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

February 27, 2015

C/007/0005
Received 2/27/15
Task ID #4806

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

RE: Southwest Reserve – Flat Canyon Lease, Federal Lease UTU-771114, Canyon Fuel Company, LLC, Skyline Mine, Task ID # 4655, C/007/005,

Dear Daron:

Attached to this letter are C1 and C2 forms outlining information submitted in response to Task ID # 4655 to include mining in the Flat Canyon Federal Lease UTU-771114. Also submitted and included with this letter is a two (2) page document titled, 'Response to Southwest Reserve Administrative Completeness Review that outlines the deficiencies that were cited in Task 4655, and how they were addressed. There are .pdf files identifying both the modifications to the M&RP to accommodate the additional mining and independent studies providing support for the amendment.

Canyon Fuel Company personnel acknowledge and appreciate your willingness to review the information prior to acquiring Federal Lease UTU-771114. Delays within the Bureau of Land Management have shortened the timeframe to review the application and acquire the necessary regulatory approvals, while still accommodating the necessary timing for underground mining and eliminate the need for a partial layoff of the mine personnel.

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

Sincerely:

Gregg A. Galecki

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: Southwest Reserves – 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# 4655

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.

Carl W. Winters | Carl W. Winters 2/27/15 General Manager
Print Name | Sign Name, Position, Date

Subscribed and sworn to before me this 27th day of February, 2015

Kathleen Atwood
Notary Public
My commission Expires: 12-02, 2015}
Attest: State of Utah } } ss:
County of Carbon

KATHLEEN ATWOOD
NOTARY PUBLIC • STATE OF UTAH
COMMISSION# 650015
COMM. EXP. 12-02-2015

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining

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: Southwest Reserve - Flat Canyon Lease Task ID # 4655 Page 1 of 2

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.

Add	Replace	Remove	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, 1-21, 1-24 1-32, 1-32(a), 1-39, Plates 1.6-1_Rev6, 1.6-2_rev.8, and 1.6-3_rev.9
☒ Add	☐ Replace	☐ Remove	Chapter 1, pages 1-20(a) and 1-20(b)
☐ Add	☒ Replace	☐ Remove	Chapter 2, Section 2.2 Geology and Geotechnical, pages 2-10, 2-11, 2-11a, 2-12, 2-13, 2-15 (2-12, 2-13 & 2-15 confidential)
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.2 Geology and Geotechnical, pages 2-19 (Table 2.2.8-2), 2-20
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.3 Groundwater Hydrology, pages 2-29, 2-29a, 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, page 2-35d
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.3 Groundwater Hydrology, pages 2-36, 2-36a (Table 2.3.7-1), 2-36b, 2-38 (Table 2.3.7-3)
☒ Add	☐ Replace	☐ Remove	Chapter 2 Section 2.3 Groundwater Hydrology, page 2-29e
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.4 Surface Water Hydrology, pages 2-41, 2-42, 2-42a, 2-42b, 2-43b, 2-44a
☒ Add	☐ Replace	☐ Remove	Chapter 2 Plates 2.3.4-1D Cross Section Structure Profile Flat Canyon LBA
☐ Add	☒ Replace	☐ Remove	Chapter2 Section 2.5 Hydrologic Impacts of Mining Activities, pages 2-48, 2-49, 2-51, 2-51c, 2-51d, 2-51e
☒ Add	☐ Replace	☐ Remove	Chapter 2 Section 2.7 Vegetation, page 2-63a
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.8 Aquatic Wildlife Resources, pages 2-67, 2-71a, 2-72a
☒ Add	☐ Replace	☐ Remove	Chapter 2 Section 2.8 Aquatic Wildlife Resources, page 2-71a(1)
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.9 Terrestrial Wildlife, page 2-99, 2-104(j2), Tables 2.9-4 and 2.9-5, Figure 2.9.3-A with 2.9.3-A through -D (page 2-100A through 2-100D),page 2-104(k)
☒ Add	☐ Replace	☐ Remove	Chapter 2 Section 2.9 Terrestrial Wildlife, Figure 2.9.7-A Greater Sage Grouse Habitat
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.10 Raptors, replace page 2-111b
☐ Add	☒ Replace	☐ Remove	Chapter 2 Section 2.12 pages 2-122, 2-124
☒ 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_rev16
☒ 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.
☒ Add	☐ Replace	☐ Remove	Chapter 2, Section 2.1 Environmental Resources, page 2-4e

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: Southwest Reserve - Flat Canyon Lease Task ID # 4655 Page 2 of 2

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.

Add	Replace	Remove	DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐	☒	☐	Chapter 3 Section 3.1 pages 3-6, ADD 3-6a
☐	☒	☐	Chapter 3 Section 3.3 page 3-81
☐	☐	☒	Chapter 3 Plate 3.1.8-2_rev9
☐	☒	☐	Chapter 3, Plates 3.3-2_rev10, 3.3-3_rev0
☐	☒	☐	Chapter 4 Section 4.17 page 4-94
☒	☐	☐	Chapter 1, Appendix 118-A, 1) USFS letter, 2) Emery Water Conservancy District letter, 3) Legal Notice
☒	☐	☐	Appendix A-4, Volume 2 - Flat Canyon Coal Lease Tract Final EIS, January 2002
☒	☐	☐	Appendix A-2, 1) Toad Survey - Alpine Ecological, 2) Prime Farmland Determination - NRCS
☒	☐	☐	Appendix A-3, Southwest Reserve Roof, Coal, and Floor analysis (holes 99-3-1, 95-21-1, 95-28-1, 98-3-2C)
☒	☐	☐	Appendix A-3, Southwest Reserves NEPA Analysis Area, 2011, Western Land Services Inc. 08.10.2011
☒	☐	☐	Appendix A-3, Southwest Reserves NEPA Analysis Area, 2012, Western Land Services Inc. 08.06.12
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	Received by Oil, Gas & Mining
Information has been submitted electronically. Two (2) paper copies of the information will be submitted at final approval.	

Form DOGM - C2 (Revised March 12, 2002)

Response to Southwest Reserve Administratively Completeness Review (ACR)

Task ID #4655

The following identifies how items in the ACR, Task ID #4655 were addressed in the Southwest Reserve – Flat Canyon Lease modification application. Deficiencies are identified in bold lettering followed by the response.

R645-301-112.100 through -112.400; Identification of Interests: Ownership and Control information is updated on an annual basis on or about June 30 for all the Canyon Fuel Company, LLC., mines. It is located in General Chapter 1 of the M&RP.

R645-301-112.500; Identification of Interests – Surface and Mineral Ownership: Plate 1.6-3 has been re-formatted to adequately illustrate the Flat Canyon lease.

R645-301-112.600; Identification of Interests: The contiguous landownership is identified on Plate 1.6-1, and coal ownership is illustrated on Plate 1.6-2. Both maps have been confirmed that no changes in landownership or coal ownership have occurred. Section 112.600 (pg 1-20 – 1-20a) has been modified to include the names and addresses of both landowners and mineral onwers contiguous with the Flat Canyon Lease. In addition, page 1-24 has been modified to identify a coal lease that is now contiguous with the Flat Canyon lease.

R645-301-113; Violation Information: Suspension or revocation information and the 3-year violation information is updated annually on approximately June 30 in "General Chapter 1" for all the Canyon Fuel mines. Since it is done on an annual basis, it is not included as part of the current submittal. Please see Table 1-2 in the currently approved "General Chapter 1" for the information.

R645-301-114; Right of Entry: Right of Entry for Federal Lease UTU-771114 will be supplied once it has been awarded by the BLM. It is anticipated the BLM will award the lease in mid-2015. A draft of a certified letter to the Emery Water Conservancy District has been added to the amendment. The letter will be sent to notify them of our intent to mine once the lease is awarded.

R645-301-115; Status of Unsuitablitiy Claim:

R645-301-116; Permit Term: The current permit expires April 30, 2017, with a right of successive renewal. A copy of the permit is available at both the Division and Mine Site. Assuming Skyline is awarded the lease, the permit term will be extended another five (5) years.

R645-301-117; Insurance: Proof of insurance will be modified and available when changes to the permit are implemented.

R645-301-117; Proof of Publication: The Legal Notice has been modified to indicate the correct lease acreage (2,692.16 acres).

R645-301-300; Biology: Raptor, Wildlife and sensitive species information has been addressed with the addition of two (2) surveys of the proposed area and additional information provided in the vegetation (2.7), terrestrial wildlife (2.8), and raptor sections (2.9), respectively. In addition to specific information being added to these sections, a clarifying statement has been added to each indicating although the EIS considered surface disturbance in the lease area, no surface disturbance is being considered with the current action.

R645-301-320; Vegetation Information: Section 2.7 Vegetation has been modified to include subsection 2.7.9 Southwest Reserve Flat Canyon area (pg 2-63a) to generally describe the area and clarify that no surface disturbance is currently planned in the lease area.

R645-301-322; Fish and Wildlife Information: Section 2.9 Terrestrial Wildlife has been updated to include additional clarification of no surface disturbance associated with the lease, additional clarification of the EIS, and the submittal of two (2) raptor/wildlife/sensitive species surveys conducted over the lease area in 2011 and 2013.

R645-301-600; Geology: Section 2.2 Geology and Geotechnical has been modified on page 2-20 (section 2.2.8) to clarify that the stratigraphic section for the addition of the Southwest Reserve Flat Canyon lease is best illustrated in the fence diagram labeled Plate 2.3.4-1D. In addition overall quality for the coal seams to be mined is updated in Table 2.2.8-2, and that roof, coal seam, and floor chemical analysis for selected exploration holes has been added to Appendix A-3.

Chapter 1

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-771114	2692.16	12/1/2014	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

Active Federal Coal Acreage	12,132.32
Active Non-Federal Coal Acreage	1171.25
Total Active Lease Acres	13,303.57

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.

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

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~~permit~~ boundary and are illustrated on Drawing 1.6-3~~1~~ (excluding the waste rock disposal

INCORPORATED

area):

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

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

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

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

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

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

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

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

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

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

Cox Inc
504 E 3230 N
Provo, UT 84604

Kenneth R. Bench
PO Box 385
Fairview, UT 84629

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

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

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

The following list contains the names and addresses of the owners of mineral acreage contiguous to the mine ~~permit~~ lease 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

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

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

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

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

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

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

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

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

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

Cox Inc
504 E 3230 N
Provo, UT 84604

Kenneth R. Bench
PO Box 385
Fairview, UT 84629

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

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

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

Point of tangency; thence Soutth 38º 32'29" West 334.32 feet to the Point of a 2031.74 foot radius curve to the right; thence along the arc Said curve; (whose long chord bears South 40º17'48" West 124.28 Feet), a length of 124.50 feet to the point of tangency; thence South 42º 03'09" West 180.47 feet to the true point of beginning and Containing 42.57 acres.

No surface disturbance or underground mining will be conducted on the lands controlled by the Permittee lying outside the mining permit area.

Canyon Fuel Company, LLC, does not own or control, indirectly or directly, legally or equitably any interest in the areas contiguous to the permit area other than the interests described above.

With the addition of the Flat Canyon lease (UTU-771114), Canyon Fuel Company, LLC has an existing coal lease with the Collard Family Trust located in the NW ¼ NW ¼ of Section 20, Township 13 South, Range 6 East, and portions of the North ½ of Section 29, Township 13 South, Range 6 East. See Plate1.6-2 for details.

The Permittee has no option, bid, or other interest in any contiguous acreage other than that stated above. No application for leasing unleased Federal lands adjacent to the permit area are currently pending

Section 24: NE-1/4 NW-1/4;
containing 557.22 acres

Federal Coal Lease Serial # UTU - 67939
Tract 1 T.12 S., R.6.E., SL Meridian, Utah
Section 26, S2SE, SESW
Section 34, Lots 1-4, S2NE, SENW, E2 SWNW, N2S2
Section 35, all
T.13S., R.6E., SL Meridian, Utah
Section 2, all
Section 3, all
Section 10, Lots 1-2, NE, E2NW;
Section 11, N2, N2S2
containing 3,291.0 Acres
Tract 2 T.12S, R.6E., SLM, Utah
Sec. 25, lots 3 and 4, SW1/4NE1/4, W1/2SE1/4, SW1/4
Sec. 26, lots 1-4, N1/2S1/4, SW1/4SW1/4
Sec. 34, NE1/4NE1/4
Containing 770.52 Acres

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

Carbon County Coal Lease
Township 12 South. Range 6 East SLB&M
Section 25: E1/2SE1/4, SE1/4NE1/4
Section 36:N1/2N1/2
S1/2SW1/4
containing 360.0 Acres
Township 13 South. Range 6 East SLB&M
Section 1: W1/2
Section 12: NW1/4NW1/4, SW¼SW¼
Section 24: Portion of W1/2 NE1/4
containing 465 Acres more or less

Pacificorp Coal Lease

Township 14 South, Range 6 East, SLB&M
Section 2: Lots 1, 2, 3, and 4; S1/2N1/2;S1/2 (All)

Section 3: Lots 1 and 2; S1/2NE1/4; E1/2SE1/4; E1/2W1/2SE1/4; NW1/4NW1/4SE1/4
containing 925.16 acres more or less

C&B Energy

Township 13 South, Range 6 East SLB&M
Section 12: NW1/4SW1/4, SW1/4NW1/4, NE1/4NW1/4
containing 120 acres more or less

Canyon Fuel Company, LLC (formerly Hanson Natural Resources)

Township 12 South, Range 6 East SLB&M
Section 36: N1/2SW1/4, S1/2NW1/4, SW1/4NE1/4, NW1/4SE
containing 240 acres more or less

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

Total acres approved for Underground Coal Mining and Reclamation activities: ~~10,733.38~~13425.54

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.

Ch. 1

Appendix 118-A

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

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

*Via Certified Mail

DATE

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-771114 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-771114, 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-771114 in 2016 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 may be examined at the Carbon County Courthouse or at the Utah Division of Oil, Gas & Mining offices in Salt Lake City, Utah.

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,

Carl W. Winters
Mine Manager, Skyline Mine
Canyon Fuel Company, LLC.

xc:Angela Nance, Utah Division of Oil, Gas & Mining

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

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

*<u>Via Certified Mail</u>

DATE

Emery Water Conservancy District
50 South 100 East
Castle Dale, Utah 84513

RE: Canyon Fuel Company, LLC, Skyline Mines; New Federal Lease UTU-771114 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-771114, 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-771114 in 2016 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 may be examined at the Carbon County Courthouse or at the Utah Division of Oil, Gas & Mining offices in Salt Lake City, Utah.

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,

Carl W. Winters
Mine Manager, Skyline Mine
Canyon Fuel Company, LLC.

xc:Angela Nance, Utah Division of Oil, Gas & Mining

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-771114. The lease modification will increase the lease acreage by approximately 2,692.16 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

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;

Total acres within Federal Coal Lease UTU-771114: 2,692.16

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, 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 Sun Advocate and the Emery County Progress on DATE, DATE, DATE and DATE.

Chapter 2
Sec. 2.1

Flat Canyon Lease

Statements regarding cultural and historical resources found within The Flat Canyon Lease area are addressed ~~made34~~ 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 recommend 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~~5~~.

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."

Pg 2-4e

See next page

Revised: ~~6-1~~8-25-14

2-4e

Chapter 2
Sec. 2.2

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 N80ºW 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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~~Division of Oil, Gas & Mining~~

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 piezometric 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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~~12/02/02~~
~~Division of Oil, Gas & Mining~~

Revised: ~~10/04/02~~8-25-14

Pages 2-12 through 2-15 in Confidential file.

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2.2.7 Mineable Coal Deposits

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The four mineable coal seams in the permit area, the Flat Canyon, the Lower O'Connor "A", the Lower O'Connor "B" and the Upper O'Connor, occur in the lower part of the Blackhawk Formation. The Lower O'Connor "A" and Flat Canyon seams merge both in the western portion of the North Lease area and west of Electric Lake. The Storrs Sandstone tongue of the Star Point Sandstone separates the Flat Canyon and the Lower O'Connor "A". Characteristics of these seams and their enclosing strata, which affect mineability, are summarized in the following discussion. Analyses of coal seams are tabulated and discussed as well. Analyses of floor and roof materials are summarized later. Map 2.2.7-7 shows abandoned working adjacent to current Skyline Mine activities.

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Flat Canyon Seam

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The Flat Canyon seam is mineable over a portion of the permit area. It reaches a maximum thickness of about 12 feet just before it merges with the Lower O'Connor "A" seam at the landward pinch-out of the Storrs Sandstone tongue. ~~Plate 2.2.7-1A shows the Flat Canyon isopachous map.~~

Lower O'Connor "A" Seam

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The Lower O'Connor "A" seam is completely absent or badly split with rock partings in the southeast part of the permit area, but reaches a maximum thickness of 24 feet in the Winter Quarters area and in the northwestern portion of the permit area. The seam is, stratigraphically, the lowest coal which is mineable within the permit area. It rests directly on the Storrs Sandstone Tongue or is separated from it by a few feet of siltstone, mudstone, and shale except where it has merged with the Flat Canyon seam in the northwest and southwest part of the permit area. The overlying or roof strata include sandstone, siltstone, mudstone and shale which are often interbedded and interlaminated. Where sandstone forms the floor or roof, the contact is generally sharp. Several inches of softer carbonaceous or coaly claystone or mudstone may form a gradational contact. Most floor and roof strata are well indurated. The Lower O'Connor "A" seam isopachous map is shown on Plate 2.2.7-1. Plate 2.2.7-2 shows overburden depth.

Lower O'Connor "B" Seam

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The Lower O'Connor "B" seam is of mineable thickness over the majority of the southern permit area, but is thin or absent in the North Lease Area. In the southwest corner of the permit area, the seam reaches its maximum thickness of nearly 17 feet. The floor and roof strata are comprised of rock types found in the Lower O'Connor "A" roof. The interval separating the Lower O'Connor "B" and the uppermost seam of the zone, the Upper O'Connor seam, thickens northward and ranges from less than two feet to more than 100 feet where the Lower O'Connor "B" seam thins to four feet. West of Electric Lake, the interburden separating the Lower O'connor "B" from the merged Lower O'Connor and Flat Canyon seams ranges from 100 to 130 feet. Plate 2.2.7-3 is an isopachous map of the Lower O'Connor "B" seam. Overburden depth is shown on Plate 2.2.7-4.

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Upper O'Connor Seam

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The Upper O'Connor seam is thickest in the east central part of the permit area where a maximum thickness of 16 feet is reported. The seam thins to less than six feet in the southwest portion of the permit area, and to less than three feet along most of the southern North Lease area boundary. Floor and roof strata are interbedded and interlaminated sandstone, siltstone, mudstone, and shale. The upper and lower contacts of the coal may be either sharp or gradational, as is the case with the previously described seams. The Upper O'Connor seam isopachous map is shown on Plate 2.2.7-5. Plate 2.2.7-6 shows overburden depth. The Upper O'Connor Seam is considered unminable in the North Lease area.

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Coal Reserves

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Coal reserves on the permit area are divided into three classifications which include: 1) reserve base or in-place reserves; 2) mineable reserves; and 3) recoverable reserves. The reserve estimates given herein are based on all data available as of December 31, 1984.

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In place reserves were calculated utilizing standard methods described in General Mining Order No.1 (U.S.G.S. Federal Register,1979): Mineable reserves were calculated utilizing a minimum mining thickness of five feet and a minimum interburden thickness of 30 feet. Recoverable reserves were calculated using the following parameters:

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a. For thicknesses of 8 to 10 feet, 1 foot of top coal would be left in mine roof.

b. For thicknesses of 11 to 14 feet, 2 feet of top coal would be left in mine roof.

c. For thicknesses of 14 feet or greater, a 12 foot mining height was assumed.

d. Longwall recovery factor of 100%.

e. Room and pillar recovery factor of 70%.

f. Mains recovery factor of 30%.

g. Coal barriers and major faulted zones would have 0% recovery factor.

