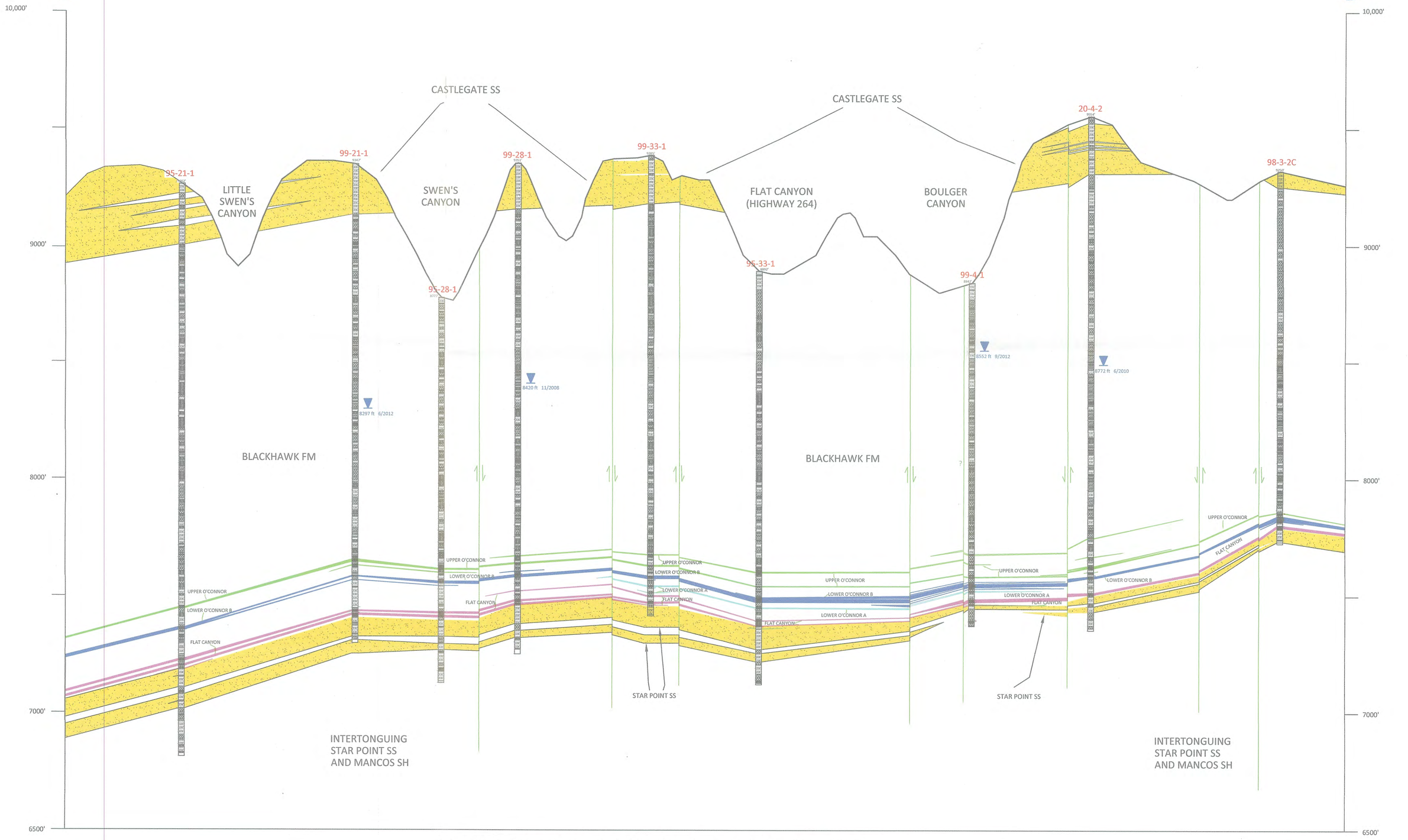
SCALE: 1" = 2000'	DATE: 06/21/00	CK.BY:C. Hansen	REVISION: 4
DWG. NO.: 2.2.7-4		DR.BY: DRB	
CAD FILE: 2.2.7-4REV4			12-30-16

North

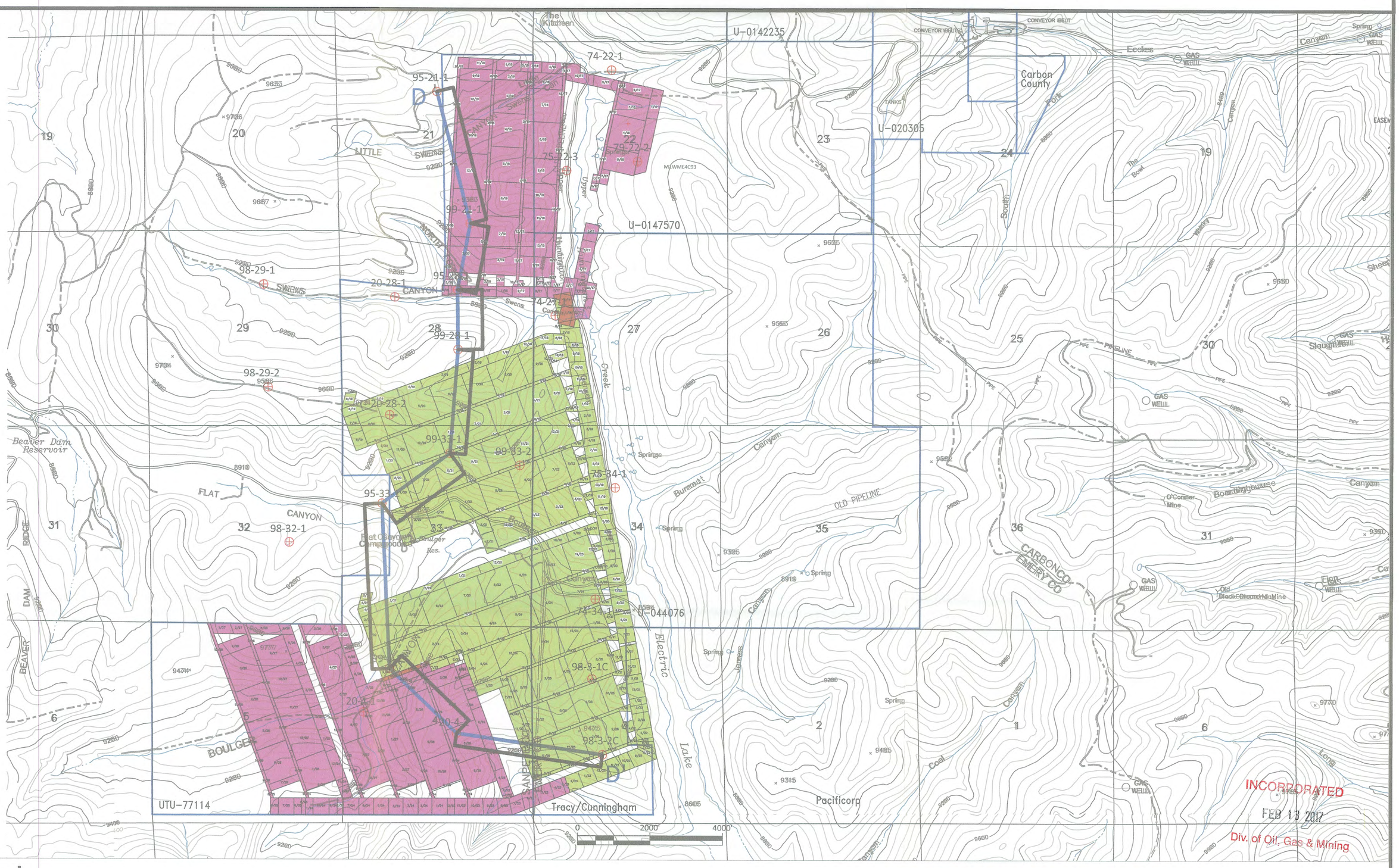
D

South

D'



Vertical Scale = 1:200 Horizontal Scale = 1:5



Legend

Lithology Reference

- COAL
- SHALE
- MUDSTONE
- SILTSTONE
- SANDSTONE
- POTENTIOMETRIC SURFACE (Depth (ft) DATE)

Seam Legend

- UO - UPPER O'CONNOR
- LOB - LOWER O'CONNOR B
- LOA - LOWER O'CONNOR A
- FC - FLAT CANYON

Location Map

- EXISTING MINE WORKINGS
- PLANNED SOUTHWEST RESERVE WORKINGS
- FAULTS
- WELL ID
- WELL LOCATION

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

NOTES:

1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH - M96147

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MAY 09 2017
DIV. OF OIL, GAS & MINING