Estimates of coal seam thickness from boreholes and correlation between boreholes are based on geophysical logs. These are supplemented by sparse outcrop measurements and in-mine drilling. Coal seam isopach maps were constructed by hand using the distance-thickness proportion method. The contour map was refined in sparse data areas, near faults or other coal seam discontinuities, or in other areas where expected or known trends are not adequately interpolated. The maps were planimetered with the use of an electronic planimeter.

Five main coal beds occur on the permit area which include (from upper to lower): 1) the McKinnon seam; 2) the Upper O'Connor seam; 3) the Lower O'Connor B seam; 4) the Lower O'Connor A seam; and 5) the Flat Canyon seam. In-place reserve estimates include all five coal beds, whereas the mineable and recoverable estimates include the Upper O'Connor, Lower O'Connor B, and Lower O'Connor A seams as previously described. The McKinnon and Flat Canyon seams are not considered economically mineable at this time. Normally, mining will be conducted so as to extract coal seams in descending order where recoverable reserves overlap.

Coal reserves (as of October, 1991) on the permit area are tabulated as follows:

Seam	In-Place Reserves*	Mineable Reserves*	Recoverable Reserves*
McKinnon	16.91	--	--
Upper O'Connor	81.46	74.47	18.13
Lower O'Connor B	74.24	72.44	26.06
Lower O'Connor A	96.99	92.40	30.76
Flat Canyon	44.18	37.15	8.32
TOTAL	313.78	276.46	83.27

*Millions of Tons

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TABLE 2.2.8-1

SUMMARY OF 24 ANALYSES *

ANALYSIS	Max.	Min.	Mean	Standard Deviation
Water Soluble Alkalies (Dry Basis)				
% Na_2O	0.025	0.007	0.009	0.004
% K_2O	0.032	0.005	0.018	0.010
Sulfur Forms (Dry Basis)				
% Pyritic	0.83	0.03	0.14	0.18
% Sulfate	0.03	0.00	0.01	0.01
% Organic (Diff)	0.42	0.00	0.05	NA
% Total	1.26	0.02	0.20	0.27
Acidity (pH)				
Equipotential	8.58	7.10	8.04	0.37
1:5	8.92	7.27	8.45	0.39
1:20	9.06	7.10	8.65	0.54

* Individual analyses are available at the mine site.

TABLE 2.2.8-2

Sulfur Forms (Dry Basis)	U. O'Connor Percent	L. O'Connor B Percent	L. O'Connor A Percent
Pyritic	0.22	0.10	0.19
Sulfate	0.00	0.00	0.00
Organic (Diff.)	0.52	0.43	0.40
Total	0.74	0.53	0.59

~~U. O'Connor L. O'Connor B L. O'Connor A~~
~~fur Forms Percent Percent~~
~~Percent~~
~~)ry Basis)~~
~~Pyritic 0.22~~
~~0.10~~
~~0.19~~
~~Sulfate 0.00~~
~~0.00~~
~~0.00~~
~~Organic (Diff.) 0.52 0.43~~
~~0.40~~

~~TOTAL 0.74~~
~~0.53~~
~~0.59~~

	Southwest Reserve - Flat Canyon LBA		
	L. O'Connor B	L. O'Connor A	Flat Canyon
Sulfur Forms	Percent	Percent	Percent
(Dry Basis)			
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

Revised: 8/25~~6/1~~/2014

- 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 Southwest Reserve (SWR)- Flat Canyon Lease provides the same low potential for generating acid and toxicity from the mining of the coal. Within the SWR, 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. Both 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.

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.

2.2.10 General Geology of the Rock Disposal Site

The coal-bearing Blackhawk Formation makes up the surface of the rock disposal site. This formation consists of alternating, laterally discontinuous layers of sandstone, siltstone, shale and coal. Only occasional sandstone ledges are exposed at the surface of the proposed site, with the remaining surface being covered with up to 20 feet of soil and weathered rock debris.

Two mineable coal seams occur beneath the site, including the Upper and Lower O'Connor seams. The pertinent data for these coal beds is as follows:

Coal Bed	Thickness	Depth below Surface
Upper O'Connor	8.0'	45'
Lower O'Connor	18.0'	130'

Four faults of undetermined displacement have been mapped near the site. These faults are generally north-south trending and have acted as local barriers to mining in coal mines near the site.

Conversations with Mr. Frank Helsten of Scofield, Utah on September 17, 1981 and May 17, 1982, revealed that the strip mining work was done from 1948 to 1950. Mr. Helsten was the spot hole driller and indicated that no abandoned underground workings were intercepted when drilling the seam lying 45 feet beneath the floor of the pit. Mining of the below-lying seam was planned but not accomplished due to economic conditions at the time.

Two drill holes (92-91-03MW and S-4) in the general area of the proposed disposal site provide the basis of the available geological information. Well logs are found in Appendix A-4. The well locations are shown on Plate 2.3.6-1. Cross-section A-A' (Plate 2.2.1-2) shows the geology of the waste rock area.

Ch. 2
Sec. 2.3

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 2.3.4-1a through 1c.

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. The gradient should return to a southwesterly direction shortly after the flooding is complete.

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 and 2013 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

The west to east slope to the potentiometric surface will likely remain until the surface drops below the lowest levels of the mine in the southern portion of the permit area.

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), and the water level in Well 91-26-1 has dropped approximately 100 ft. This is continued to be monitored. ~~in~~ 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 t~~T~~he two wells completed in the North Lease area have shown some drawdown~~little~~, the ~~if any~~ 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.

Wells W22-2-2 and W14-2B 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 Peteresen 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.

As mining moves west of Electric Lake into the Southwest Reserve (SWR) area and the Flat Canyon lease~~e and Southwest Reserve (SWR) area~~, 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 the Southwest Reserve. The FC-LOA seam area may~~will~~ be used as a sump for any mine water that ~~will~~ needs to be discharged from the Mine while mining the LOB seam. As has been stated

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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, with 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 Appendix N and Appendix O, respectively.~~during the mining of the LOB seam. The~~

~~Revised: 6-1-14 2-29d~~

Four (4) monitoring wells located in the area that are completed in the regional Starpoint Formation aquifer below the coal seams to be mined have a potentiometric surface ranging from 700 to 1000 feet above the coal seam. This has remained consistent since 2001 when pumping from Mine #2 began. It is possible that water from the underlying Starpoint aquifer could be transmitted into the mine through fault gouge in the associate southwest-northeast trending faults. A fence diagram depicting the relationship of the wells with their location and with the geology are illustrated on Plate 2.3.4-1D. Any groundwater that is encountered will be diverted from the mine into Eccles Creek. The Blackhawk Formation groundwater is monitored at the surface using four (4) springs spread throughout the area being undermined. The sites were selected in conjunction with a spring and seep survey summerized by Petersen Hydrologic Report (located in Appendix M of PHC Volume 2).

2.3.4.5 Southwest Reserves - Flat Canyon Lease

Aquifer characteristics are similar to what has been observed in Mines #1 and #2 located east of Electric Lake. The primary difference is with the regional dip trending to the west, the mineable coal seam is separated from the surface with more overburden which further reduces the likelihood of potential impacts associated with subsidence. The near-surface groundwater system in the Blackhawk formation will be monitored by a series of springs located in the Little Swens, Swens and Boulger canyons. The lower regional aquifer of the Starpoint Formation is monitored by deep ground water wells located in Swens and Boulger canyon.

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 Southwest Reserve 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.

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 Southwest Reserve and Flat Canyon lease include nine (9) Groundwater rights that are primarily privately owned. Four~~Three~~ (4~~3~~) of the sites are proposed to be ~~monitored~~added as water monitoring sites, and will be assigned site numbers ~~. These include WR 93-3362,3363,3655, WR 93-95, and WR 93-534 and will be assigned site numbers~~ SW32-277~~9~~, SW4-429, SW33-268, and SW4-173, respectively.

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

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.

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 Southwest Reserve (SWR) and Flat Canyon lease, initial baseline data was collected beginning in 1997 in preparation of the Flat Canyon EIS. Baseline sampling in the SWR resumed in 2006 and continued through 20166~~6~~. The number of sites were refined based on proposed mining by adding some stream sites upstream of mining and selecting ~~limit~~spring sites representative of the geologic units~~ing the spring to~~ in areas proposed for undermining. 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~~

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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 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 and 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. Mine #1 and the Southwest Reserve discharge is sampled at Station CS-14. Mine #3 discharge is sampled at Station CS-12.Mine #2 water is discharged at JC-3.

Deleted: 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. Baseline laboratory ¶

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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~~Copies~~ of the current UPDES permit (expires ~~September 30, 2004~~November 30, 2014) 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 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.

In the Southwest Reserve (SWR) the groundwater monitoring will include the addition of springs ~~SW28-110~~, SW32-277~~9~~, SW33-268, SW4-429, SW4-173, and ~~SW4-429~~ SW28-110 which represent water from the Price River Formation, Castlegate Sandstone, and Blackhawk Formation, respectively . 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. Surface-water monitoring for the SWR includes the addition of upstream-of-mining sites on the following creeks: Little Swens (CS-27), Swens Creek (CS-28), Flat Canyon (CS-29), and Boulger above the reservoir (CS-30), respectively. This is in addition to stream, springs, and wells that have been included in the Water Monitoring program for a number of years.

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.

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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. Spring WQ36-1 will monitor groundwater within the Blackhawk formation above active mining areas.

Revised: ~~9-16-10~~8-25~~6-1~~-14 2-~~35c~~35d

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

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/3rd/4th: Qtrly Field parameters* only[1]	2nd/3rd/4th: Quarterly Flow	2nd/3rd/4th: Monthly Flow	2nd/3rd/4th: Monthly Seasonal Flow	2nd/3rd/4th: Quarterly Water Level Only	2nd/3rd/4th: Dissolved Oxygen	2nd/3rd/4th: TDS,TSS, T-P	2nd/3rd/4th: O & G	2nd/3rd/4th: Carbon 14	2nd/3rd/4th: Tritium	2nd/3rd/4th: Deuterium	2nd/3rd/4th: 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									X											
CS-11								X								X				
CS-12	X							X												
CS-13	X							X												
CS-14	X							X												
CS-16									X											
CS-17									X											
CS-18									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												
CS-29								X												
CS-30								X												
MD-1			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										
NL-1 through NL-42 (See Section 2.4.4)												X								

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

	1st Quarter						2nd[2] / 3rd[3] / 4th Quarters												
Sample Site	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	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											
SW4-173							X												
SW4-429							X												
SW28-110							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												

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

Sample Site	1st Quarter: Lab Analysis*[a]	Field parameters only*[1]	Monthly Flow	Dissolved Oxygen	TDS,TSS, T-P	O & G	2nd[2] / 3rd[3] / 4th Quarters: 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	O & G	Carbon 14	Tritium	Deuterium	Oxygen 18
Wells																			
WQ36-1							X												
JC-3			X					X		X				X					
ELD-1			X							X									
WC-1 thru WC-9S (See Section 2.3.7)												X							
W79-10-1B												X							
W79-14-2A												X							
W79-26-1												X							
W79-35-1A												X							
W79-35-1B												X							
W2-1(98-2-1)												X							
W20-4-1												X							
W99-4-1												X							
W99-21-1												X							
W20-28-1												X							
91-26-1												X							
91-35-1												X							
92-91-03							X												
08-1-5												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.)

** Flow measurements discontinued at CS-6 in 12/2009, lower Eccles flow documented with VC-9

Table 2.3.7-3
MONITORING STATION IDENTIFICATION

ECCLES CANYON/MUD/FISH CREEK DRAINAGES

STREAM STATIONS - 14 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)					

MINE DISCHARGE STATIONS - 4 Stations
CS-12 (Mine #3)　CS-14 (Mine #1)　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

HUNTINGTON CANYON

STREAM STATIONS - 16~~12~~ 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		

WASTE ROCK DISPOSAL SITE

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

GROUNDWATER STATIONS

SPRINGS - 34~~127~~ 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	S26-13	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	SW4-173	SW4-429	SW28-110	SW32-277~~9~~	SW33-268	

WELLS (MONITORING) - 28~~91~~ Well Stations

W79-10-1B	W79-14-2A	W79-26-1	W79-35-1A	W79-35-1B
92-91-03	W2-1(98-2-1)	W20-4-1	W08-1-5 ~~W20-4-2~~	W99-4-1
W99-21-1	W20- 28-1	JC-1	JC-3	91-26-1
91-35-1	ELD-1 (Total of JC-1 and JC-3)*	~~W08-1-5~~	WC-1 thru WC-9	

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 Area　003 Waste Rock Area　004 Winter Quarters JC-3 James Canyon

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

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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 ~~partially~~ in the project area is Electric Lake, a 31,200 acre-foot reservoir whose upstream tip covers a ~~small~~ portion of the southwest ~~corner~~ 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.

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.

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 other ~~in a~~ representative sampling of seeps and springs throughout~~in~~ 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 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 ~~continues and~~ included~~s~~ monitoring the flows in the stream biweekly and performing annual stream gradient surveys. Four surface water monitoring points were monitored in this 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 in this part of the permit area are decreasing. This is likely due to the present drought conditions (Climatology, Volume 4)~~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

- 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.

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2.4.4 Monitoring Program

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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 through 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 Southwest Reserve - 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. in 2014 (PHC Addendum Volume 2 Appendix N) while acquiring the Flat Canyon lease.

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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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Groundwater Monitoring" by Mayo and Associates, recommended some changes ~~to~~ the original monitoring plan. These changes were made by Mayo and Associates after a careful review of local hydrogeology, monitoring conditions, sampling parameters, and sampling data. The changes proposed by Mayo and Associates are considered valid and reasonable and are therefore incorporated herein. An evaluation of UPDES and waste rock disposal site monitoring stations were not included within the scope of work completed by Mayo, but continue to be an integral part of the water monitoring program.

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A copy of the 1996 PHC evaluation is included within Appendix A-1 Volume 2 of this MRP. An update to the PHC, "Addendum to the PHC, July 2002" has also been included in this M&RP. Since the modifications to the PHC have taken place over time and conditions within the mine have changed, it should be assumed that where the most recent text conflicts with text in earlier modifications or original text, the latest supercedes the earlier.

Surface water monitoring programs are conducted at each of the appropriate stations identified in Tables 2.3.7-1, 2.3.7-2, and 2.3.7-3 and shown on Drawings 2.3.6-1 and 2.3.6-2. Samples are collected quarterly, with the 1st Quarter (January-March) having a shortened list of sites due to inaccessibity during winter months. Also duoe to weather conditions, sampling in the 2nd quarter (April-June) can be conducted through July 15 in years when snowmelt conditions prohibit access prior to June 1. Baseline laboratory 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 thatn 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.

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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 Southwest Reserve (SWR) - Flat Canyon lease, a total of four (4) 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. Streams include Little Swens (CS-27), Swens (CS-28), Flat Canyon (CS-29), and Boulger above the reservoir (CS-30), respectively.

~~Eccles Canyon~~All stream stations are shown on Table 2.3.7-3 and are analyzed for those constituents identified in Tables 2.3.7-2 with an annual monitoring as per Table 2.3.7-1.

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.

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

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accessible 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.

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.

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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 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. Additional PHC supporting studies for both the North Lease modification and the Flat Canyon – Southwest Reserves are located in **Addendum to the Probable Hydrologic Consequences – Volume 2, Appendix L and M, and N and O, 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

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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 gleacio-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 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.

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Prior to acquiring the Southwest Reserve – 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 Appendix N and O 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. Both studies reaffirmed there are no apparent adverse effects to existing water rights.

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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 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, 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.

In preparation of acquiring the Flat Canyon Lease and developing the Southwest Reserves, in 2014 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 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. The 2014 work conducted by Petersen Hydrologic, Inc. (PHC Appendix N and Q) reinforces previous studies that indicate the source of

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the water encountered in the floor of the mine is from a large 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 demonstrated by how the 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 Groundwaters and surface waters should not be impacted by mining in the Southwest Reserves – 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. 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 well-nest located in Burnout Canyon (wells 79-35-1A and 79-35-1B) are an example where water level in the well completed in the Inactive-zone groundwater system dropped significantly in response to pumping while the well completed in the adjacent Active-zone groundwater system was unaffected. 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 unit of a sandstone 1000-feet thick. Skyline continues to monitor stream flows in Winter Quarters, Woods, Huntington, Eccles, and Mud Creeks to identify any impacts if they occur in these drainages related to the mine inflows.

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No springs or water production wells in the mine permit or adjacent areas have negatively impacted by the large mine inflows. There has been some concern 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 the mine has been able to pass its chronic water testing.The Utah Division of Water Quality recently modified the mine's UPDES discharge permit to include a limit of 500 mg/l TDS and no total ton per 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.

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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 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 Southwest Reserves – 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 the area. Extensive research has been performed by the mine to verify that water currently entering the mine is not coming from the surface or depleting surface waters. The recent July 2002 Addendum to the PHC presents data supporting this statement. The data suggests the water intercepted underground is at least 4,000 to 25,000 years old and, based on the results of tritium analyses from most of the mine waters, does not typically contain water that has been exposed to the atmosphere in the past 50 years. Additionally, the steady rate of decline in ground water levels in monitoring wells within the permit area and the results of age-dating the ground water inflows to the mine indicating the water is not getting appreciably younger, suggests that the aquifer is not receiving significant recharge of "young" surface waters.. Continued monitoring by the mine of the surface waters and seeps and springs flows in the permit and adjacent areas have shown no discernable impacts due to the increased mine inflows that were encountered in March 1999 and have continued through November 2002. It is the operator's position that the water consumed in operating Skyline Mine is not depleting surface water sources. In fact, there is an overall net gain to local river systems discharging to the Colorado River as a result of Skyline Mine discharge.

In anticipation of the Winter Quarters Ventilation Facility being constructed, a discharge point (004) was added to accommodate both storm water and mine discharge into Winter Quarters Creek in 2009. A numeric model study conducted by Earthfax Engineering (Appendix A-1, Volume 2) indicates Winter Quarters Creek can receive a maximum discharge of 6,200 gpm while not being erosive to the creek. In the event discharge from Outfall 004 routinely exceeds 6,200 gpm additional armoring to the outfall location and investigation of the impacts to Winter Quarters creek will be initiated.

As mining progressed north of Winter Quarters Canyon, the longwall panel orientation was rotated 90 degrees to maximize the coal recovery. This rotation increased mining in an easterly direction into an area of thinner overburden. The study conducted by Apagito Associates indicates longwall mining can be conducted in areas with overburden dow to 475 feet. In Panel 11 Left Woods Canyon creek overlies the center of the panel with overburden ranging from approximately 1000 feet to 500 feet. Water monitoring of the creek, shallow groundwater in the creek bottom, macroinvertebrate, fish and vegetation monitoring of the stream corridor will all be studied to monitor any impacts to the creek. The combination of geology, cover, the panel located in the center of the creek, and the minimal aquatic habitat available in Woods Canyon Creek all support that there will be minimal probable hydrologic consequences to mining further east in Woods Canyon. Detailed discussions of water monitoring are discussed in consequences to mining further east in Woods Canyon. Detailed discussions of water monitoring are discussed in Sections 2.3 and 2.4, the aquatic wildlife resources are discussed in Section 2.8, and the subsidence control plan discussed in Section 4.17 of this M&RP.