LICENSED PROFESSIONAL GEOLOGISTS
GREGG GALECKI
5248584
5.5.17
STATE OF UTAH

INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

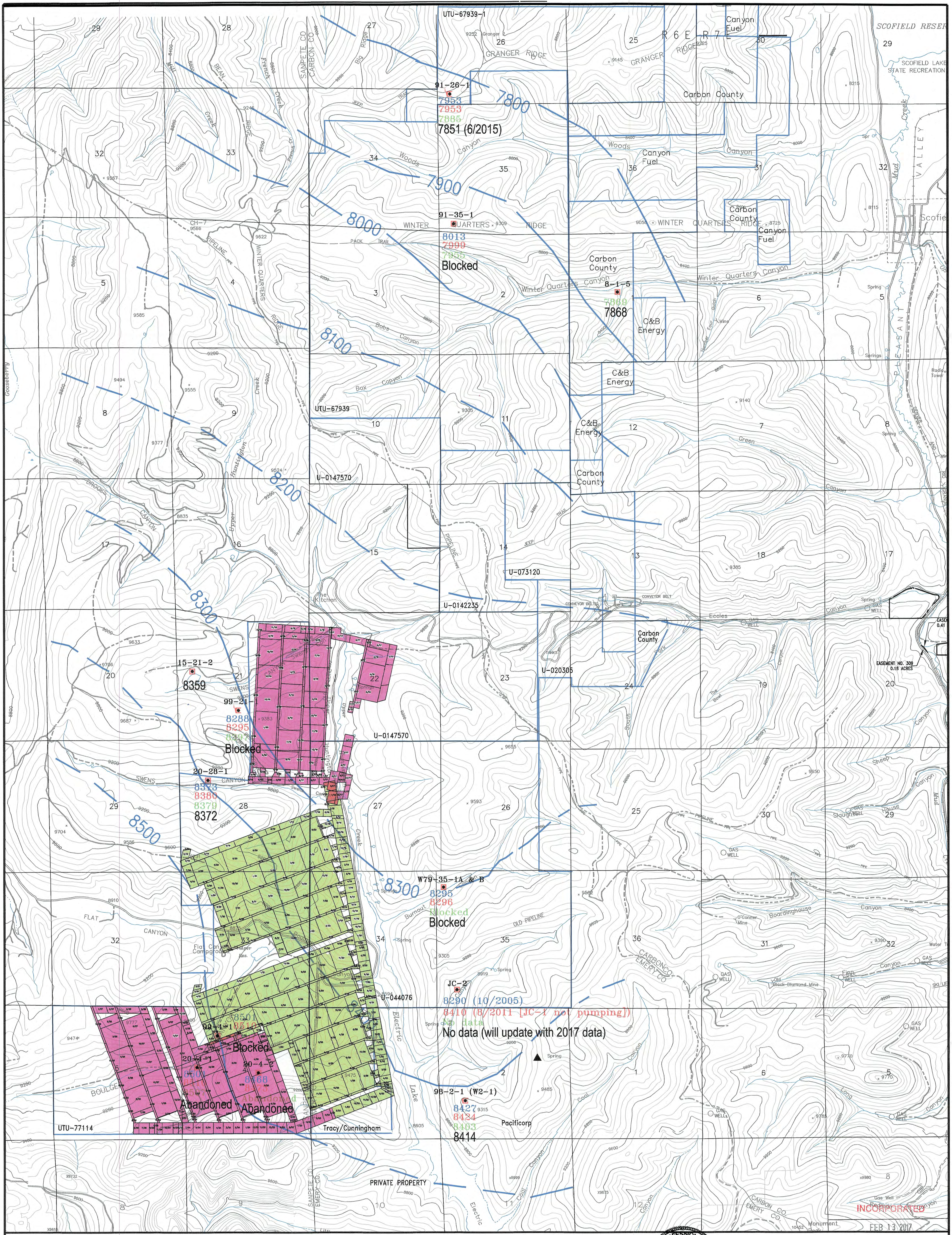
N

DATE	No.	REVISIONS	BY	CHKD

Skyline Mine Cross Section
Structure Profile
Flat Canyon LBA

Canyon Fuel Company, LLC
Skyline Mines

SCALE: Varied	DATE: 6/1/2014	CK.BY: G. GALECKI	REVISION: 0
DWG. NO.: 2.3.4-1D		DR.BY: P. JENSEN	12/30/2016
C.D. REF: 2.3.4-1D			



LEGEND

8500 - 2006

8500 - 2010

8500 - 2013

8500 - 2016 (Current Contours)

STARPOINT MONITORING WELL*

WATER LEVEL CONTOUR (ft, NGVD)

(DASHED WHERE INFERRED)

*Refer to Table 2.3.7-4 for detail on wells

Potentiometric Surface Drawn by G. Galecki, water level Data 11-2006

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
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3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

2000' 0' 1000' 2000'

CONTOUR INTERVAL: 80 Feet

LICENSED PROFESSIONAL GEOLOGIST GREGG GALECKI 5248584 STATE OF UTAH 5.5.17

RECEIVED MAY 09 2017 DIV. OF OIL, GAS & MINING

Div. of Oil, Gas & Mining

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

DATE	No.	REVISIONS	DR. / CHKD.
09/04/02	1		/CDH
06/05/03	2		/CDH
06/24/03	3		CDH/T.F.
10/4/2007	4	INCIDENTAL BOUNDARY CHANGE/ UPDATED WATER LEVELS, UPDATED MINE PLAN	BR/GG
12/17/09	5	MODIFIED PERMIT BOUNDARY, ADDED MONITORING WELLS, UPDATED MINE PLAN	AB/GG
07/20/10	6	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JH/GG
9/09/10	7	MODIFIED FUTURE MINING TIMING, PANEL ORIENTATION AND ADDED 2010 WATER LEVELS	AB/GG
12/30/16	8	MODIFIED FUTURE MINING, AND ADDED 2013 & 2016 (2015) WATER LEVELS	JA/GG
			/
			/

POTENTIOMETRIC SURFACE MAP

Canyon Fuel Company, LLC

HC35 BOX 380, HELPER, UTAH 84526
435-448-6463

Skyline Mines

SCALE: 1" = 2000' | DATE: 09\04\02 | CK.BY: C. HANSEN | REVISION: 8

DWG. NO.: 2.3.4-2 | DR.BY:

CAD FILE: 2.3.4-2REV8 | 12/30/2016

LEGEND

93–1546 WATER USE CLAIM NUMBER

STREAM SEGMENT

● 91–3641 DIVERSION POINT (STOCK POND OR RESERVOIR USE)

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

I, Gregg A. Galecki, certify the Water Right information supplied to me by the Utah Division of Water Rights is plotted as accurately as the information allows.

2000' 0' 1000' 2000'

CONTOUR INTERVAL: 80 Feet

LICENSED PROFESSIONAL GEOLOGIST
GREGG GALECKI
5248584
5-5-17
STATE OF UTAH

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

~~INCORPORATED~~
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		REVISIONS	
DATE	No.		BY
AUG 02	1		VSM
OCT 02	2		VSM
Oct 07	3		BR\GG
DEC 09	4	MODIFIED PERMIT BOUNDARY	AB\GG
JULY 10	5	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JH\GG
Oct 13	6	EXTENDED COVERAGE TO NORTH	GG\GG
DEC 16	7	CORRECTED SCALE 1"=2000'	BB\GG

Surface Water Rights on and Adjacent to the Skyline Property

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435–448–2632	DATE: 8/20/96	CK.BY:GAG	REVISION: 7
CAD FILE: 2.3.5.1–1rev7	SCALE: 1" = 2000'	DR.BY:DRB	12–30–16
DWG. NO.: 2.3.5.1–1			