The following information is supplied as required by the Windy Gap process as it applies to existing coal mines in the Upper Colorado River basin:

Mine Consumption: (culinary well - Water Right 91-5010) =41.69 ac-ft (2004 consumption)

Ventilation Consumption / Evaporation:
(assumes 70 deg. F, 60 total days annually, 20% humidity air intake, 95% humidity air out-take; air density difference of 0.001 lbs/ft)

(353,312 cu-ft/min) (.001)(0.1198) = 42 gal/min.
= 11.21 ac-ft annually

Coal Producing Consumption / Coal Moisture Loss:
- 6.1% Inherent moisture
- 8.54 % run-of-mine moisture
- 2.44% moisture added to coal by cutting (8.54-6.1)

Projected 2005 Tonnage 237, 500 tons
Projected 5 yr Average 1,898,672 tons
Tons water/year = (1,898,672)(0.0244)= 46,328 tons water/year
Lbs water/year = 92,656,000
Gallons/year = 92,565,000 (0.1198)=11,100,189 gallons/year
=34.06 ac-ft annually

Sediment Pond Evaporation:
Evaporation estimate calculation uses evaporation data from Pacificorp evaporation pan located at Electric Lake spillway. Data was from 1998 through 2003.
Pond 001 (Mine Site) - 0.39 acre (surface area)

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- 0.15 ac-ft/month (ET)
- 228,096 (gallons/year)
- 0.70 ac-ft/yr

Pond 002 (Rail Loadout) - 0.44 acre (surface area)
- 0.15 ac-ft/month (ET)
- 257,422 gallons/year
- 0.79 ac-ft/yr

Pond 003 (Refuse Pile) - 0.27 acre (surface area)
- 0.15 ac-ft/month (ET)
- 159,667 gallons/year
- 0.49 ac-ft/yr

Pond 004 (Winter Quarters) – 0.036 acre (surface area)
- 0.15 ac-ft/month (ET)
- 19,551 gallons/year
- 0.06 ac-ft/yr

Total Annual Pond Evaporation = 2.04ac-ft

Springs and Seeps Effects From Subsidence - Not Applicable to this calculation
Alluvial Aquifer Abstractions into Mine - Not Applicable
Deep Aquifer Pumpage - Not Applicable
Postmining Inflow - (0)
Direct Diversions - Not Applicable
Dust Suppression - 5,000 gallons/truck load. Data based on 2003 use; last fully active year.
= 3.7 ac-ft/yr

Mine Discharge - last 6 month average = 3,757 gpm = 6,059 ac-ft/yr

Using the Windy Gap Process at the Mine site, water depletions include Mine Consumption, Ventilation Consumption, Coal Producing Consumption, Sediment Pond Evaporation, and Dust Suppression totaling approximately 94 acre-feet per year. The only addition to the system, as defined by the Windy Gap process is the mine discharge which is currently averaging approximately 6,060 acre-feet per year, indicating the Skyline Mine has a net gain of approximately 5,966 acre-feet year to the Colorado River drainage system.

2.5.3 Alternative Water Supply

OSM Regulation 30 CFR 783.17 requires that alternative sources of water supply be identified if mining impacts will result in the contamination, diminution, or interruption of existing sources. Because no significant adverse hydrologic impacts are expected as a result of mining in the Skyline permit area, no individual or collective source of alternative water supply has been identified.

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2.7.9 Southwest Reserve 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, January 2002, Section3.17 pg. 3-25) Although 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 anticipated.

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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 and Tiger trout, 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.

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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.

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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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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.

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 ~~both~~ fish ~~and macroinvertebrates.~~ ~~Both~~AA fish ~~and macroinvertebrate~~ monitoring programs 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 strea~~er~~am for one year and every third year thereafter. ~~A macroinvertebrate survey will be initiated the same year will be performed twice a year for two consecutive years, and then every third year thereafter. To be consistent with existing aquatic monitoring programs, the macroinvertebrate survey will begin in 2015, with~~ Tthe fish surveys will begin~~ning in 2016,~~ one year prior to undermining any portion of the creek ~~respectively~~. Unless otherwise noted, sampling methods will be consistent with surveys conducted previously on James, Burnout, Eccles, Woods, and Winter Quarters creeks.

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 will be 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 will be performed in the fall and spring of each year on or about the same date.

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 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

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Table 2.8-1a

Sample Site	End Date	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011	
		Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Fish																									
Burnout	F, 2007		C		C						C						C								
Eccles	ND				C						C						C						X		
James	F, 2007		C		C						C						C								
Winter							C																X		
Woods	RC						C																X		
		2012		2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
Eccles	ND				X						X						X						X		
Winter					X						X						X						X		
Woods	RC				X						X						X						X		
Boulger											X						X						X		

Macroinvertebrate

		2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011	
Burnout			C	C	C	C	C	C	C	C							RC	RC							
Eccles	ND				C	C	C	C	C	C	C						C	C						X	X
James			C	C	C	C	C	C	C	C							RC	RC							
Winter	2yr ptm						C	C	C	C							C	C						X	X
Woods	2yr ptm						C	C	C	C							C	C						X	X
		2012		2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
Eccles	ND								X	X							X	X							X
Winter	2yr ptm								X	X							X	X							X
Woods	2yr ptm								X	X							X	X							X

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

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

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2.9.3 Endangered and Threatened Species

Passage of the Endangered Species Act of 1973 (Public Law 23-205) provided a legal basis for establishment of lists of endangered and threatened plants and wildlife (Tables 2.9-4, 2.9-5, and 2.9-6).

According to National Wildlife Federation (1977), Dalton (1978) and the Federal Register (1979), there are no endangered or threatened species of amphibians or reptiles, or any threatened mammals that inhabit the south-eastern region of Utah. Dalton (1978), however, indicates that one endangered species, the black-footed ferret, might be found in the Wasatch Plateau east of the Skyline Drive. Durrant (1952) reports that he knows "...of no occurrence of the black-footed ferret north of the Colorado River in Utah...". There are unconfirmed reports of black-footed ferrett sightings east of Castle Dale and Ferron in Emery County, Utah. Many hours have been spent trying to verify the presence of these animals. Up to now these efforts have been unsuccessful. Observations on all of the Skyline lease and immediate surrounding areas show no signs of prairie dog colonies nor sufficient ground squirrel populations to support ferret populations (Figures~~.~~ 2.9.3-A through 2.9.3-D).

In recent decades, the bald eagle has recovered from the endangered status and is now listed as threatened. Despite the recovery, very few nests have been identified in Utah as of 2000. The golden eagle is quite common in Utah and is not listed as threatened or endangered. The Skyline Mine permit area was flown in 2005 by DWR and no nests were identified for either eagle.

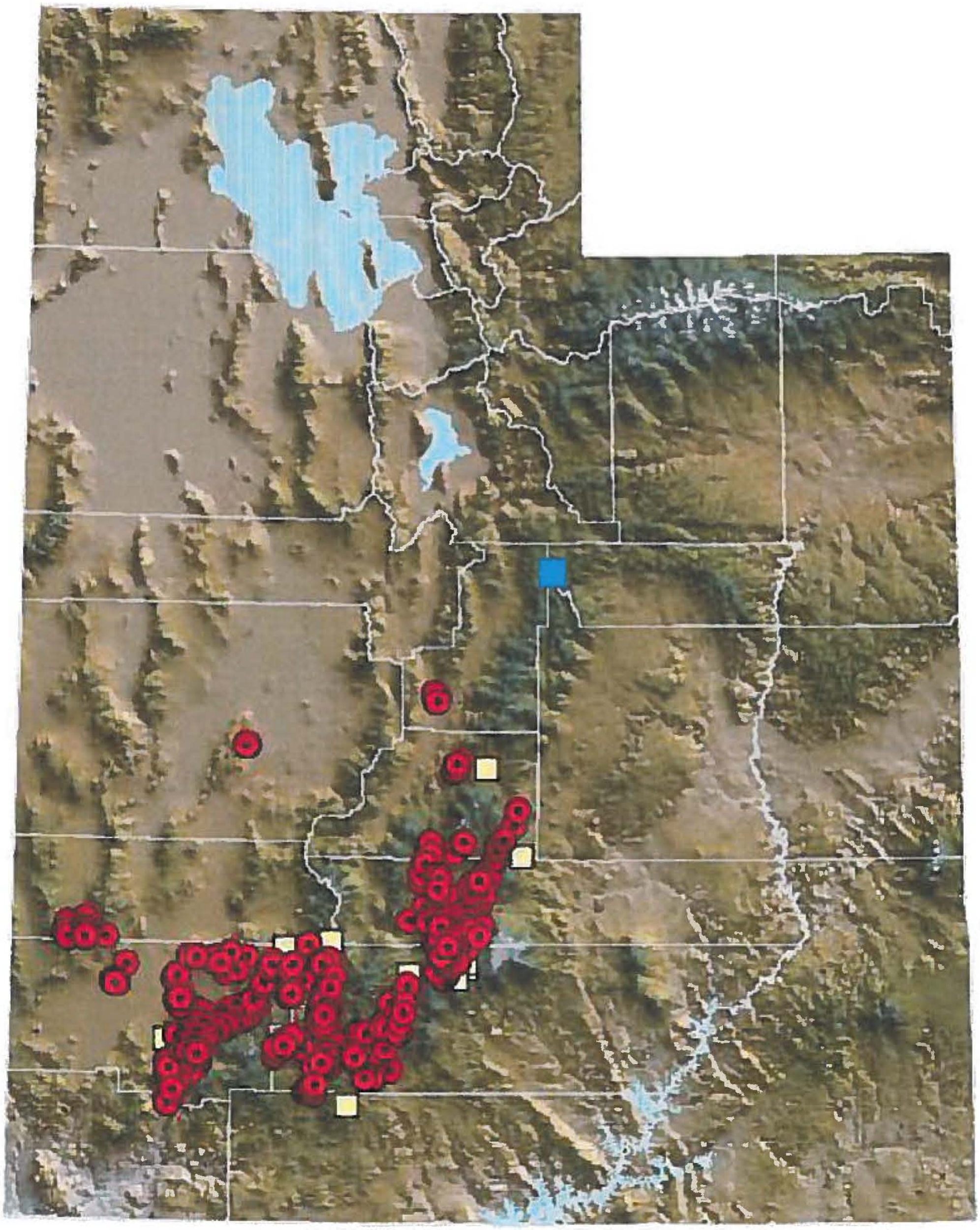
Threatened and Endangered, and sensitive species were re-evaluated in 2012 as part of the North Lease modification which extended the area approved for mining into portions of the Fish Creek drainage. The lease modification encompasses approximately 770 acres. A pre-survey investigation determined only the Western Toad needed a survey. The survey for the Western Toad was conducted in 2013 and determined they were not in the area. See Appendix Volume A-2 for Alpine Ecological report.

~~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. 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 no amphibians being found (report located in Appendix A-3 Volume 2) THIS MAY CHANGE PENDING SURVEY.~~

Figure 2.9.3-A

Distribution of endangered mammalian species in Utah in relation to the Skyline lease area. Modified from Utah Division of Wildlife Resources – Utah Natural Heritage Program "Vertebrate Information Compiled by the Utah Natural Heritage Program: A Progress Report" by William R. Bosworth, III December 2003. Publication Number 03-45

Utah prairie-dog *Cynomys parvidens*

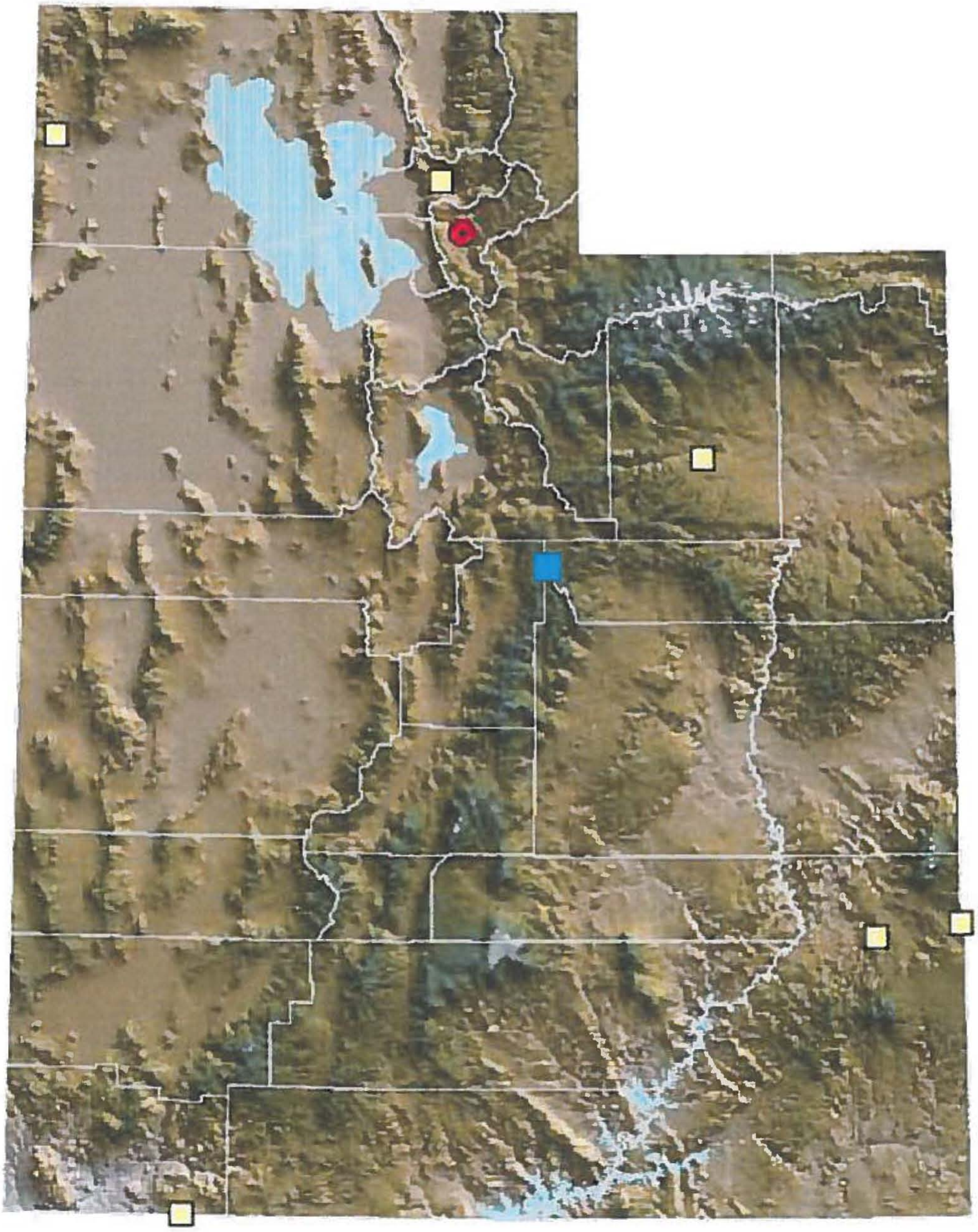


The distribution of records of the Utah prairie-dog (Cynomys parvidens). Red circles represent records since 1983, inclusive, and yellow squares represent records before 1983. Blue rectangle represents the Skyline lease area.

Figure 2.9.3-B

Distribution of endangered mammalian species in Utah in relation to the Skyline lease area. Modified from Utah Division of Wildlife Resources – Utah Natural Heritage Program "Vertebrate Information Compiled by the Utah Natural Heritage Program: A Progress Report" by William R. Bosworth, III December 2003. Publication Number 03-45

Gray wolf *Canis lupus*

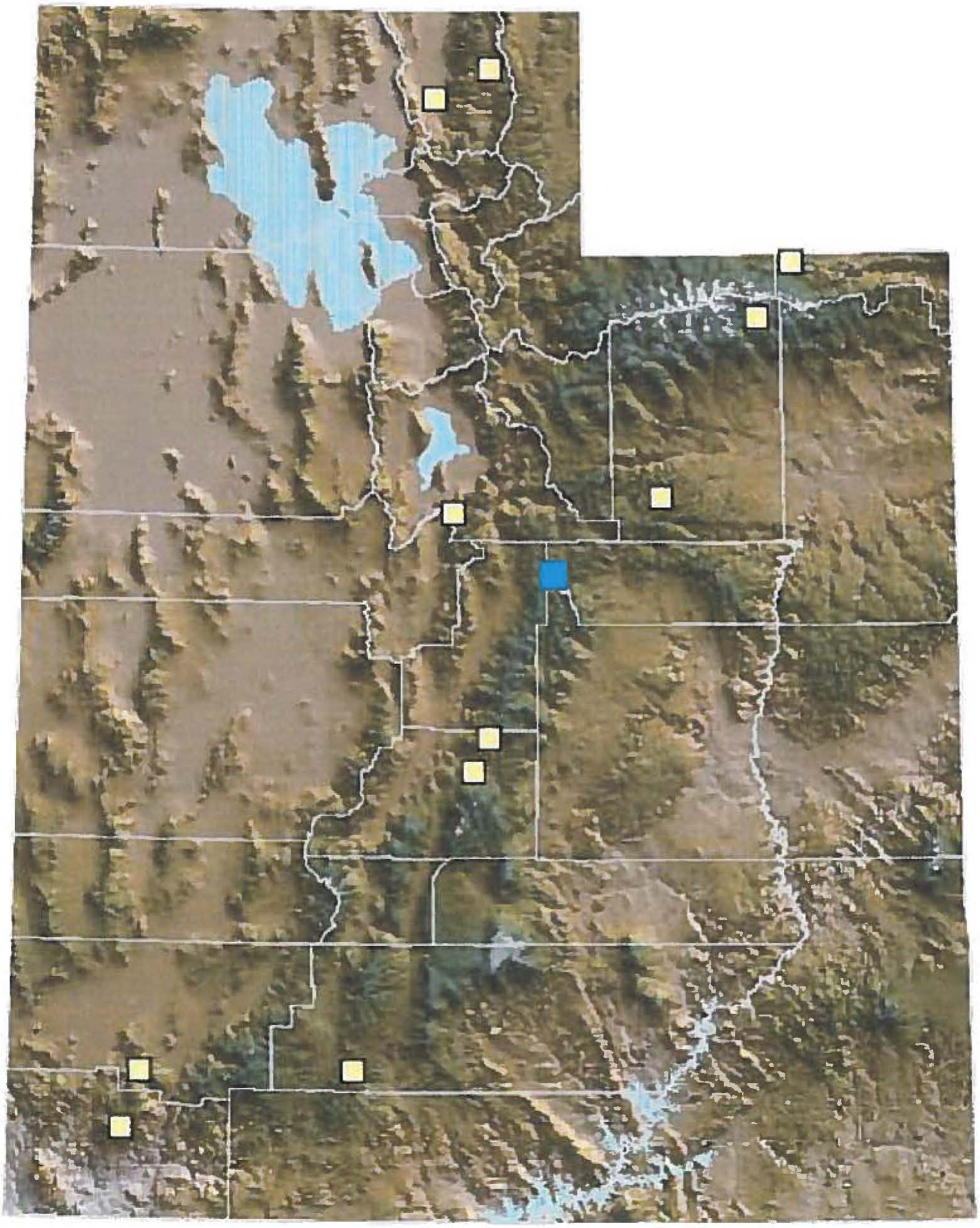


The distribution of records of the Gray wolf (Canis lupis). Red circles represent records since 1983, inclusive, and yellow squares represent records before 1983. Blue rectangle represents the Skyline lease area.