CS-26
Located where Wife Creek crosses Fish Creek Road

16-24-1

T 12 S
R 6 E R 7 E

S26-1
S25-32

WC-1
WC-3N
WC-3S
WC-5N
WC-5S
WC-7N
WC-7S
WC-9N
WC-9S

91-26-01

WQ 3-41
CS-25
CS-21
WQ36-1
WQ 3-43
WQ 1-39

CS-19

91-35-1

WQ 3-26
WQ 4-12
WQ 3-6

CS-20
08-1-5
WQ 1-1
CS-24

WRDS #1
WRDS #2
WRDS #3
92-91-03
UPDES 003
WRDS #4
MC-3 (INACTIVE)
MC-4 (INACTIVE)
MC-6 (INACTIVE)
MC-2 (INACTIVE)

W10-1 (W79-10-1B)
S10-1

S12-1
S13-7

W13-1 (Abandoned Culinary Test Well)
S13-2
CS-9
CS-12
MINE DISCHARGE UPDES 001 & SRD-1
CS-3
CS-14
CS-2
VC-6
CS-11
MD-1
VC-10
W17-1 (Culinary Well)
CS-4
W14-2 (W79-14-2A)

S14-4
S22-5
CS-17
CS-10
CS-8
F-6
F-7
F-8
S15-3

CS-6
VC-9 (INACTIVE)
CS-13
UPDES 002
S17-2
MC-1 (INACTIVE)
MC-5 (INACTIVE)

15-21-2
CS-27
SW21-104
99-21-1
W22-2 (W79-22-1 & 2)
S22-11
S23-4
CS-1
CS-15
S24-12

20-28-1
CS-28
CS-35
SW28-110
SW28-111
99-28-1
CS-16
S26-13
W26-1 (W79-26-1)
F-1
F-2
F-3
F-4

SW32-277
SW32-276
W35-1 (W79-35-1A & 1B)
UPL-10
EL-1
S35-8
CS-7 (F-5)
S36-12
VC-11

CS-29
SW33-268
CS-30
P17-33-1 E&W
CS-34
CS-18
S34-12
ELD-1
JC-1
JC-2
JC-3
MINE WATER DISCHARGE UPDES SAMPLING POINT
F-9
VC-12

SW4-173
SW4-169
SW4-429
99-4-1
P-17-4-1 E&W
CS-33
20-4-1
CS-32
20-4-2
SW5-590
CS-31
3-290
8-253
F-10
2-413
W2-1 (W98-2-1)

EL-2
S24-1
SULFUR SPRING
CS-22
CS-23
LOCATED WHERE HIGHWAY CROSSES HUGHES CREEK

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

LOCATIONS F-1 THROUGH F-4 AND F-6 THROUGH F-8 ARE PART OF A USFS SUBSIDENCE STUDY ON BURNOUT CREEK AND NOT PART OF THE M&RP WATER MONITORING PROGRAM
F-5 AND CS-7 ARE THE SAME LOCATION

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

LEGEND
- STREAM
- STREAM– Flow Only
- SPRING
- WELL – MONITORING
- MINE DISCHARGE
- STREAM SUBSIDENCE POINTS
- FLUME LOCATION
- UPDES DISCHARGE POINTS
- DISCONTINUED
- ABANDONED

DATE	No.	REVISIONS	BR	CHKD.
09/04/02	1			GAG
10/07/02	2			GAG
04/03/03	3			GAG
06/04/03	4			GAG
03/19/04	5			GAG
06/18/04	6			GAG
11/19/04	7			CDH
05/05/05	8			CDH
JUNE 07	9	MODIFIED PERMIT BOUNDARY (IBC & WASTE ROCK) ADDED WQ1-1; INACTIVATED MC SITES	BR	GG

DATE	No.	REVISIONS	BR	CHKD.
AUG 09	10	Updated Current Water Monitoring Sites, Discontinued W99-28-1, CS-4, F-9 and Removed the Permit Boundary	ARB	GAG
DEC 09	11	MODIFIED PERMIT BOUNDARY and Discontinued F-1 – F-8	ARB	GAG
JULY 10	12	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	ARB	GAG
SEPT	13	RELOCATED CS-24, ADDED CS-25 AND WQ36-1	ARB	GAG
JULY 11	14	Added WC-1 thru WC-9S, Discontinued W20-4-2	ARB	GAG
OCT 12	15	Added NOG Sites S25-32. S26-1and CS-26	ARB	GAG
DEC 15	16	Added Sites CS-28	GAG	GAG
Dec 16	17	Added CS-27, -29 thru -35; Nine (9) SW-springs, 15-22-2, Boulger Cr. Piezometers, Discontinued WC (Woods Cyn) piezometers, (6) failed wells: (W14-2, W79-35-1 A & B, 20-4-1, 91-35-1, 91-26-1)	GAG	GAG

INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

LICENSED PROFESSIONAL GEOLOGIST
GREGG GALECKI
6248584
5.5.17
STATE OF UTAH

CONTOUR INTERVAL: 80 Feet

RECEIVED
MAY 09 2017
DIV OF OIL, GAS & MINING

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

Location of Hydrologic Monitoring Stations

Canyon Fuel Company, LLC
Skyline Mines
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463

SCALE: 1" = 2000'	DATE: 04-04-01	CK.BY:GAG	REVISION: 17 12-30-16
DWG. NO.: 2.3.6-1		DR.BY:JLP	
CAD FILE: 2.3.6-1REV17			

UTU-67939-1

U-0147570

U-073120

U-020305

NL-1 NL-2 NL-3 NL-4 NL-5 NL-6 NL-7 NL-8 NL-9 NL-10 NL-11 NL-12 NL-13 NL-14 NL-15 NL-16 NL-17 NL-18 NL-19 NL-20 NL-21 NL-22 NL-23 NL-24 NL-25 NL-26 NL-27 NL-28 NL-29 NL-30 NL-31 NL-32 NL-33 NL-34 NL-35 NL-36 NL-37 NL-38 NL-39 NL-40 NL-41

GRANGER RIDGE

WINTER QUARTERS RIDGE

Winter Quarters Canyon

Canyon Fuel

Carbon County

C&B Energy

The Kitchen

7R 6R 5R 4R 3R

Eccles

GAS WELL

CONVEYOR BELT

CONVEYOR BELTS

TANKS

PACK TRAIL

JEEP TRAIL

PIPE

OLD PIPELINE

Springs

Woods Canyon

Little Swens Canyon

Upper Huntington

Huntington Canyon

Fork

The Bowl

South Fork

Whisky Canyon

Four Number Gulch

Mine

R6E R7E

T15 T14 T13 T12 T11 T10 T9 T8 T7

27 26 25 30 34 35 36 31 3 2 1 6 10 11 12 7 14 15 18 22 23 24 19 13

9622 9524 9383 9655 9385 9140 9650 9050 8725 9252 9225

Granger 2

SANPETE CO CARBON CO

Big Ridge

French Creek

WINTER QUARTERS RIDGE

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LICENSED PROFESSIONAL GEOLOGIST
GREGG GALECKI
5248584
5-5-17
STATE OF UTAH

NL-14 MONTHLY NORTH LEASE FLOW MONITERING POINT

NL-14 *DISCONTINUED NORTH LEASE FLOW MONITORING POINT

NL-14 NEVER ACTIVATED NORTH LEASE FLOW MONITORING POINT

700' FT OF OVERBURDEN LOWER "A" SEAM

-2 POTENTIAL SUBSIDENCE CONTOUR (FEET)

MINED

POTENTIAL FIRST MINING

PROPOSED MINING

*NORTH LEASE SUBSIDENCE MONITORING PROGRAM COMPLETED IN 2016 AFTER 1 YEAR OF POST-MINING MONITORING OF 11 LEFT LONGWALL PANEL

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH, AND FAIRVIEW LAKES, UTAH.
3. MINE FACILILTY CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

1000' 0' 500' 1000'

BASE PREPARED BY INTERMOUNTIAN AERIAL SURVEYS, SALT LAKE CITY, UTAH-M96147

DATE	No.	REVISIONS	DR./CHKD.
11/19/02	1		/CDH
08/29/05	2	UPDATED MINE PLAN	/CDH
JUNE 07	3	MODIFIED PERMIT BOUNDARY (IBC) AND MINE PLAN	BR/GG
AUG 09	4	ADJUSTED FLOW STATIONS	AB/GG
DEC 09	5	MODIFIED PERMIT BOUNDARY	AB/GG
JULY 10	6	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JH/GG
SEPT 10	7	MODIFIED MINE PLAN, PROJECTED SUBSIDENCE CONTOURS AND NL MONITORING LOCATIONS	AB/GG
DEC 16	8	UPDATED MINE PLAN, SUBSIDENCE, AND DISCONTINUED ALL NL MONITORING LOCATIONS	JA/GG
			/
			/

NORTH LEASE
SUBSIDENCE HYDROLOGIC MONITORING POINTS

Canyon Fuel Company, LLC
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463
Skyline Mines

SCALE: 1" = 1000'	DATE: 11/04/02	CK.BY:C. HANSEN	REVISION: 8
DWG. NO.: 2.3.6-2		DR.BY:CDH	12/30/16
CAD FILE: 2.3.6-2REVB			

North Lease Modification

FEDERAL LEASE UTU-67939

FEDERAL LEASE UTU-67939

Carbon County

Canyon Fuel Company

Granger Ridge (GZA)

Carbon County

C&B Energy

Carbon County

FEDERAL L.M.U.

FEDERAL LEASE UTU-67939

Eccles (GZA)

C&B Energy

Carbon County

Eccles (GZA)

FEDERAL L.M.U. U-044076

Burnout (GZA)

FLAT CANYON FEDERAL LEASE UTU-771114

Swens (GZA)

Swens (GZA)

Burnout (GZA)

Boulger (GZA)

FLAT CANYON FEDERAL LEASE UTU-771114

Bear Canyon (GZA)

ENERGY WEST LEASE

PRIVATE PROPERTY

Bear Canyon (GZA)

Monument Peak (GZA)

Monument Peak (GZA)

Bob Wright (GZA)

Trough Springs Ridge (GZA)

East Gooseberry (GZA)

East Gooseberry (GZA)

Granger Ridge (GZA)

Beaver Dams (GZA)

R 6 E R 7 E

T 12 S
T 13 S

T 13 S
T 14 S

SCOFIELD RESERVOIR

SCOFIELD LAKE STATE RECREATION AREA

Scofield

MANTI – LA SAL

Gooseberry Campground

Beaver Dam Reservoir

LEGEND

- LEASE BOUNDARIES
- MANTI – LA SAL — MANTI – LA SAL NATIONAL FOREST
- Bob Wright (GZA) — USFS GRAZING ALLOTMENT AREA
- --- PIPE --- QUESTAR GAS PIPELINE
- WELLS
- ABANDONED GAS WELLS
- USGS GAUGING STATION (ABANDONED)
- WATER TANK
- POWER LINE CORRIDOR
- CABIN

NOTES:

1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

2000' 0' 1000' 2000'

CONTOUR INTERVAL: 80 Feet

DATE	No.	REVISIONS	DR.\CK.
AUG 02			VSM
JUNE 07			BR\GG
DEC 09	3	MODIFIED PERMIT BOUNDARY	AB\GG
JULY 10	4	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JH\GG
JUNE 2014	5	ADDED POWER LINE CORRIDOR	JA\GG
DEC 16	6	ADDED STRUCTURES AND SKYLINE BOUNDARIES	BB\GG