Figure 2.9.3-C

Distribution of endangered mammalian species in Utah in relation to the Skyline lease area. Modified from Utah Division of Wildlife Resources – Utah Natural Heritage Program "Vertebrate Information Compiled by the Utah Natural Heritage Program: A Progress Report" by William R. Bosworth, III December 2003. Publication Number 03-45

Grizzly bear *Ursus arctos*

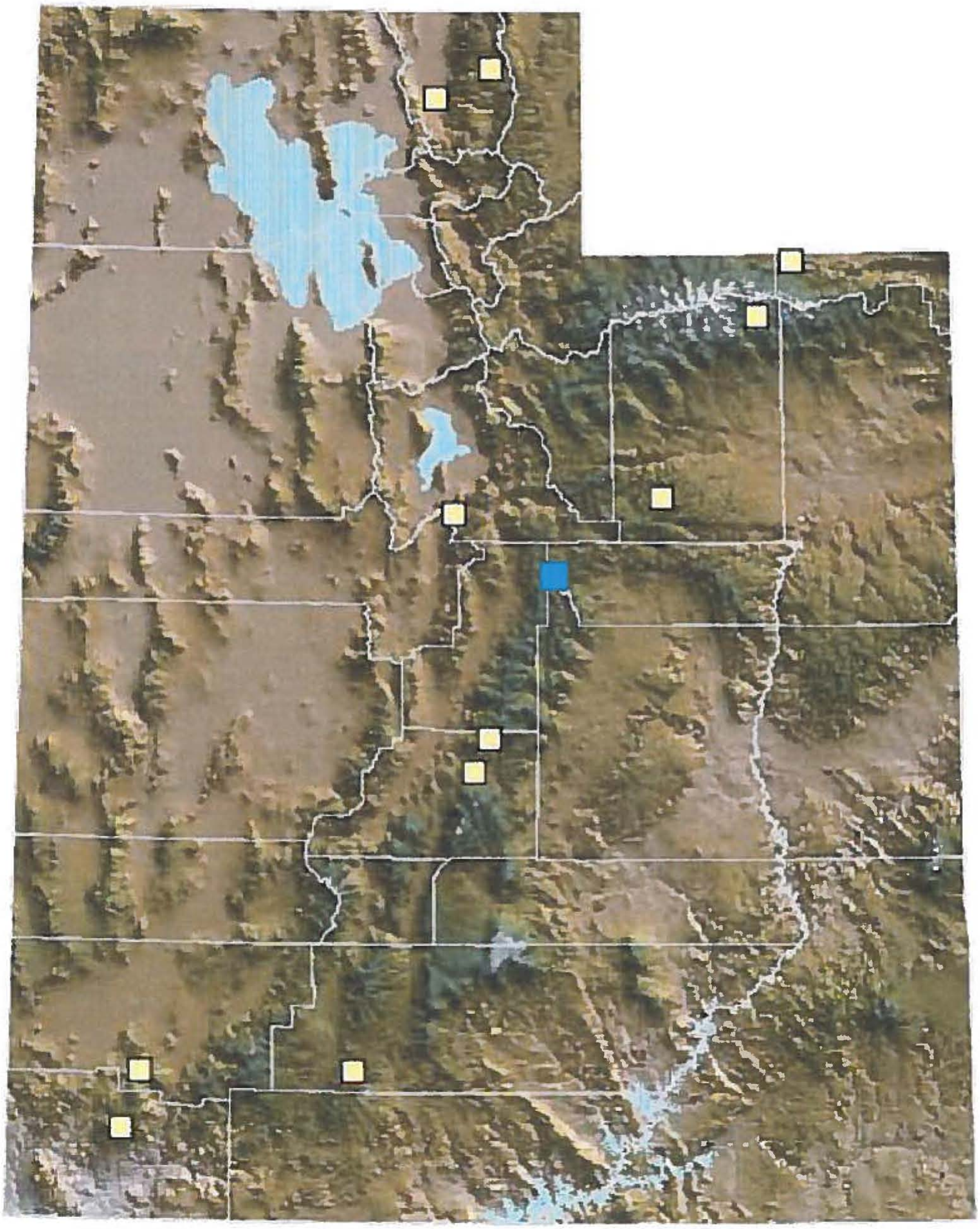


The distribution of records of the Grizzly bear (*Ursus arctos*). Yellow squares represent records before 1983. Blue rectangle represents the Skyline lease area.

Figure 2.9.3-D

Distribution of endangered mammalian species in Utah in relation to the Skyline lease area. Modified from Utah Division of Wildlife Resources – Utah Natural Heritage Program "Vertebrate Information Compiled by the Utah Natural Heritage Program: A Progress Report" by William R. Bosworth, III December 2003. Publication Number 03-45

Canada lynx *Lynx canadensis*



The distribution of historical records of the Canada Lynx (*Lynx canadensis*). Yellow squares represent records before 1983. Blue rectangle represents the Skyline lease area.

Table 2.9-4

County Lists for Carbon, Emery and Sanpete Counties of Federally Listed Threatened (T), Endangered (E), and Candidate Species

Carbon County

Common Name	Scientific Name	Status
Uinta Basin Hookless Cactus	*Sclerocactus wetlandicus*	T
Graham Beardtongue	*Penstemon grahamii*	T Proposed
Humpback Chub	*Gila cypha*	E
Bonytail	*Gila elegans*	E
Colorado Pikeminnow	*Ptychocheilus lucius*	E
Razorback Sucker	*Xyrauchen texanus*	E
Greater Sage-grouse	*Centrocercus urophasianus*	C
Black-footed Ferret	*Mustela nigripes*	E Extirpated
Gray Wolf	*Canis lupus*	E

Emery County

Common Name	Scientific Name	Status
Jones Cycladenia	*Cycladenia humilis var jonesii*	T
Last Chance Townsendia	*Townsendia aprica*	T
Barneby Reed-mustard	*Schoenocrambe barnebyi*	E
San Rafael Cactus	*Pediocactus despainii*	E
Winkler Pincushion Cactus	*Pediocactus winkleri*	T
Wright Fishhook Cactus	*Sclerocactus wrightiae*	E
Humpback Chub	*Gila cypha*	E
Bonytail	*Gila elegans*	E
Colorado Pikeminnow	*Ptychocheilus lucius*	E
Razorback Sucker	*Xyrauchen texanus*	E
Greater Sage-grouse	*Centrocercus urophasianus*	C
Yellow-billed Cuckoo	*Coccyzus americanus*	C
Mexican Spotted Owl	*Strix occidentalis lucida*	T
Black-footed Ferret	*Mustela nigripes*	E Extirpated
Canada Lynx	*Lynx canadensis*	T
Gray Wolf	*Canis lupus*	E

Sanpete County

Common Name	Scientific Name	Status
Heliotrope Milkvetch	*Astragalus montii*	T
Greater Sage-grouse	*Centrocercus urophasianus*	C
Utah Prairie-dog	*Cynomys parvidens*	T
Brown (Grizzly) Bear	*Ursus arctos*	T Extirpated
Canada Lynx	*Lynx canadensis*	T

Disclaimer: This list was compiled using known species occurrences and species observations from the Utah Natural Heritage Program's Biodiversity Tracking and Conservation System (BIOTICS); other federally listed species likely occur in Utah Counties. This list includes both current and historic records. (Last updated on January 12, 2012).

DEFINITIONS

E
A taxon that is listed by the U.S. Fish and Wildlife Service as "endangered" with the probability of worldwide extinction.

E Experimental
An "endangered" taxon that is considered by the U.S. Fish and Wildlife Service to be "experimental and non-essential" in its designated use areas in Utah.

E, T, or C Extirpated
An "endangered," "threatened," or "candidate" taxon that is "extirpated" and considered by the U.S. Fish and Wildlife Service to no longer occur in Utah.

E or T Proposed
A taxon "proposed" to be listed as "endangered" or "threatened" by the U.S. Fish and Wildlife Service.

T
A taxon that is listed by the U.S. Fish and Wildlife Service as "threatened" with becoming endangered.

C
A taxon for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threats to justify it being a "candidate" for listing as endangered or threatened.

For additional information contact: U.S. Fish and Wildlife Service (801-975-3330)

Table 2.9-5

State of Utah
Department of Natural Resources
Division of Wildlife Resources

Utah Sensitive Species List

March 29, 2011

This list has been prepared pursuant to Utah Division of Wildlife Resources Administrative Rule R657-48. By rule, wildlife species that are federally listed, candidates for federal listing, or for which a conservation agreement is in place automatically qualify for the *Utah Sensitive Species List*. The additional species on the *Utah Sensitive Species List*, "wildlife species of concern," are those species for which there is credible scientific evidence to substantiate a threat to continued population viability. It is anticipated that wildlife species of concern designations will identify species for which conservation actions are needed, and that timely and appropriate conservation actions implemented on their behalf will preclude the need to list these species under the provisions of the federal Endangered Species Act. Please see Appendix A for the rationale behind each wildlife species of concern designation.

Utah Sensitive Species List

Fishes

Federal Candidate Species	
Least Chub*	*Iotichthys phlegethontis*
Federally Threatened Species	
Lahontan Cutthroat Trout (introduced)	*Oncorhynchus clarkii henshawi*
Federally Endangered Species	
Humpback Chub	*Gila cypha*
Bonytail	*Gila elegans*
Virgin Chub	*Gila seminuda*
Colorado Pikeminnow	*Ptychocheilus lucius*
Woundfin	*Plagopterus argentissimus*
June Sucker	*Chasmistes liorus*
Razorback Sucker	*Xyrauchen texanus*
Conservation Agreement Species*	
Bonneville Cutthroat Trout	*Oncorhynchus clarkii utah*
Colorado River Cutthroat Trout	*Oncorhynchus clarkii pleuriticus*
Virgin spinedace	*Lepidomeda mollispinis mollispinis*
Roundtail Chub	*Gila robusta*
Bluehead Sucker	*Catostomus discobolus*
Flannelmouth Sucker	*Catostomus latipinnis*
Wildlife Species of Concern	
Northern Leatherside Chub	*Lepidomeda copei*
Southern Leatherside Chub	*Lepidomeda aliciae*
Desert Sucker	*Catostomus clarkii*
Yellowstone Cutthroat Trout	*Oncorhynchus clarkii bouvieri*
Bear Lake Whitefish	*Prosopium abyssicola*
Bonneville Cisco	*Prosopium gemmifer*
Bonneville Whitefish	*Prosopium spilonotus*
Bear Lake Sculpin	*Cottus extensus*

*Least chub is a Federal Candidate Species and a Conservation Agreement Species.

See Appendix A for the rationale behind each wildlife species of concern designation.

Utah Sensitive Species List

Amphibians

Federal Candidate Species

Relict Leopard Frog (extirpated)	*Rana onca*

Federally Threatened Species
(None)

Federally Endangered Species
(None)

Conservation Agreement Species

Columbia Spotted Frog	*Rana luteiventris*

Wildlife Species of Concern

Western Toad	*Bufo boreas*
Arizona Toad	*Bufo microscaphus*
Great Plains Toad	*Bufo cognatus*

See Appendix A for the rationale behind each wildlife species of concern designation.

Utah Sensitive Species List

Reptiles

Federal Candidate Species
(None)

Federally Threatened Species

Desert Tortoise	*Gopherus agassizii*

Federally Endangered Species
(None)

Conservation Agreement Species
(None)

Wildlife Species of Concern

Zebra-tailed Lizard	*Callisaurus draconoides*
Western Banded Gecko	*Coleonyx variegatus*
Desert Iguana	*Dipsosaurus dorsalis*
Gila Monster	*Heloderma suspectum*
Common Chuckwalla	*Sauromalus ater*
Desert Night Lizard	*Xantusia vigilis*
Sidewinder	*Crotalus cerastes*
Speckled Rattlesnake	*Crotalus mitchellii*
Mojave Rattlesnake	*Crotalus scutulatus*
Cornsnake	*Elaphe guttata*
Smooth Greensnake	*Opheodrys vernalis*
Western Threadsnake	*Leptotyphlops humilis*

See Appendix A for the rationale behind each wildlife species of concern designation.

Utah Sensitive Species List

Birds

Federal Candidate Species	
Yellow-billed Cuckoo	*Coccyzus americanus*
Greater Sage-grouse	*Centrocercus urophasianus*
Gunnison Sage-grouse*	*Centrocercus minimus*
Federally Threatened Species	
Mexican Spotted Owl	*Strix occidentalis lucida*
Federally Endangered Species	
California Condor (experimental)	*Gymnogyps californianus*
Whooping Crane (extirpated)	*Grus americana*
Southwestern Willow Flycatcher	*Empidonax traillii extimus*
Conservation Agreement Species*	
Northern Goshawk	*Accipiter gentiles*
Wildlife Species of Concern	
Bald Eagle	*Haliaeetus leucocephalus*
Grasshopper Sparrow	*Ammodramus savannarum*
Short-eared Owl	*Asio flammeus*
Burrowing Owl	*Athene cunicularia*
Ferruginous Hawk	*Buteo regalis*
Black Swift	*Cypseloides niger*
Bobolink	*Dolichonyx oryzivorus*
Lewis's Woodpecker	*Melanerpes lewis*
Long-billed Curlew	*Numenius americanus*
American White Pelican	*Pelecanus erythrorhynchos*
Three-toed Woodpecker	*Picoides tridactylus*
Sharp-tailed Grouse	*Tympanuchus phasianellus*
Mountain Plover	*Charadrius montanus*

*Gunnison sage-grouse is a Federal Candidate Species and a Conservation Agreement Species.

See Appendix A for the rationale behind each wildlife species of concern designation.

Utah Sensitive Species List

Mammals

Federal Candidate Species
(None)

Federally Threatened Species

Utah Prairie-dog	*Cynomys parvidens*
Brown/Grizzly Bear (extirpated)	*Ursus arctos*
Canada Lynx	*Lynx canadensis*

Federally Endangered Species

Black-footed Ferret (experimental, non-essential in Duchesne and Uintah counties)	*Mustela nigripes*
Gray Wolf	*Canis lupus*

Conservation Agreement Species
(None)

Wildlife Species of Concern

Preble's Shrew	*Sorex preblei*
Townsend's Big-eared Bat	*Corynorhinus townsendii*
Spotted Bat	*Euderma maculatum*
Allen's Big-eared Bat	*Idionycteris phyllotis*
Western Red Bat	*Lasiurus blossevillii*
Fringed Myotis	*Myotis thysanodes*
Big Free-tailed Bat	*Nyctinomops macrotis*
Pygmy Rabbit	*Brachylagus idahoensis*
Gunnison's Prairie-dog	*Cynomys gunnisoni*
White-tailed Prairie-dog	*Cynomys leucurus*
Silky Pocket Mouse	*Perognathus flavus*
Dark kangaroo Mouse	*Microdipodops megacephalus*
Mexican Vole	*Microtus mexicanus*
Kit Fox	*Vulpes macrotis*

See Appendix A for the rationale behind each wildlife species of concern designation.

Utah Sensitive Species List

Mollusks

Federal Candidate Species
(None)

Federally Threatened Species
(None)

Federally Endangered Species

Kanab Ambersnail	*Oxyloma kanabense*

Conservation Agreement Species
(None)

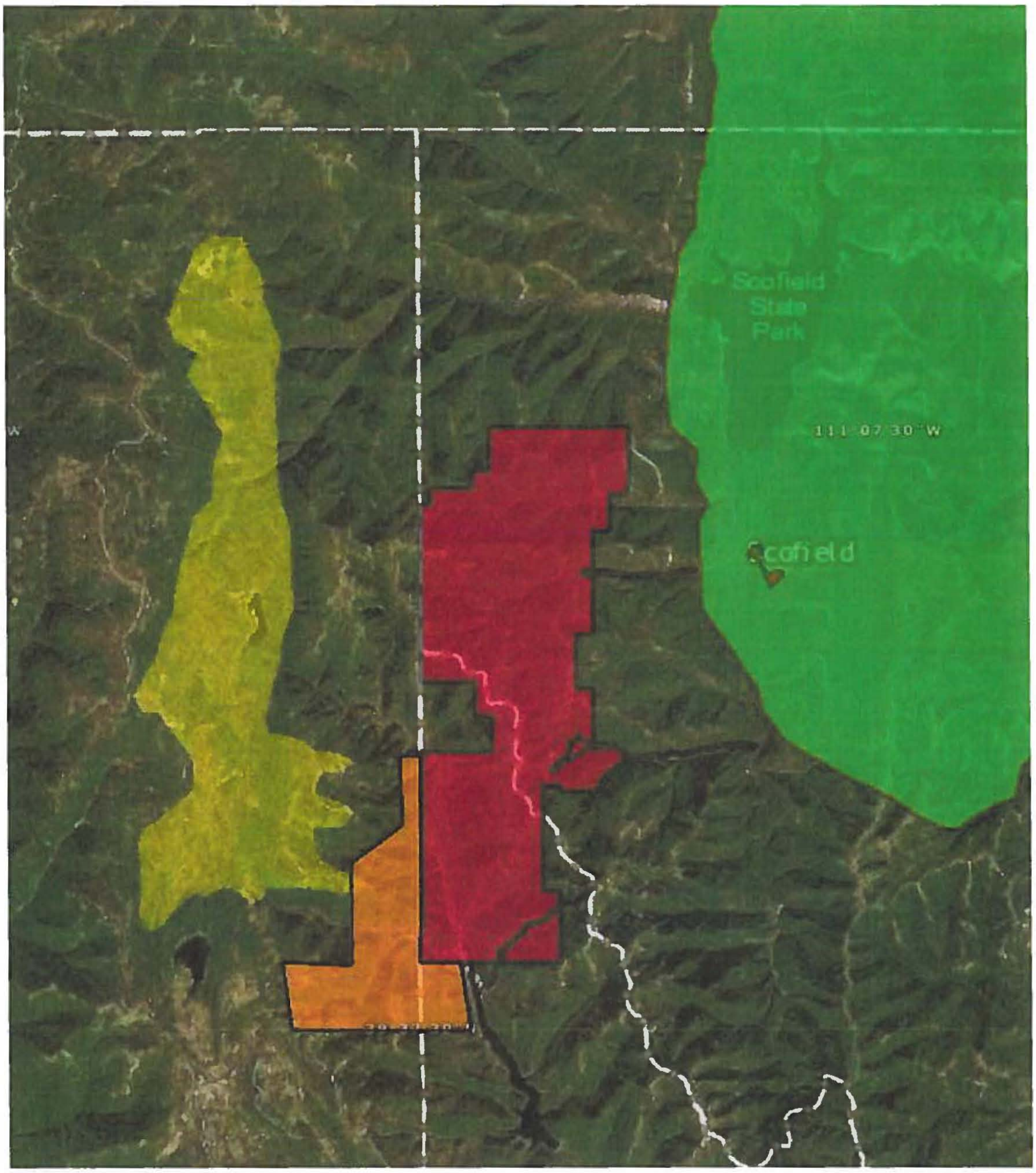
Wildlife Species of Concern

California Floater	*Anodonta californiensis*
Western Pearlshell	*Margaritifera falcata*
Southern Tightcoil	*Ogaridiscus subrupicola*
Eureka Mountainsnail	*Oreohelix eurekensis*
Lyrate Mountainsnail	*Oreohelix haydeni*
Brian Head Mountainsnail	*Oreohelix parawanensis*
Deseret Mountainsnail	*Oreohelix peripherica*
Yavapai Mountainsnail	*Oreohelix yavapai*
Cloaked Physa	*Physa megalochlamys*
Utah Physa	*Physella utahensis*
Wet-rock Physa	*Physella zionis*
Longitudinal Gland Pyrg	*Pyrgulopsis anguina*
Smooth Glenwood Pyrg	*Pyrgulopsis chamberlini*
Desert Springsnail	*Pyrgulopsis deserta*
Otter Creek Pyrg	*Pyrgulopsis fusca*
Hamlin Valley Pyrg	*Pyrgulopsis hamlinensis*
carinate Glenwood Pyrg	*Pyrgulopsis inopinata*
Ninemile Pyrg	*Pyrgulopsis nonaria*
Bifid Duct Pyrg	*Pyrgulopsis peculiaris*
Bear Lake Springsnail	*Pyrgulopsis pilsbryana*
Black Canyon Pyrg	*Pyrgulopsis plicata*
Sub-globose Snake Pyrg	*Pyrgulopsis saxatilis*
Southern Bonneville Pyrg	*Pyrgulopsis transversa*
Northwest Bonneville Pyrg	*Pyrgulopsis variegate*

See Appendix A for the rationale behind each wildlife species of concern designation.