LAND USE

Canyon Fuel Company, LLC
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463
Skyline Mines

SCALE: 1" = 2000'	DATE: 3/7/02	CK.BY:VSM	REVISION: 6
DWG. NO.: 2.12.1-1		DR.BY:VSM	12-30-16
CAD FILE: 2.12.1-1REV6_6-30-16			

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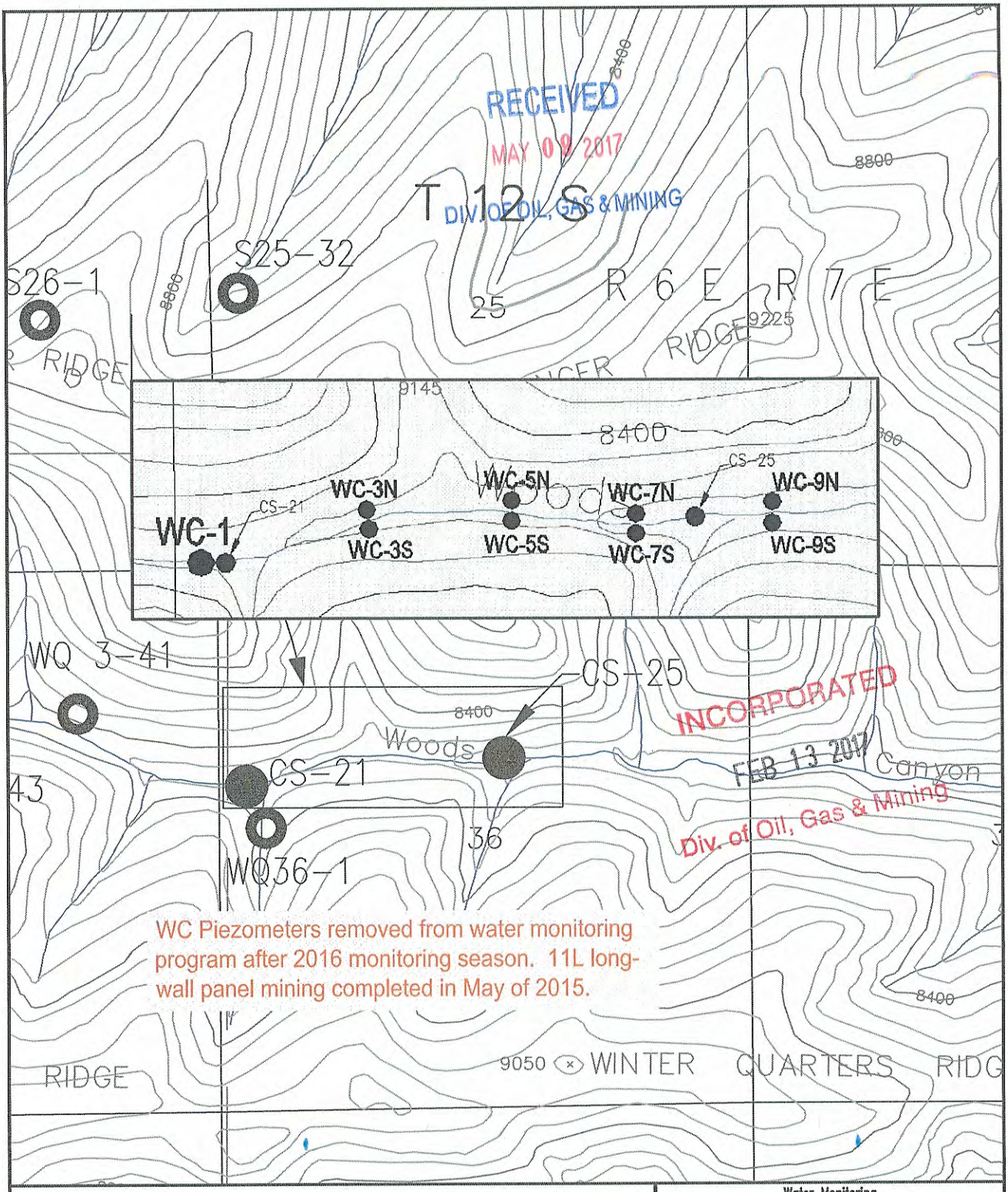
SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS



WC Piezometers removed from water monitoring program after 2016 monitoring season. 11L long-wall panel mining completed in May of 2015.

NOTES:
1. COORDINATE BASE ON NAD 1983 UTM ZONE 12 NORTH, NAD83, UTM AND DATUM USED.
2. MAP PLOTTED FROM 1:24000 USGS QUADRANGLE MAPS, NAD83, UTM AND DATUM USED.
3. MINE FACILITY, EXTENSION, AND NEW ESCAPE CANYON BOAS LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH - 1/09/17

Water Monitoring
WOODS CANYON PIEZOMETERS
Historical

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435-448-2632	DATE: 12/30/16	CK.BY:GG	REVISION:
CAD FILE 2.3.6-1a	SCALE: FULL	DR.BY:JA	0
DWG. NO.: 2.3.6-1a			12-30-16

Flow Data

(Historic Mine 2 data [#1-#8] from 2002 "Mine Inflow Map" PHC A-2)

1 14L HG- March 1999
Originally Est. App. 1600 gpm
Est. App. 300 gpm

2 16L HG- December 1999
Originally Est. App. 1200
Est. App. 300 gpm

3 W. Submains Fault- March 2000
(Now Referred to as Diagonal Fault)
Originally Est. App. 1000 gpm
Measured 01-07-04 at 209 gpm
Tritium Sampling Location