Figure 2.9.7-A

Greater Sage-grouse *Centrocercus urophasianus* habitat relative to Skyline Mine



Skyline Mine area

Flat Canyon Lease area

Greater Sage-grouse Winter Habitat*

Greater Sage-grouse Brood-rearing Habitat*

*Data from Utah Automated Geographic Reference Center (AGRC)

Habitat Loss

The amount of habitat loss due to surface disturbance is minimal when considering the extent of similar surrounding habitat, and areas of contemporaneous reclamation that were previously disturbed prior to the current mining activities. Disturbed areas will be minimized to approximately 3 acres as the area is contemporaneously reclaimed. Noise and human activity in the expansion area is consistent with the historic mining activities. Also, wildlife studies indicates the surrounding area is used as a migratory route between summer and winter ranges. Enhancement measures at reclamation will include the planting of seeds and woody species seedlings that are diverse and palatable to wildlife, and a pond to be used by both wildlife and livestock. The pond is being left intact at the landowner=s request - historically the pond has only periodically retained a very limited water supply.

2.9.7 WILDLIFE OF THE SOUTHWEST RESERVE - FLAT CANYON LEASE

Tables 2.9-1 through 2.9-3 provide a historic species list of mammals, amphibians, and reptiles whose published ranges exist in the general area of the Skyline Mine. Tables 2.9-4 and 2.9-5 have been updated (2015) to include the federally listed threatened, endangered, candidate, and sensitive species in Carbon, Emery, and Sanpete Counties. ~~Table 2.9-6 provides the the updated Sensitive Plant, Wildlife, and Fish Species of the Manti-LaSal National Forest.~~ In addition, Figure 2.9.3-A has been modified and updated ot illustrate the endangered mammalian species in relation to the Skyline Mine lease areas. Figure 2.9.3-E illustrates the ranges for the Greater Sage Grouse. Brood-rearomg~~Occupied~~ habitat for the Greater Sage Grouse exists to the west of areas to be mined in the Southwest Reserve - Flat Canyon lease~~, however when brood-rearing habitat is considered, only winter habitat exists~~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 #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) – (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 ~~no~~ amphibians being found (report located in Appendix A-3 Volume 2). No impacts to Wildlife are anticipated with the Southwest Reserve – Flat Canyon lease as no surface disturbance is associated with the lease.

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July 1, 2005. Details of the method of the survey are outlined in Appendix A-2, ABiological Studies in Winter Quarters Canyon Creek and Woods Canyon Creek - A Study Plan@. Results of the survey will be provided in Appendix A-2, Volume 2 when completed.

Raptor surveys were conducted in 2005, 2007, 2008, 2009, 2011, and 2013 in the Winter Quarters area associated with drilling programs. Those surveys and the presence or lack of presence of raptors has not prohibited our work in the area. The raptor surveys are located with the respective exploration permits for each year. A summary report addressing the affects on raptors with the addition of the Winter Quarters Ventilation Facility is included in Appendix A-3, Volume 2. In 2009, an additional survey of the Northern goshawk, flammulated owl, and other comprehensive wildlife was conducted with similar results. No long term detrimental affects associated with the ventilation facility are anticipated. The 2011 survey identified a newly established goshawk nest in the lease modification area. This nest will continue to be monitored in future annual surveys, with additional lands to be monitored as mining advances in the North Lease modification area.

THREATENED & ENDANGERED SPECIES

No threatened or endangered species have been documented in studies surrounding the Winter Quarters Ventilation Facility that would prohibit construction. See Appendix A-2, Volume 2 and Appendix A-3, Volume 2 for reports.

Because no surface disturbance in planned for the North Lease Tract Area, no impact to endangered, threatened, or otherwise sensitive species should occur.

2.10.3 Raptors of the Southwest Reserve 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 #2, #3, and #14 as outlined in the Record of Decision (ROD) (ROD Attachment 1, pp2-3) which was based on the Final Environmental Impact Statement for 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

Southwest Reserve Flat Canyon lease area, no impact to endangered, threatened or otherwise sensitive species should occur.

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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.

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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 Southwest Reserve (SWR) and 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.

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Private lands east of the National Forest boundary and west of the Southwest Reserve 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 LEASE AREAS OFTHE SKYLINE MINE

Allotment	Sheep Numbers	Season of Use
Eccles Canyon	637	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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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).

A Prime Farmland Determination conducted in 2014 determined no Prime Farmland exists in the Southwest Reserve – Flat Canyon lease area (See Appendix Volume A-2).

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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 Southwest Reserve, which includes mining of existing lease U-0147570 and Flat Canyon lease UTU-771114. Conventional mining will be used for development of longwall panels on the existing lease and for accessing lease UTU-771114 west of Huntington Creek. Longwall mining is scheduled to begin in approximately 2019. Undermining portions of Boulger, Swens, and Little Swens is planned, but only minor subsidence is anticipated. No longwall mining or subsidence is planned for Huntington Creek. The Southwest Reserve, 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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3.3 TIMING OF OPERATION

The construction phase of the Skyline Mines project commenced in the summer of 1980. The construction phase included the dirtwork and installation of surface facilities and premining activities such as portal conveyor slope drivage. 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. The Southwest Reserves are illustrated on Plate~~s 3.3-2~~ and 3.3-3. For the 5-year mining plans refer to the Annual report for updated information.

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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extraction thickness rule-of-thumb. However, this criteria was meant to be applied only to extraction below 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.

In the case of Boulger Reservoir, 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 is conducted.

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

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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 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.

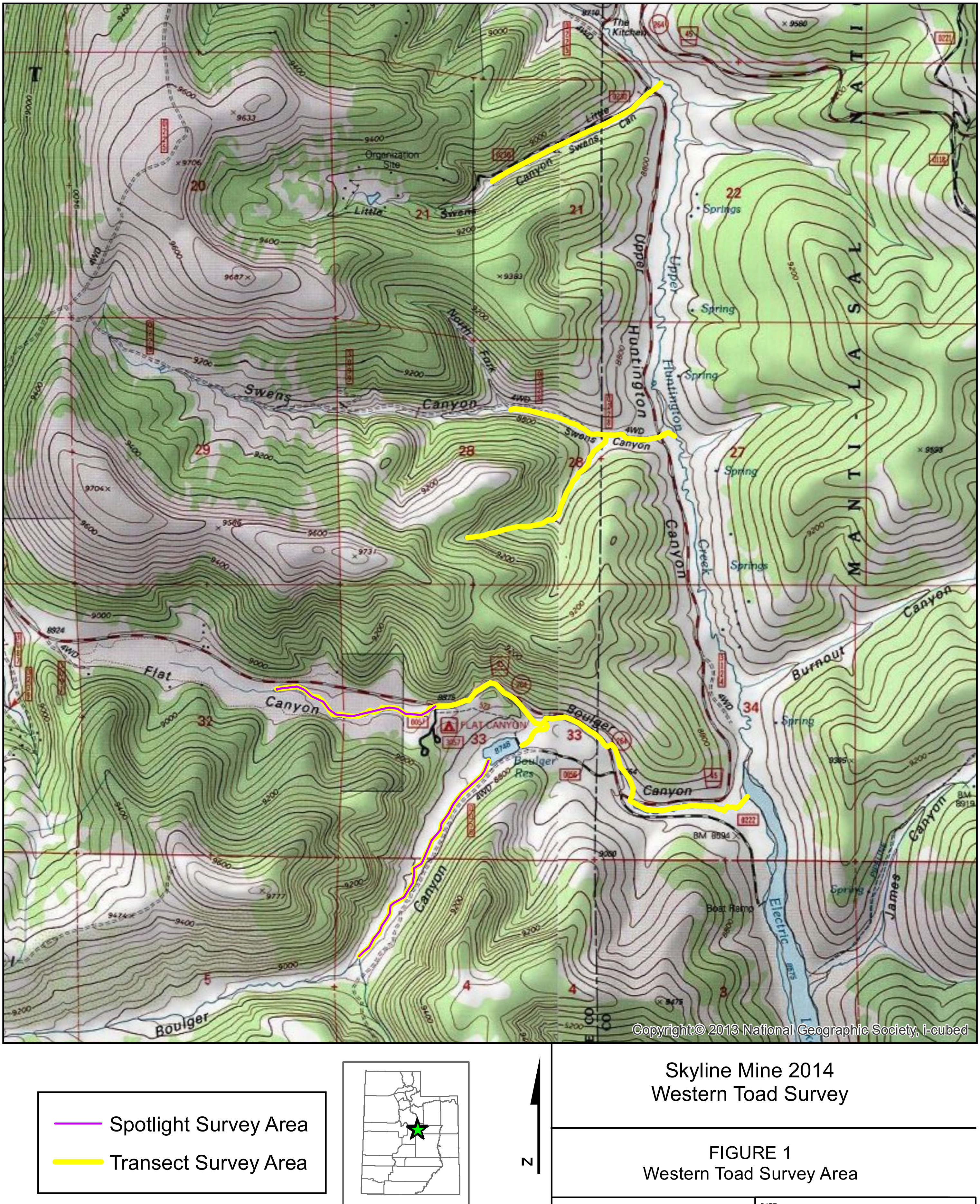
.

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.



Skyline Mine 2014
Western Toad Survey

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

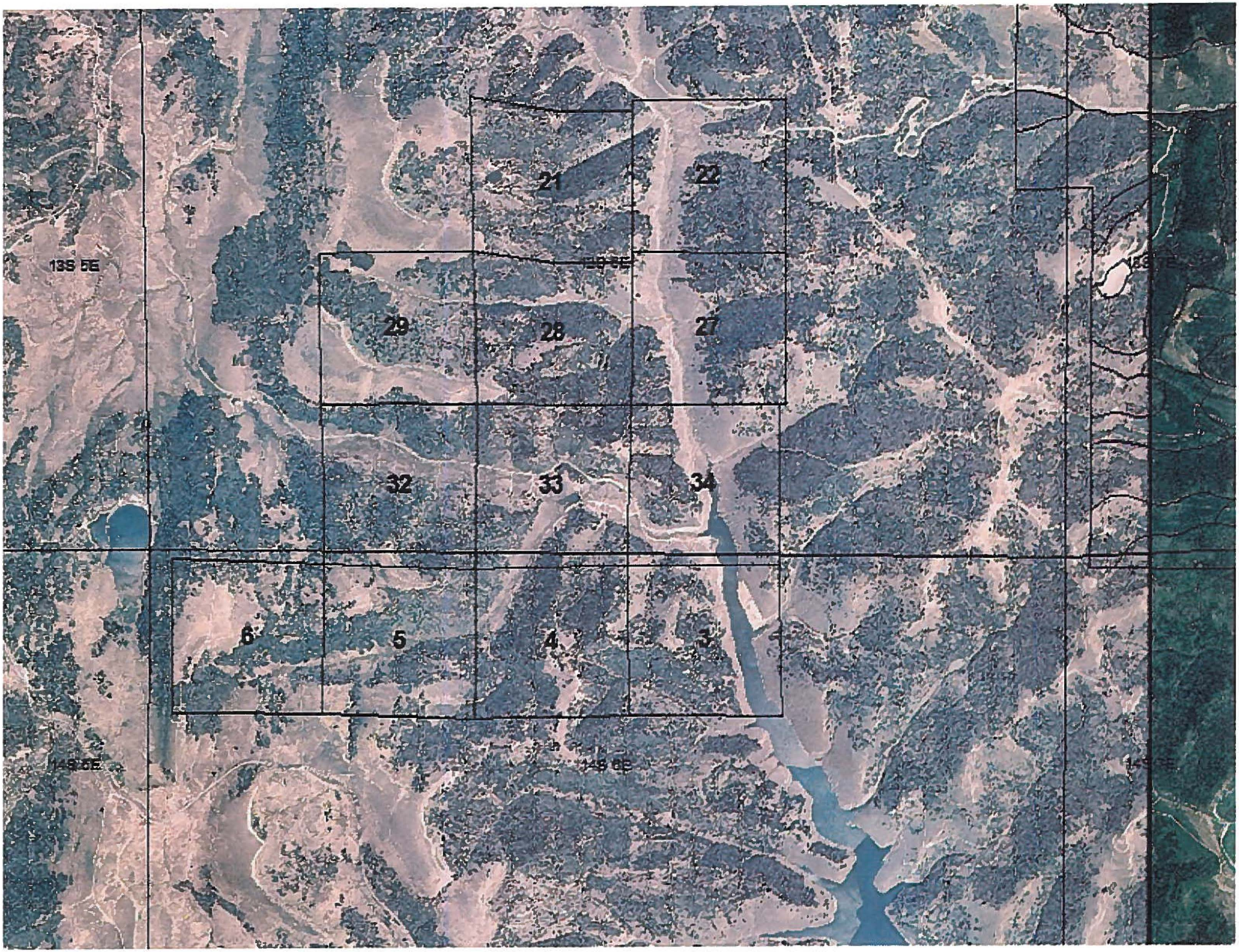
Joseph Dyer
Area Resource Soil Scientist
Office 435 637 0041 ext 102
Cell 435 630 3137

Jeremiah Armstrong
Environmental Engineer – Skyline Mine

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.



13S 5E
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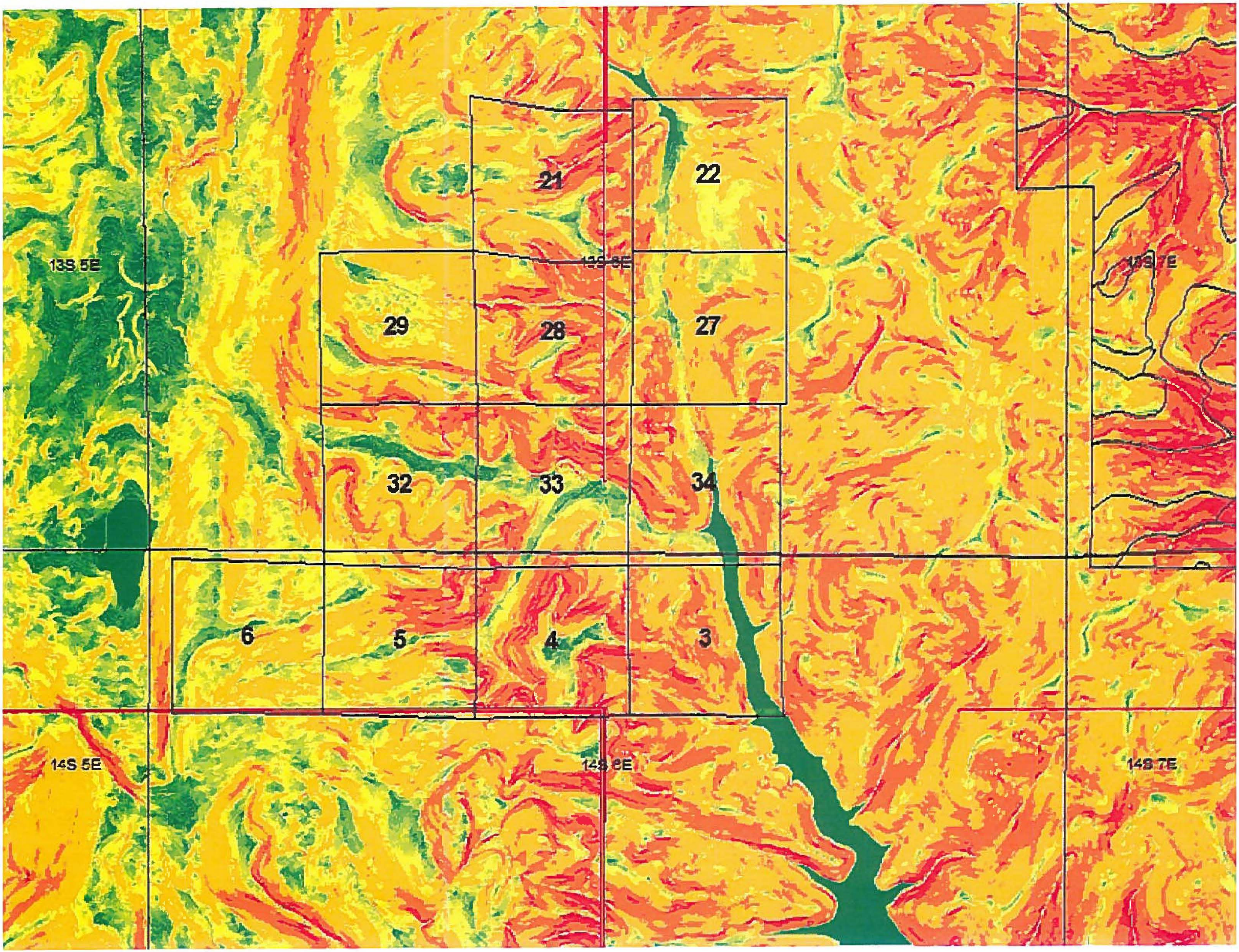
14S 5E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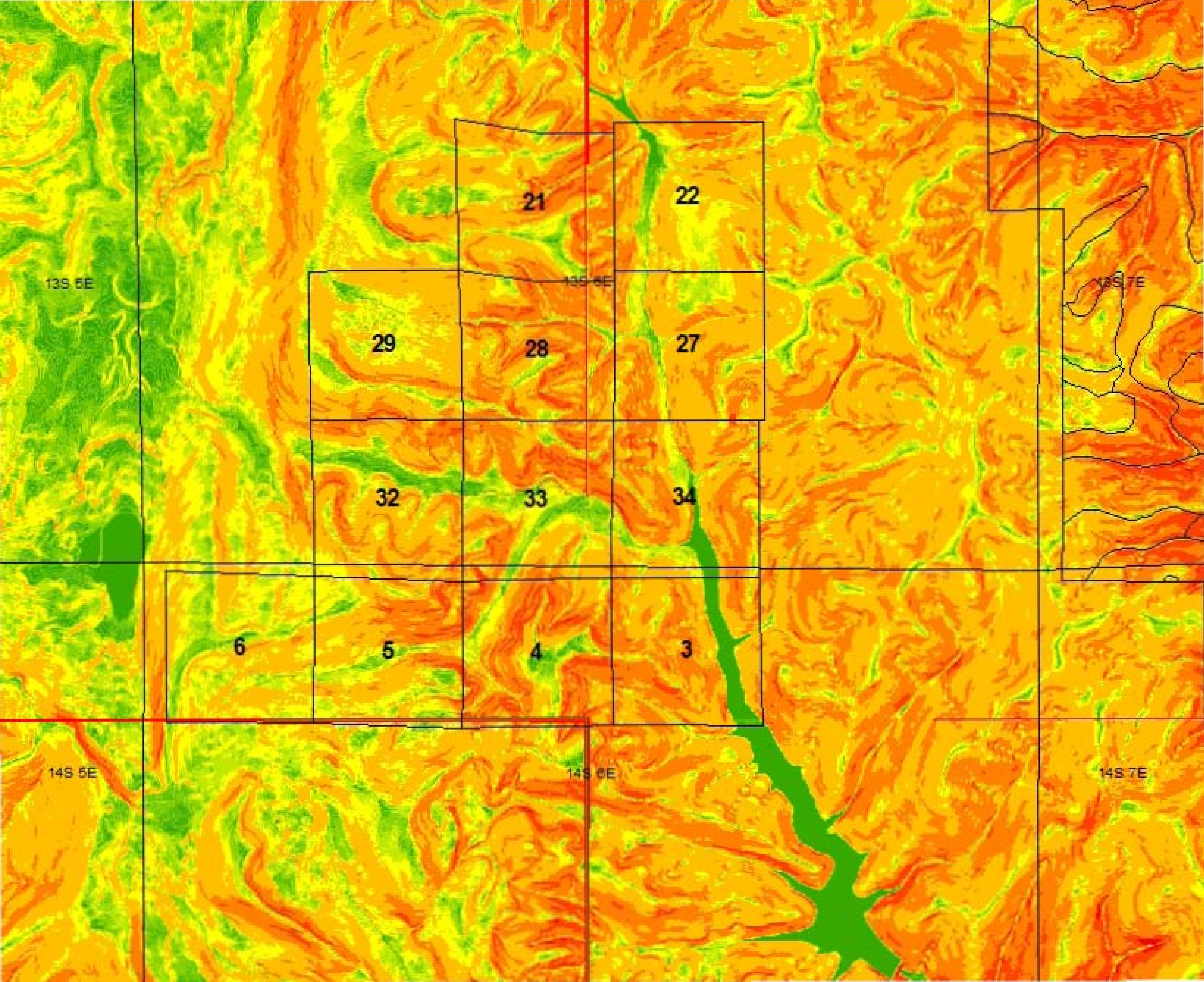
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14S 5E
14S 6E
14S 7E

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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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Denver 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:33-11831

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.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.
Ezequiel Barro
Manager, Denver Laboratory

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COMMERCIAL TESTING & ENGINEERING CO.