4 10 Left- August 2001
Initially Est. App. 6200 gpm
Measured App 3200 gpm

5 11 Left Headgate XC-24 - February 2002
Initially Est. App. 1000 gpm
Est. App. 900 gpm

6 11 Left Headgate XC 40 - March 2002
Initially Est. App. 1000 gpm
Est. App. 1000 gpm
Tritium Sampling Location

7 11 Left Longwall Set-up Room
March 2002 Initially Est. App. 1500 gpm
App. 1300 gpm
Tritium Sampling Location

8 East Submains E1 XC-5
(Now Reffered to by Mine as West Submains)
October 2001 Initially Est. App. 1000 gpm
Measured at 380 gpm 01-07-04
Tritium Sampling Location

Flow Data

Mine 4 Inflows

LOWER O'CONNER "A" SEAM
LOWER O'CONNER "B" SEAM
PROJECTED FAULT
FAULT
25'
50'
38'
12.5'
D 46'
U
D 5-10'
D 20-30'
D 10-20'
D 40-50'
D 170-200'
Huntington Creek
Electric Lake
Projected Shaft
Projected Inter Seam Bunker
1
3
7
8
2L
3L
4L
5L
6L
7L
8L
9L
11L
12LA
12LB
14L
15L
16L

LEGEND

Faults

1 Mine 2 Inflows (Historic)

9 Mine 4 Inflows

LICENSED PROFESSIONAL GEOLOGIST
GREGG GALECKI
5248584
5-5-17
STATE OF UTAH

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH - M96147

Mine Inflows
Mine 2 (Historic) &
Mine 4

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435-448-2632	DATE: 12/30/2016	CK.BY: G.Galecki	REVISION: 0
CAD FILE: 2.3.6-3REVD	SCALE: Full	DR.BY: J.Armstrong	12/30/2016
DWG. NO.: 2.3.6-3			

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Mine #3
Current (2016) Mine Pool
Elevation: 7730 ft

Mine #3
Estimated Final Mine Pool
Elevation: 8100 ft

Old Mine #3
Current (2016) Mine Pool
Elevation: 8040 ft

Old Mine #3
Estimated Final Mine Pool
Elevation: 8200 ft

Mine #2
Current (2016) Mine Pool
Elevation: 8300 ft

Mine #2 & 4
Estimated Final Mine Pool
Elevation: 8500 ft

Winter Quarters Portal
Elevation: 8150 ft

Mine Portals
Portals 1-5 Elevation: 8573 ft
Trespass Portal Elevation: 8599 ft

Swens Canyon Vent Shaft
Elevation: 8710 ft

Carbon County
Canyon Fuel
C&B Energy
Tracy/Cunningham
Pacificorp
UTU-77114
U-044076
U-014570
U-020305

Legend

- Mine 2 Current Mine Pool
- Mine 2 & 4 Estimated Final Mine Pool
- Old Mine 3 Current Mine Pool
- Old Mine 3 Estimated Final Mine Pool
- Mine 3 Current Mine Pool
- Mine 3 Estimated Final Mine Pool

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

1000' 0 500' 1000'

CONTOUR INTERVAL: 80 Feet

DATE	No.	REVISIONS	DR.	CHK'D.

Mine Pools
Current (2016) and Estimated Final

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526
435-448-2632

DATE: 12/30/2016 | CK.BY: GG/CB | REVISION: 0

CAD FILE: | SCALE: FULL | DR.BY: J.Armstrong

DWG. NO.: 2.5.2-2 | 12/30/2016

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INCORPORATED
FEB 13 2017
Div. of Oil, Gas & Mining

REGISTERED PROFESSIONAL ENGINEER
No. 8781250-2202
CRAIG WILLIAM BROWN
5/8/2017
STATE OF UTAH

TIMING LEGEND

1st QUARTER 2017
2nd QUARTER 2017
3rd QUARTER 2017
4th QUARTER 2017

2018
2019
2020
2021
2022–2026
2027–2028

Faults

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
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SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

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INCORPORATED
9485
FEB 13 2017
Div. of Oil, Gas & Mining

REGISTERED PROFESSIONAL ENGINEER
No. 8781250-2202
CRAIG WILLIAM BROWN
5/8/2017
STATE OF UTAH

Mine 4
Mine Plan
2017

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526
435-448-2632

CAD FILE: 3.1.8-3REV2017	DATE: 12/30/2016	CK.BY:G.Galecki	REVISION: 2017
DWG. NO.: 3.1.8-3(2017)	SCALE: Full	DR.BY: J.Armstrong	12/30/2016

R6E R7E

GRANGER RIDGE

WINTER QUARTERS RIDGE

MINE 3

SKYLINE MINE SITE

NATIONAL FOREST

91-1039
91-3916
91-3917
91-3638
91-3634
91-3631
91-3915
91-3918
91-4322
91-1038
91-4348
91-1036
91-1037
91-1046
91-1045
91-1035
91-1034
91-1033
T26901
91-1032
91-4361
91-1031
91-4029
93-5
93-3678
93-1006
93-3679
93-1041
91-1030
91-3635
E1934
91-3633
91-462
91-423
91-483
91-3007
91-3008
91-463
91-424
91-431
91-471
91-436
91-476
91-482
91-432
91-472
91-433
91-473
91-1148
91-2018