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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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

AMERICAN COUNCIL OF INDEPENDENT LABORATORIES INC.

Manager, Skyline Laboratory

COMMERCIAL TESTING & ENGINEERING CO.

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FAX: (303) 373-4791

January 4, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE ID:33-11834

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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Denver Laboratory

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FAX: (303) 373-4791

January 4, 1996

CT&E SKYLINE
P.O. BOX 690
PRICE UT 84501

Sample identification by
CTE SKYLINE

SAMPLE ID:33-11834

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.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Esequiel Baca

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 #: 33-12156
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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Denver Laboratory

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FAX: (303) 373-4791

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.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

E Aegund Baro

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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Denver Laboratory

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FAX: (303) 373-4791

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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.
Byron C. Cat
Denver Laboratory

COMMERCIAL TESTING & ENGINEERING CO.
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FAX: (303) 373-4791

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.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Ezequiel Baro

Manager, Denver Laboratory

AMERICAN COUNCIL OF INDEPENDENT LABORATORIES, INC.

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FAX: (303) 373-4791

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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.
Byron C. Cate
Denver Laboratory

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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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, Denver Laboratory

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FAX: (303) 373-4791

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.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Manager, 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
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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.
Esequiel Jones
Denver Laboratory

MEMBER ACIL

COMMERCIAL TESTING & ENGINEERING CO.
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DENVER, CO 80239
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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.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

E. Segrid Jones

Denver Laboratory

MEMBER ACIL

COMMERCIAL TESTING & ENGINEERING CO.
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SUITE B-200
DENVER, CO 80239
TEL: (303) 373-4772
FAX: (303) 373-4791

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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Esequiel Jarco

Denver Laboratory

MEMBE ACII

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 630-953-9300 FAX: 630-953-9306

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PLEASE ADDRESS ALL CORRESPONDENCE TO:
4665 PARIS STREET
SUITE B-200
DENVER, CO 80239
TEL: (303) 373-4772
FAX: (303) 373-4791

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

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Byron C. Cat

Denver Laboratory

MEMBER ACIL

STANDARD LABORATORIES, INC.

04/05/00

CUSTOMER: CANYON FUEL COMPANY

JOB NO.: 20000028500б
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

FORM NO 20

STANDARD LABORATORIES, INC.

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 Na20	1.04
SPECIFIC GRAVITY	1.96
FREE SWELLING INDEX	

GRINDABILITY (HGI)

AT % MOISTURE

WATER SOLUBLE ALKALIES (%)

AS RECD	DRY

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 Na20	1.07
SPECIFIC GRAVITY	2.32
FREE SWELLING INDEX	

GRINDABILITY (HGI)

AT % MOISTURE

WATER SOLUBLE ALKALIES (%)

	AS RECD	DRY

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

Prepared By:

Western Land Services, Inc
195 North 100 East, Suite 201
Richfield, UT 84701
Phone: (435) 896-5501

WESTERN LAND SERVICES, INC

08.10.2011

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Appendices

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).

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> 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."*
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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 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

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	

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

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

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

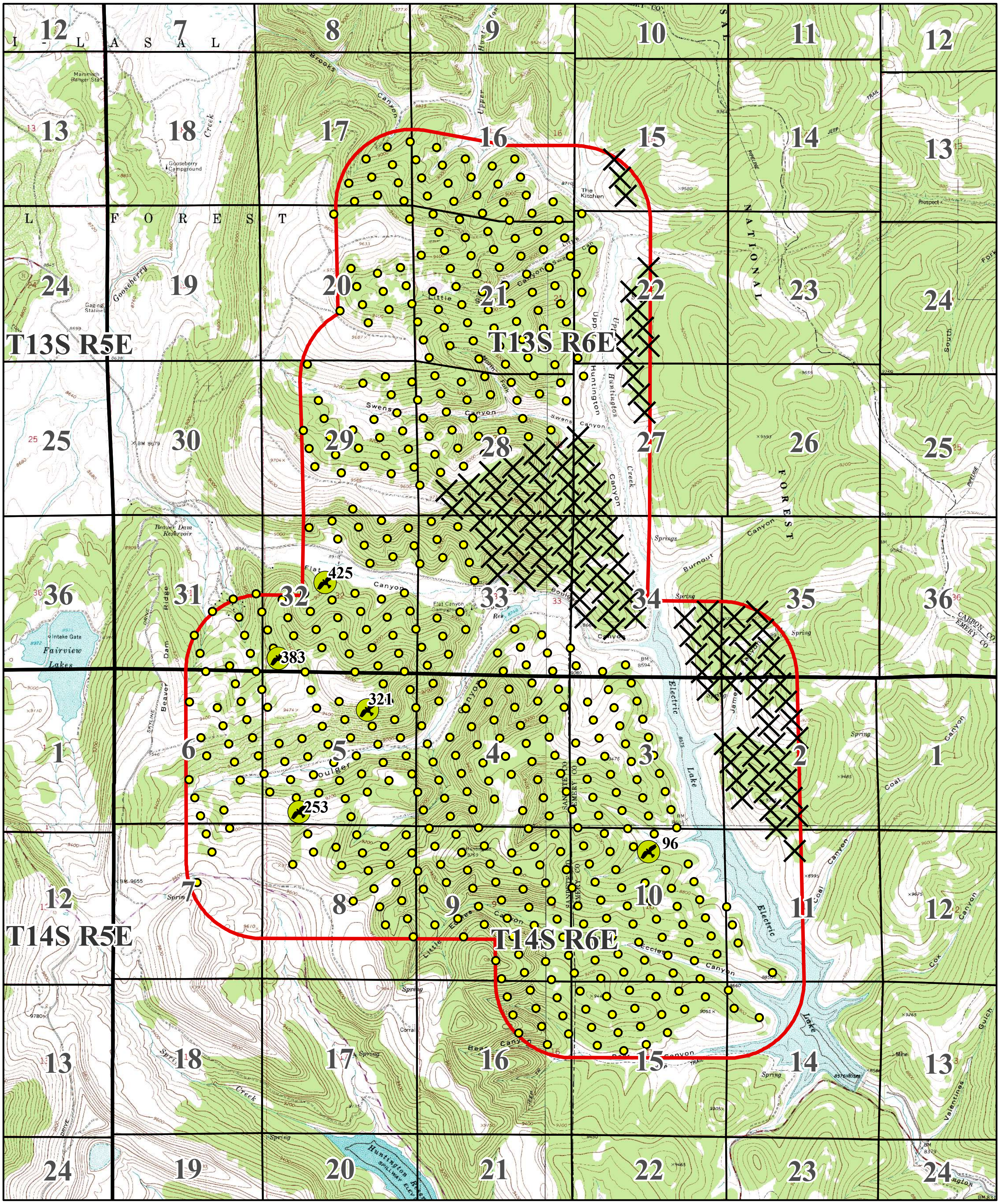
6.0 Conclusions and Recommendations

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.

Appendix A

Project Map



Raptor Territories

Call Stations

Call Stations

USFS Survey

Project Area

N W E S

1:55,000

Datum NAD 83

Zone 12

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

Appendix B

Data Sheets

Southwest Reserves
NEPA Analysis Area
2012

Northern Goshawk, other Raptors and
General Wildlife Surveys

Prepared for:

Skyline Mine
Gregg Galecki
Environmental Engineer
Canyon Fuel Company, LLC

Prepared By:

Western Land Services, Inc
195 North 100 East, Suite 201
Richfield, UT 84701
Phone: (435) 896-5501

WESTERN LAND SERVICES, INC

08.06.2012

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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.

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 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

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

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.

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.

Appendix A-Plant Species Table

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

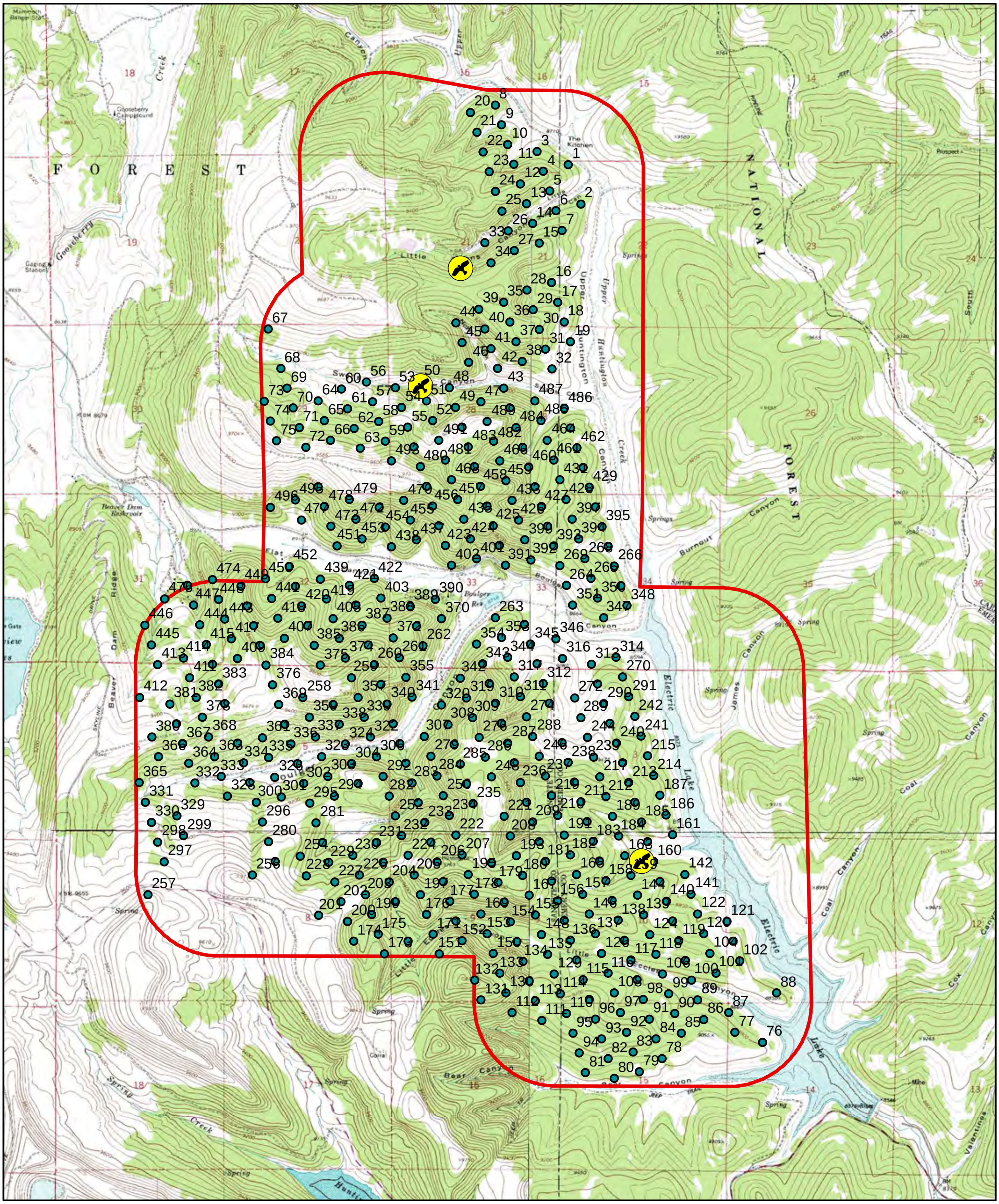
Shrub Species	
Scientific Name	Common Name
Artemisia cana	Silver Sagebrush
Artemisia tridentata vaseyana	Mountain Big Sagebrush
Potentilla fruticosa	Bush Cinquefoil
Prunus virginiana	Chokecherry
Ribes inerme	Whitestem Gooseberry
Ribes viscosissimum	Sticky Currant
Salix boothii	Booth's Willow
Salix drumondiana	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

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

Appendix B-Project Maps



Raptor Nests
2012 Call Stations
Project Area

1:50,000
Datum NAD 83
Zone 12

Skyline Mine
Southwest Reserve Project

WESTERN LAND SERVICES
Richfield, UT 84701 (435) 896-5501
CONFIDENTIAL
Prepared By: LB Date: June 22, 2012

Appendix C-UDOGM Raptor Survey Forms

RAPTOR SURVEY FORM

Division of Oil Gas and Mining
Coal Regulatory Program

Utah DNR Oil, Gas & Mining

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 with this form must be submitted to the Division in an electronic format suitable for uploading into AVG-8. 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: SkyLine
3. Survey Date: July 21, 2012

4. Survey Type: (Check One)
- [ ] Aerial
- [x] 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 (# fledged)	Elevation/Exposure of nest (optional)	Comments
NEW	RTHA	Active	Excellent	/	/	/	CON	2	8873 North	2 Adult - 2 Fledglings observed vocalization

12S 0477430
4390469


Active REHA Nest.

RAPTOR SURVEY FORM

Division of Oil Gas and Mining
Coal Regulatory Program

UTAH 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 with 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
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- ☐ 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	8407 North	2 adult - 1 Fledgling observed vocalization 12S 0477812 4391602
NEW	RTHA	Tended AL	Good	/	/	/	CON	/	8887 North	alt nest app 300 yrds lower in canyon

Active REHA Nest.

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

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:	**Elaine Zieroth** Forest Supervisor Manti-La Sal National Forest 599 West Price River Drive Price, Utah 84501	**Sally Wisely** Utah State Director Bureau of Land Management 324 South State Street, Suite 301 Salt Lake City, Utah 84111
Cooperating Agencies:	**USDI Office of Surface Mining Reclamation and Enforcement** Western Regional Coordinating Center 1999 Broadway, Suite 3320 Denver, Colorado 80202-5733	
For Further Information Contact:	**Carter Reed**, Forest Geologist Manti-La Sal National Forest 599 West Price River Drive Price, Utah 84501 (435) 637-2817	**Stan Perks**, Mining Engineer Bureau of Land Management Utah State Office 324 South State Street, Suite 301 Salt Lake City, Utah 84111 (801) 539-4038

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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A. APPENDICES

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S-1.0 FEIS SUMMARY

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):

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.

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.

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

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.

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.

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.

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:

- 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 <u>underlined</u>.

Structures and Facilities

- <u>Mining-induced subsidence and seismicity could damage the Boulger Dam (including the fish ladder) and Reservoir</u> (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.

- <u>Mining-induced subsidence could damage State Highway 264</u> (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.

- <u>Mining-induced subsidence and seismicity could damage facilities at the Flat Canyon Campground (Significant Issue)</u>.
  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.

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.

- 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.

- 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.

- 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.

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

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.

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.

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):

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.

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.

1.0 INTRODUCTION

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.

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.

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.

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.

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.

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.

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.

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.

1.9 CONFORMANCE WITH LAND USE PLANS

1.9.1 Availability

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.

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

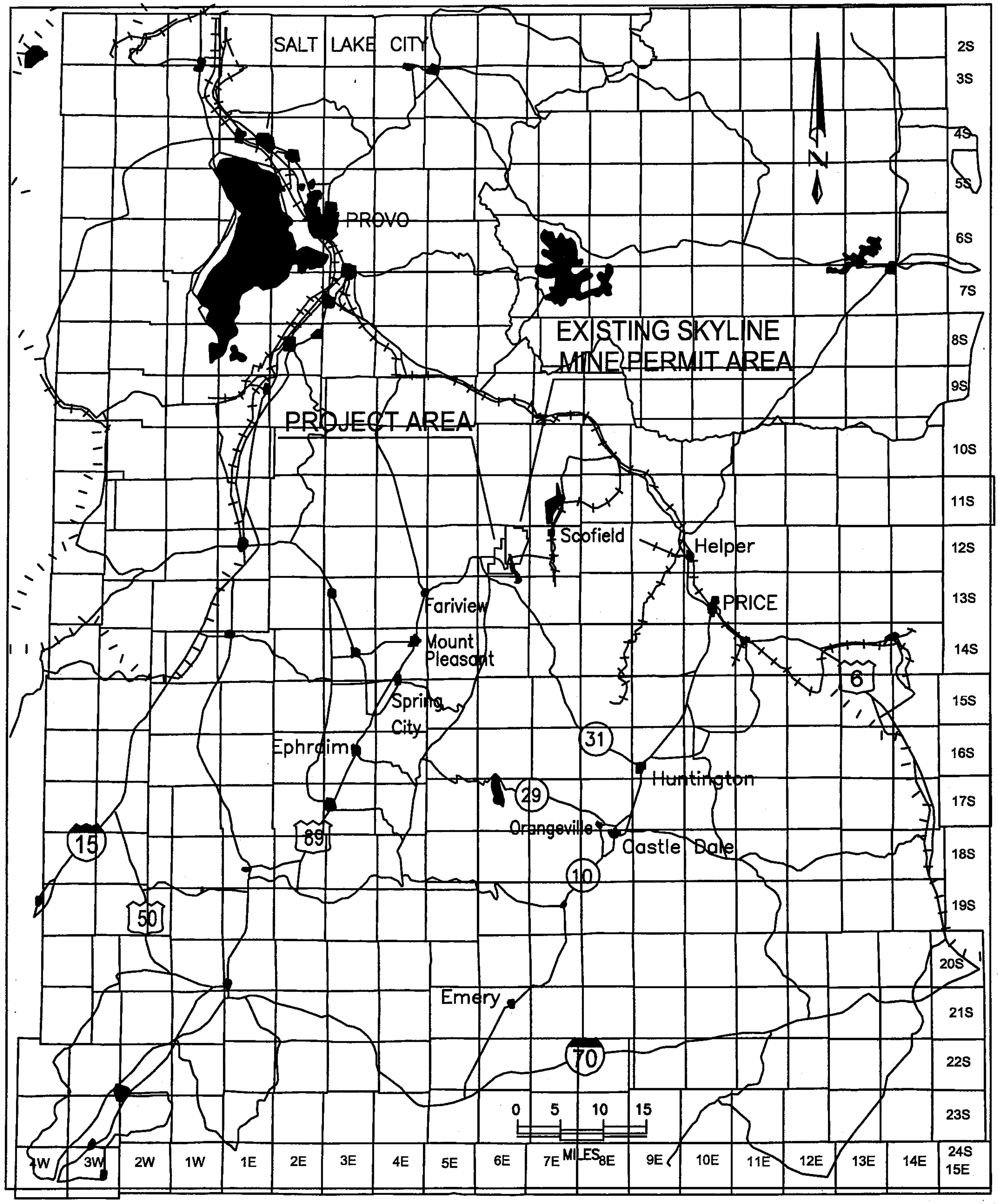
The Boulger Canyon dam, reservoir, and associated dispersed recreation area and Flat Canyon Campground lie within the tract. The lease must contain stipulations to protect or mitigate impacts to these facilities and provide for public safety.

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.



LEGEND

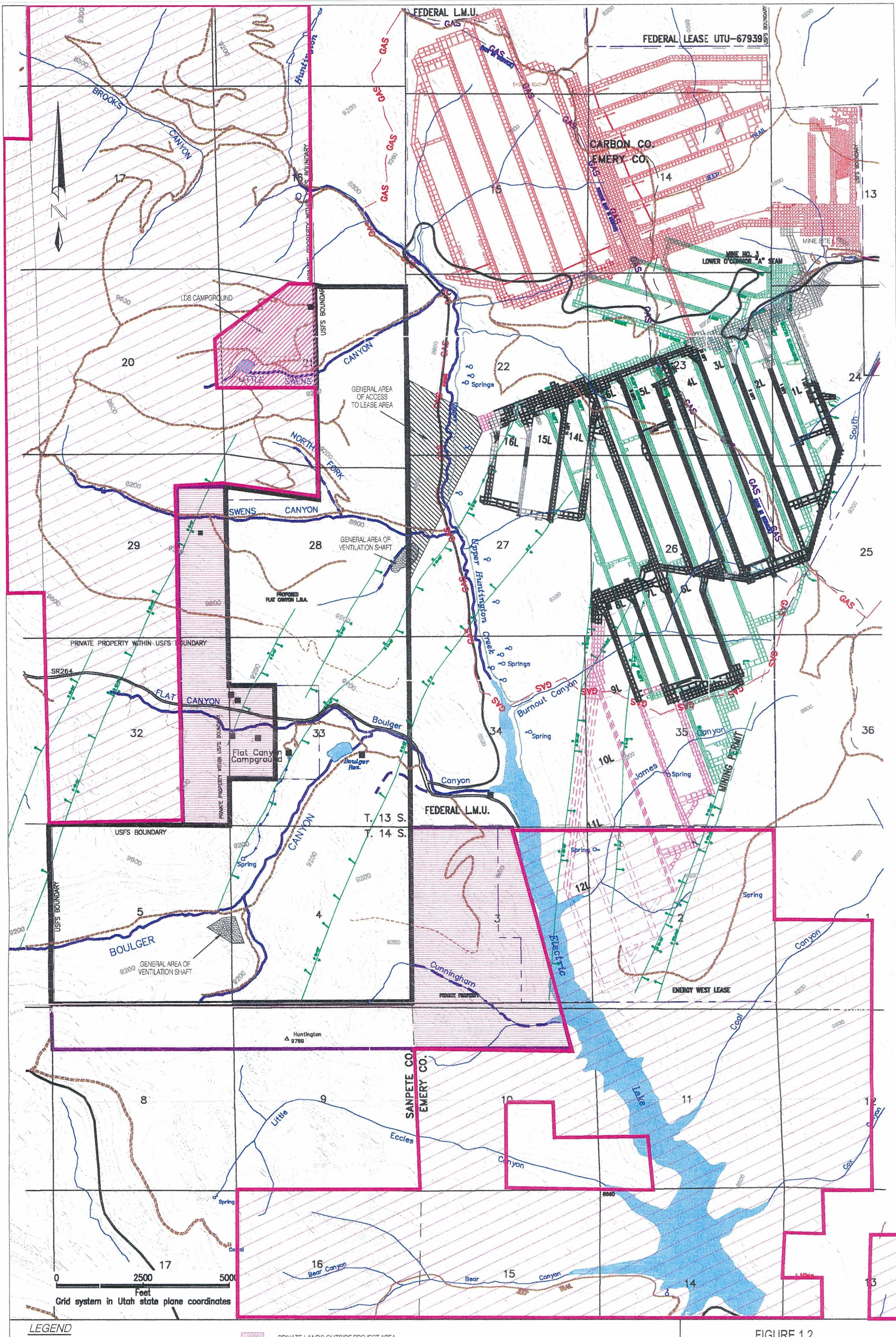
RAILROAD
HIGHWAY
ROAD
LAKE/RIVER
CITY
PROJECT AREA
50 U.S. HIGHWAY
10 STATE HIGHWAY
15 INTERSTATE HIGHWAY

FIGURE 1.1

PROJECT LOCATION MAP

DATE: 3/19/1999

FILE: 2273F1.DWG



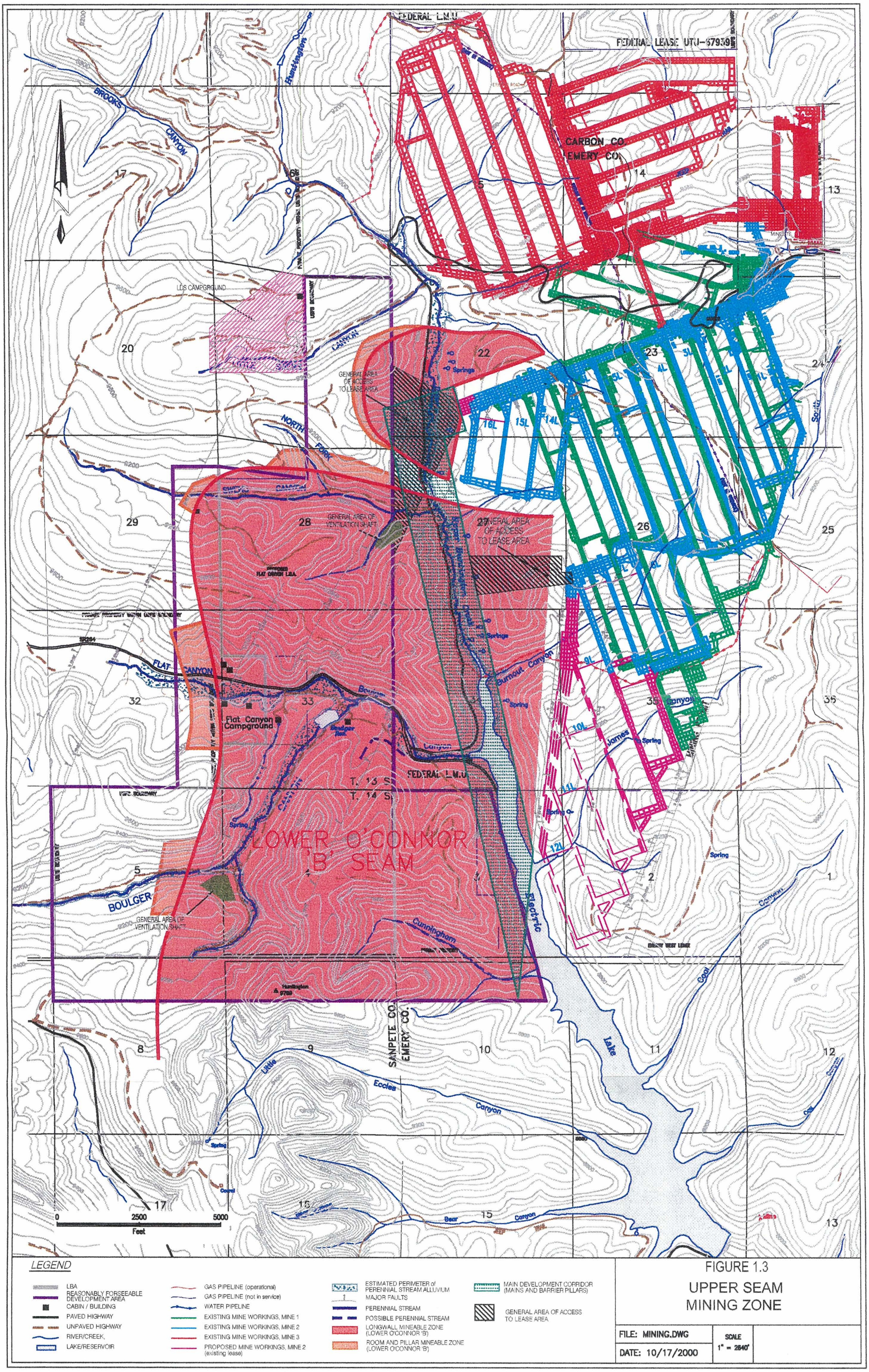
LEGEND

- 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 (existing lease)
- 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


FEDERAL L.M.U.
FEDERAL LEASE UTU-67939
CARBON CO.
EMERY CO.
LDS CAMPGROUND
GENERAL AREA OF ACCESS TO LEASE AREA
GENERAL AREA OF VENTILATION SHAFT
GENERAL AREA OF ACCESS TO LEASE AREA
Flat Canyon Campground
FEDERAL L.M.U.
T. 13 S.
T. 14 S.
LOWER O'CONNOR 'B' SEAM
GENERAL AREA OF VENTILATION SHAFT
SANPETE CO.
EMERY CO.
BROOKS CANYON
NORTH FORK
FLAT CANYON
BOULGER
Burnout Canyon
James Canyon
Electric Lake
Cunningham
Little Eccles Canyon
Bear Canyon
Coal Canyon
0 2500 5000
Feet
LEGEND
LBA
REASONABLY FORSEEABLE 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 lease)
ESTIMATED PERIMETER of PERENNIAL STREAM ALLUVIUM
MAJOR FAULTS
PERENNIAL STREAM
POSSIBLE PERENNIAL STREAM
LONGWALL MINEABLE ZONE (LOWER O'CONNOR 'B')
ROOM AND PILLAR MINEABLE ZONE (LOWER O'CONNOR 'B')
MAIN DEVELOPMENT CORRIDOR (MAINS AND BARRIER PILLARS)
GENERAL AREA OF ACCESS TO LEASE AREA
FIGURE 1.3
UPPER SEAM MINING ZONE
FILE: MINING.DWG
DATE: 10/17/2000
SCALE 1" = 2840'

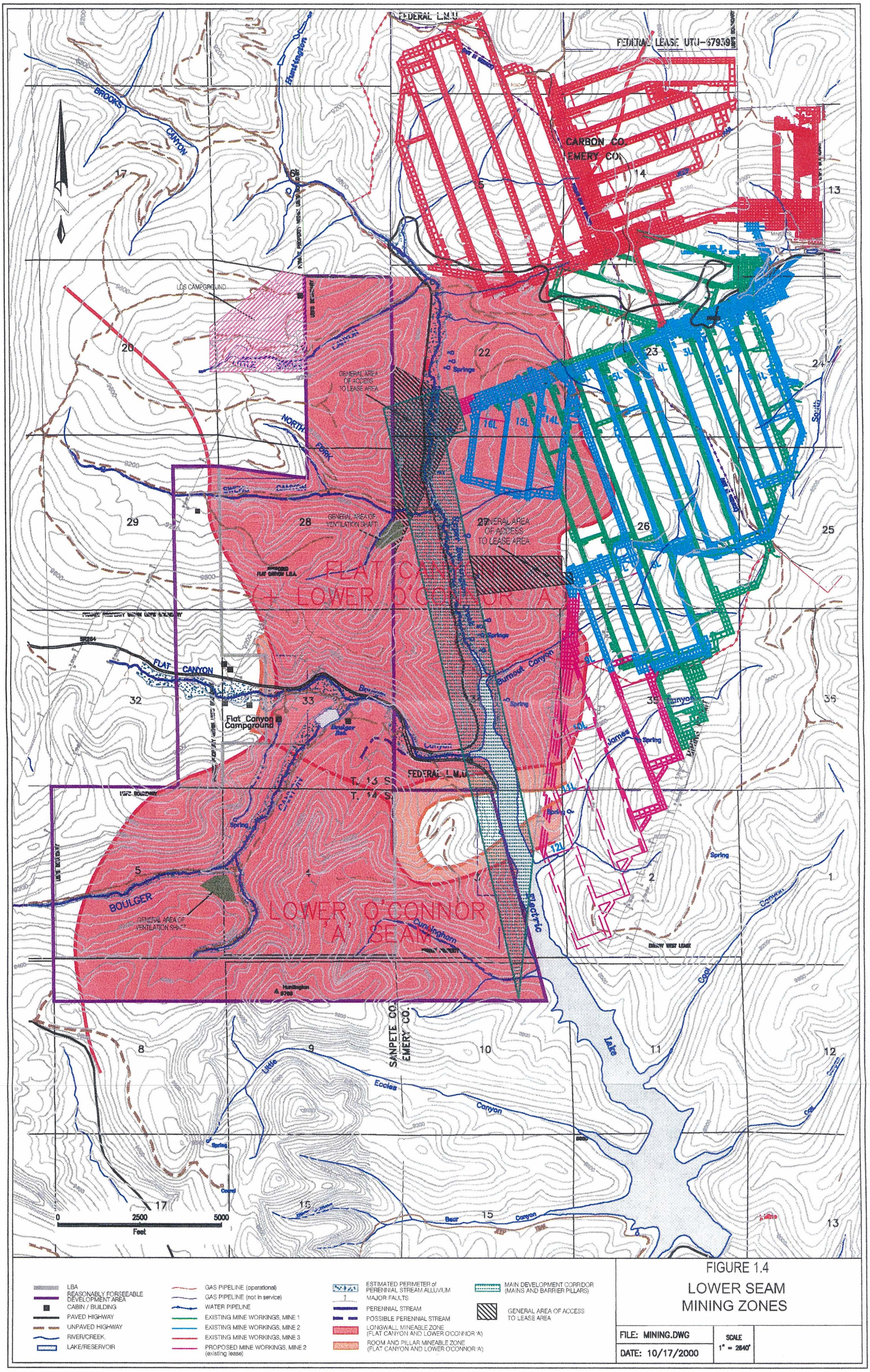


FIGURE 1.4
LOWER SEAM MINING ZONES

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.

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.

- 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 <u>underlined</u>.

2.3.1 Structures and Facilities

- <u>Mining-induced subsidence and seismicity could damage the Boulger Dam (including the fish ladder) and Reservoir</u> (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.

- <u>Mining-induced subsidence could damage State Highway 264</u> (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.

- 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

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.

- 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.

- <u>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</u>. <u>Includes changes in morphology due to flow changes and subsidence</u> (Significant Issue).
  Evaluation Criteria: Changes to habitat, productivity, and populations, Length of stream habitat affected (miles), Duration of effects.

- <u>Changes to flow in drainages and points of mine water discharge would affect aquatic wildlife species and habitat</u> (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

- <u>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</u> (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.

- 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).

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.

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:

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."

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.

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

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.

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.

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'

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'.

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'.

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.

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.

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.

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.

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

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'.

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'.

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'.

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).

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).

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'.

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'.

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).	Same effects as Alternative B but SCLS #3 and #7 require vegetation baseline information and monitoring necessary to quantify changes.	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.
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

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'.

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

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)..
RECREATI ON				
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'.

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

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.

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'.

RESOURCE/ ISSUE	ALTERNATIVES			
	A	B	B'	C
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.	Same as Alternative B'.
		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.
		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.
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

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.

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.

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.

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.

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.

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.

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.

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.

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.

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))

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-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.

The specific characteristics of each sub-basin in the project area are described below.

<u>Flat Canyon Sub-Basin</u>

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.

<u>Boulger Canyon Sub-Basin</u>

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.

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.

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.

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.

<u>Little Swens Sub-Basin</u>

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.

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.

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.

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 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.

<u>Boulger Canyon Alluvial Groundwater System</u>

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.

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, 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.

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.

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.

<u>Starpoint Sandstone Groundwater Systems</u>

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.

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 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 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.

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.

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.

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

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.

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

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 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.

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.

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.

<u>Little Swens Canyon</u>

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 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 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.

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.

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.

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.

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.

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:

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.

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.

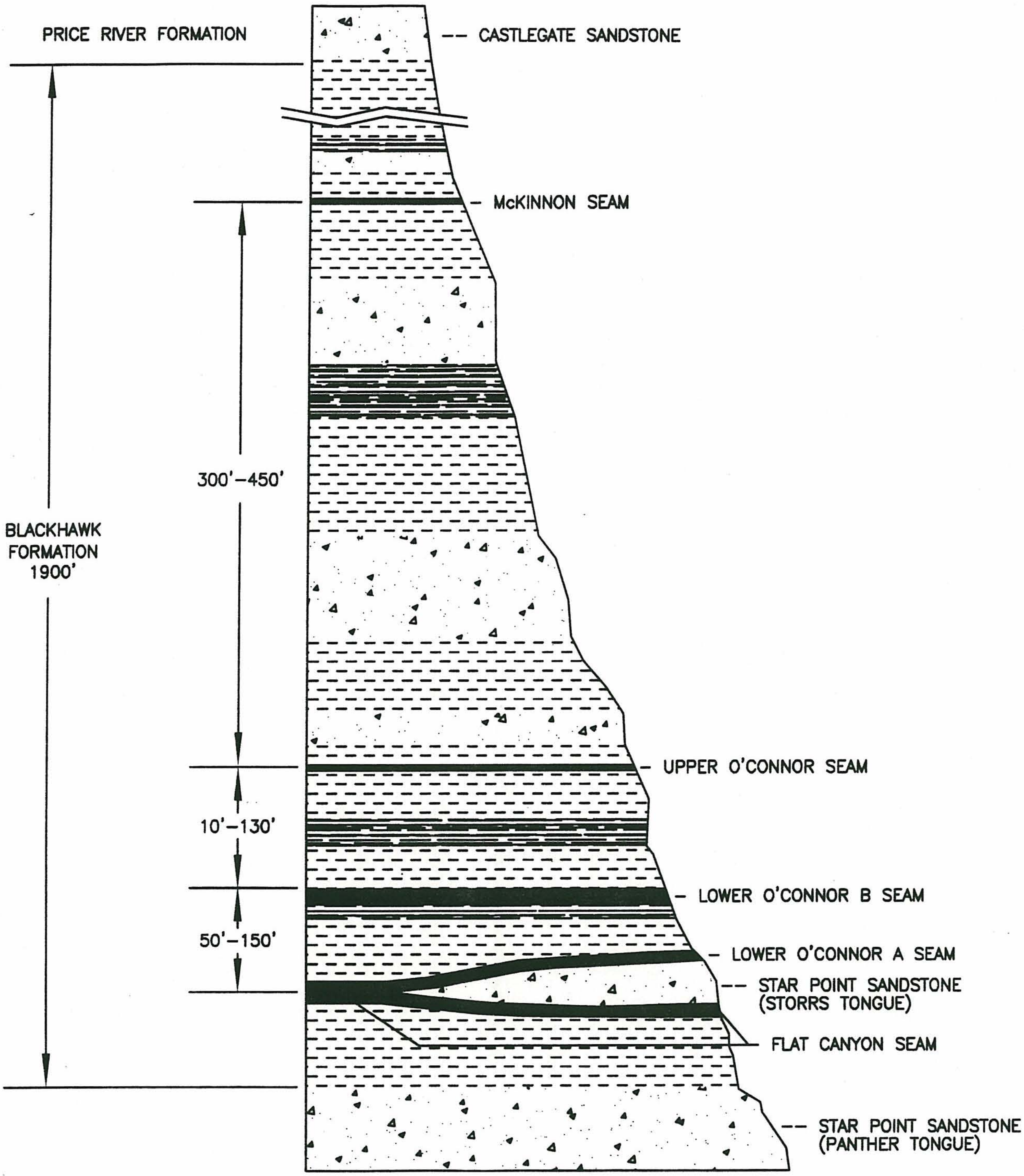
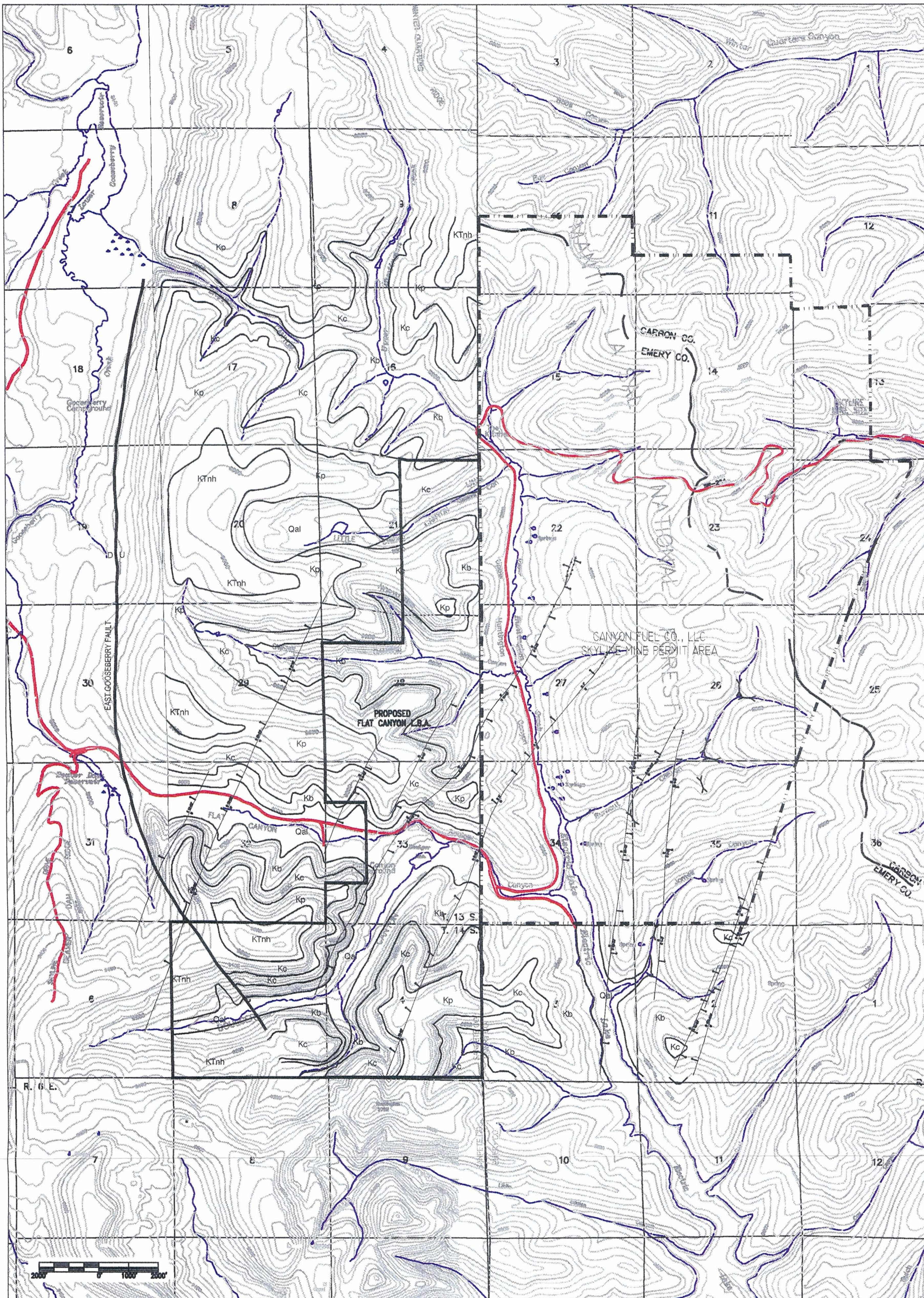