OPTIONAL ACCESS

NEEDS IMPROVEMENT

FDR 018

FDR 230

FDR 228

FDR 057

FDR 056

FDR 236 NEEDS IMPROVEMENT

PRIVATE EASEMENT

MOWER EASEMENT APPLICATION

USFS BOUNDARY

PRIVATE PROPERTY WITHIN USFS BOUNDARY

PRIVATE PROPERTY

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

AREAS WHERE MINOR SURFACE CRACKING MAY OCCUR

POTENTIAL SUBSIDENCE CONTOUR

700' FT. OF OVERBURDEN OVER LOWER O'CONNOR "A" SEAM

91-3638 GROUND WATER RIGHT LOCATION AND NUMBER

91-3635 SURFACE WATER RIGHT LOCATION AND NUMBER

93-1006 SURFACE WATER DIVERSION LOCATIONS

PROJECTED NORTH LEASE & FLAT CANYON WORKINGS

MINED BEHIND SEALS

MINED NOT SEALED

NOTES:

1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

DATE	No.	REVISIONS	DR. / CHKD.
05/05/05	1		/CDH
08/29/05	2		/CDH
10/19/05	3		JT /GG
06/14/07	4	MODIFIED PERMIT BOUNDARY (IBC) UPDATED PROJECTED MINE PLAN	BR /GG
Oct 09	5	Modified Permit Boundary	AB /GG
JULY 10	6	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JH /GG
SEPT 10	7	MODIFIED PANEL ORIENTATION, SUBSIDENCE CONTOURS AND AREAS OF POSSIBLE SURFACE CRACKING	AB /GG
OCT 13	8	Updated mined areas, added panels 13 Left through 15 Left, modified 8 Left through 12 Left	GG /GG
DEC 16	9	Updated mined areas, added SWR panels.	JA /GG

PRE-SUBSIDENCE SURVEY MAP

Canyon Fuel Company, LLC
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463
Skyline Mines

SCALE: 1" = 1500'	DATE: 11/04/02	CK.BY:C. HANSEN	REVISION: 9
DWG. NO.: 4.17.3-1A		DR.BY:C. HANSEN	12/30/16
CAD FILE: 4.17.3-1AREV9			

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DIV. OF OIL, GAS & MINING

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0 2000' 4000'

CONTOUR INTERVAL: 80 Feet

R 6 E R 7 E

T 12 S
T 13 S

T 13 S
T 14 S

SCOFIELD RESERVOIR

SCOFIELD LAKE STATE RECREATION AREA

Scofield

GRANGER RIDGE

WINTER QUARTERS RIDGE

Winter Quarters Canyon

Woods Canyon

Bobs Canyon

Box Canyon

Huntington Canyon

Eccles Canyon

Broads Canyon

Sheep Canyon

Boulger Canyon

Clear Creek Canyon

Gooseberry Campground

Beaver Dam Reservoir

Gooseberry Reservoir

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

INCORPORATED
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LICENSED PROFESSIONAL GEOLOGIST
GREGG GALECKI
5248584
STATE OF UTAH
5.5.17

LEGEND

1 Gooseberry Enterprises, Inc.
2 50% Mason 50% Peterson Ent.
3 Collard Family Trust, Leased to CFC
4 Carbon County (Leased to Canyon Fuel Co., LLC)
5 Church of Jesus Christ of LDS
6 State of Utah
7 U-7714, State of Utah
8 Utah Power & Light
9 Chevron
10 75% L. Uhl 25% Mave H. & Harvey R. Carson & Jim Davis
11 C.K. Cox Family Corp.
12 E. Odell Cox
13 Dee Cox
14 Elmer N. Fillis
15 Cox Inc.
16 Leif M. Greco
17 Dwight W. Peterson
18 Robert S. Hansen
19 W. Chad Cox Family Inc.
20 Margaret B. Bench
21 Anna Marie Kellett
22 DKL, LLC
23 T. & L. Tracey & D. & R. Cunningham
24 United States of America
25 Arkland
26 C & B Energy (Leased to Canyon Fuel Co., LLC)
27 Jeffery V. Jensen et. al.
28 Shirley Cox Trust
29 Kenneth R. Bench
30 Roy F. Hatch (Four Seasons)
31 Terry R. Cox et. al.
32 G. Wayne Mower et. al.
33 Leslie Scott Watson et. al.
34 Sandra Lynn Shelly et. al.
35 Jeffery V. Jensen et. al.
36 Energy Fuels (Leased to Canyon Fuel Co., LLC)
37 Canyon Fuel Company, LLC

COAL OWNERSHIP BOUNDARY

NOTES:
1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN ARE IN METERS.

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

2000' 0' 1000' 2000'

CONTOUR INTERVAL: 80 Feet

DATE	No.	REVISIONS	DR.	CHKD.
AUG 02	1			VSM
OCT. 02	2			VSM
NOV 02	3			VSM
OCT 07	4	Modified Permit Boundary (IBC & WASTE ROCK), Corrected Carbon Co. ownership/modified legend	BR	GG
DEC 09	5	MODIFIED PERMIT BOUNDARY	AB	GG
JULY 10	6	REMOVED PERMIT BOUNDAY, ADDED LOCATION NOTE	JH	GG
Oct 12	7	Changed Hanson Natural Resources to Canyon Fuel Company, LLC in Legend – #37	GG	GG
JUNE 16	8	Modified ownership adjacent to Flat Canyon lease; #'s 22, 29, 30; removed UTU-77114 lease line	GG	GG

Coal Ownership

Canyon Fuel Company, LLC
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463
Skyline Mines

SCALE: 1" = 2000'	DATE: 2/20/01	CK.BY:C. HANSEN	REVISION: 8
DWG. NO.: 1.6-2		DR.BY:JLP	12-30-16
CAD FILE: 1.6-2REVB			