FIGURE 3.2

GENERALIZED COLUMNAR SECTION
FLAT CANYON TRACT AREA

DATE: 8/30/2000
DWG: HYDRO3-4.DWG



LEGEND

FLAT CANYON COAL LEASE TRACT	GEOLOGIC UNITS
RFDS AREA	FAULTS
SKYLINE MINE PERMIT AREA	

Qal	QUATERNARY ALLUVIUM
KTnh	NORTH HORN FORMATION
Kp	PRICE RIVER FORMATION
Kc	CASTLEGATE SANDSTONE
Kb	BLACKHAWK FORMATION

(After Knowles, 1998 and Obenhansley, 1990)

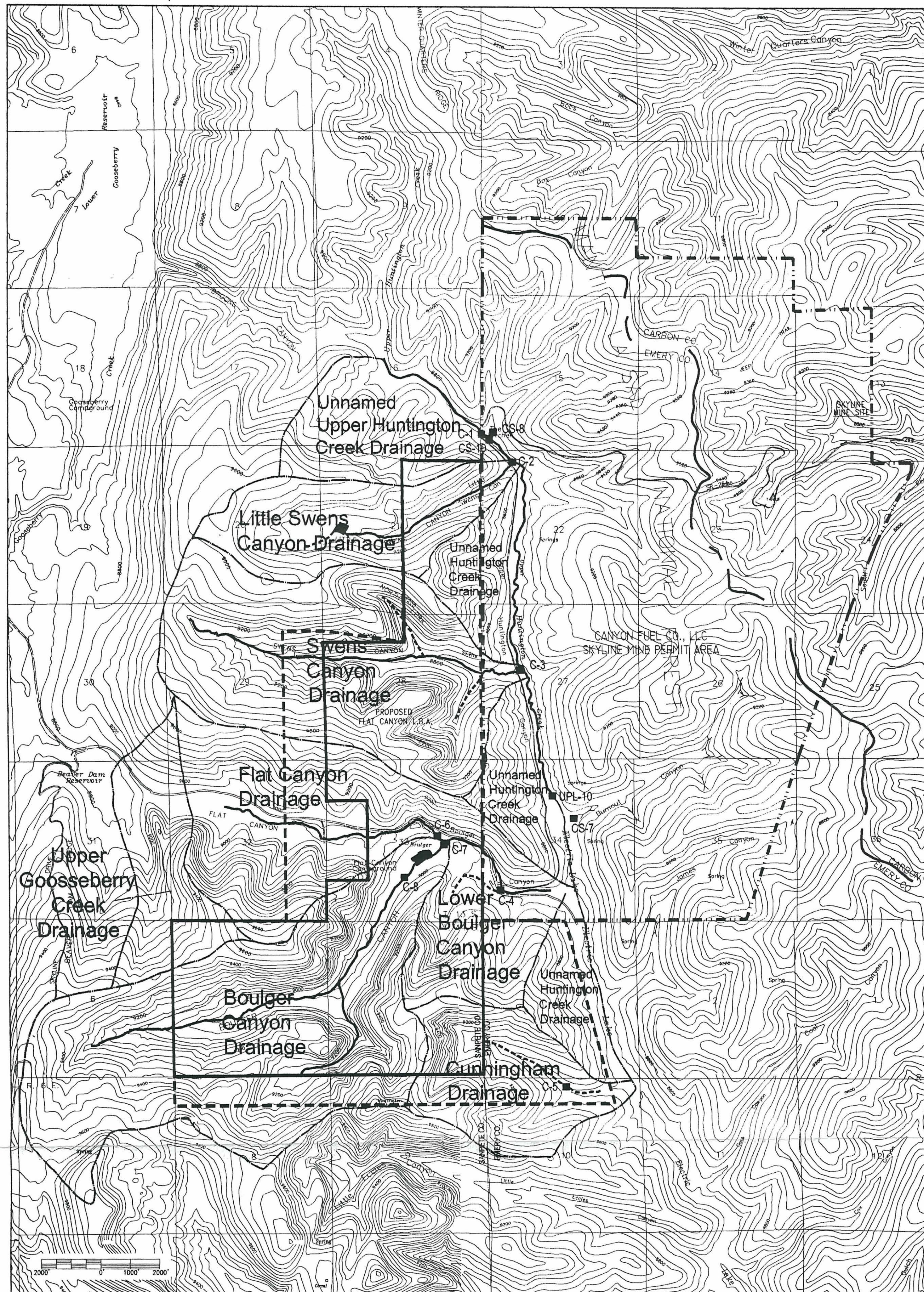
FIGURE 3.1

GEOLOGY MAP

FILE: HYDRO1-2.DWG

DATE: 9/11/2000

SCALE 1" = 3200'



LEGEND

———	FLAT CANYON COAL LEASE TRACT
– – – –	RFDS AREA
–··–··–	SKYLINE MINE PERMIT AREA
–·–·–	HYDROLOGY STUDY AREA
———	PERENNIAL STREAM
- - - - - -	POSSIBLY PERENNIAL STREAM
■	STREAM MONITORING SITE

FIGURE 3.3

WATERSHED BOUNDARIES AND PERENNIAL STREAM REACHES

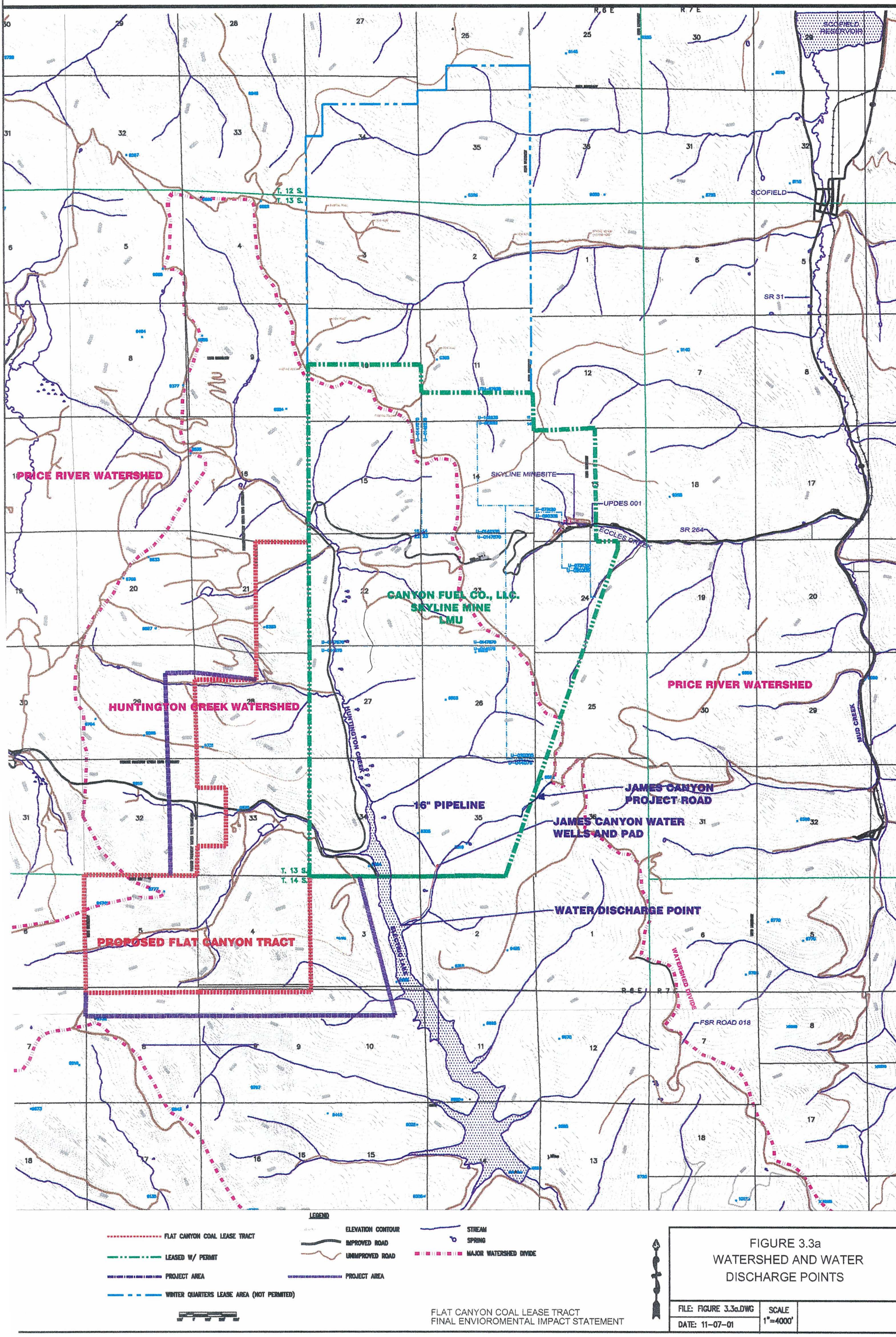
FILE: HYDRO1-2.DWG

SCALE 1" = 3200'

DATE: 8/30/2000

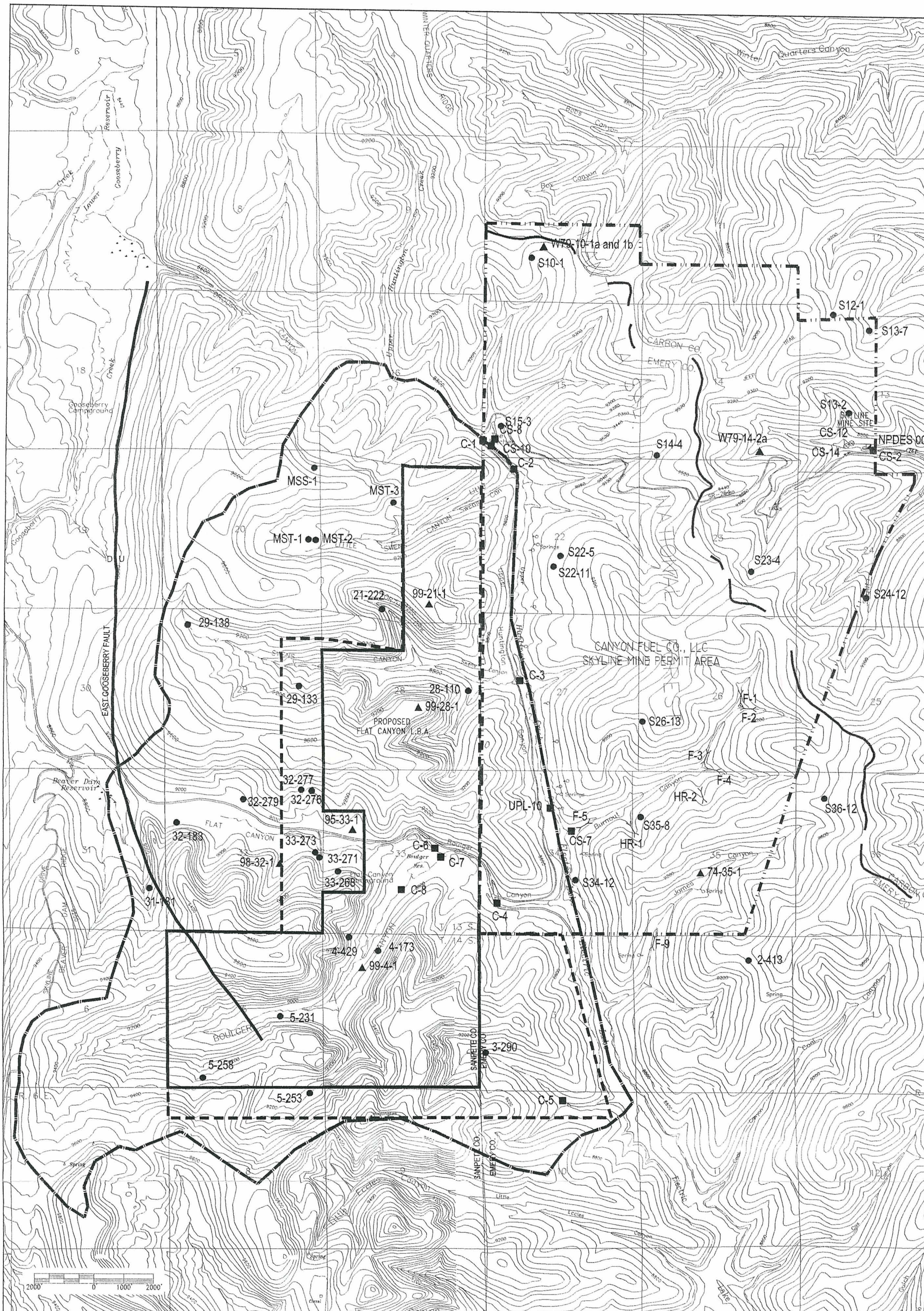
FLAT CANYON COAL LEASE TRACT

DRAFT ENVIRONMENTAL IMPACT STATEMENT



FLAT CANYON COAL LEASE TRACT
FINAL ENVIROMENTAL IMPACT STATEMENT

FIGURE 3.3a WATERSHED AND WATER DISCHARGE POINTS	
FILE: FIGURE 3.3a.DWG	SCALE 1"=4000'
DATE: 11-07-01	



LEGEND

FLAT CANYON COAL LEASE TRACT
RFDS AREA
SKYLINE MINE PERMIT AREA
HYDROLOGY STUDY AREA

■ STREAM
● SPRING
▲ WELL – MONITORING
MINE DISCHARGE
NPDES DISCHARGE POINTS
STREAM FLOW MONITORING SITE (FLUME OR HALF-ROUND)

FIGURE 3.4
LOCATION MAP AND HYDROLOGIC MONITORING POINTS

FILE: HYDRO1-2.DWG	SCALE 1" = 3200'
DATE: 10/13/2000	

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

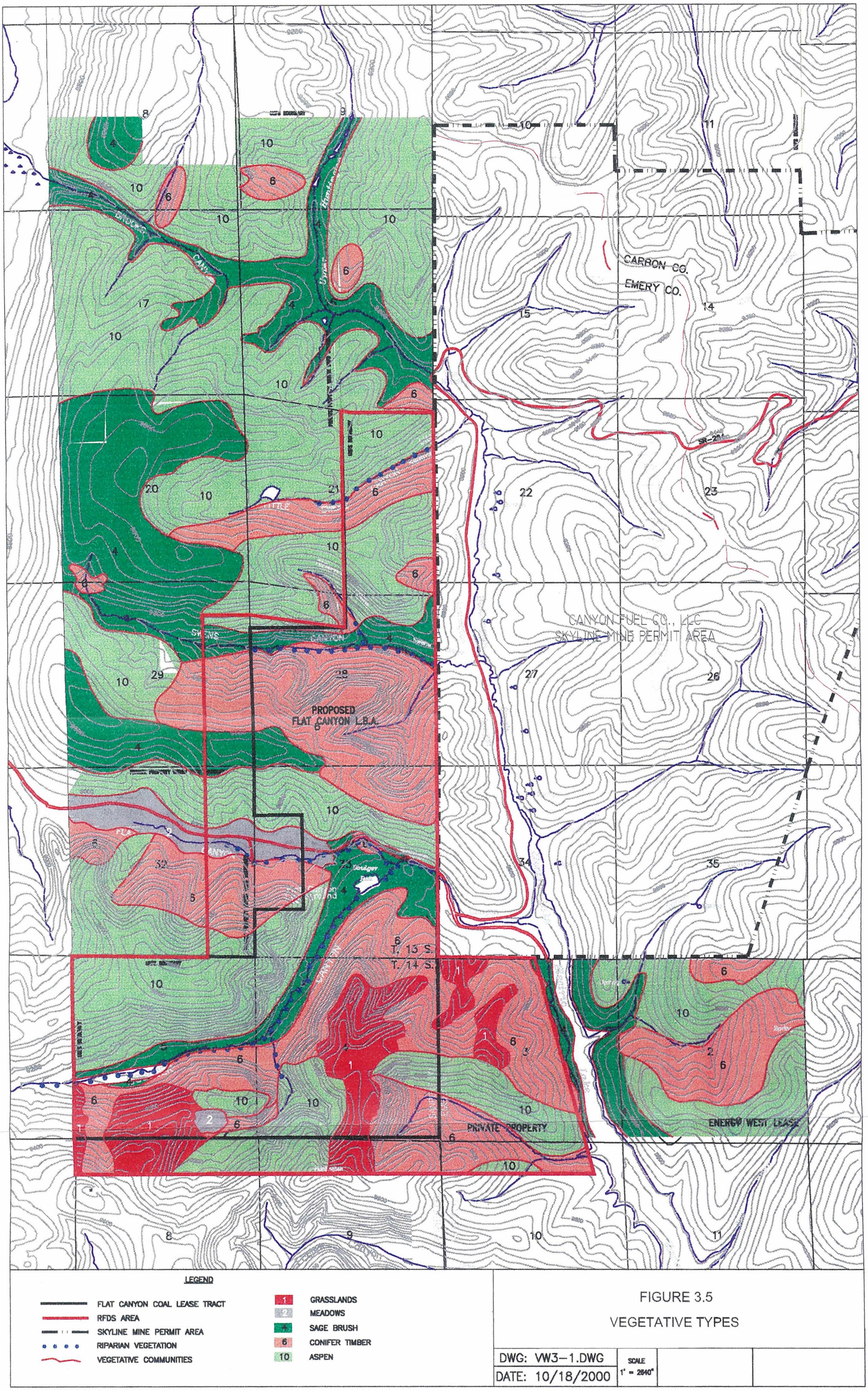


FIGURE 3.5

VEGETATIVE TYPES

DWG: VW3–1.DWG

DATE: 10/18/2000

SCALE 1" = 2640'

FLAT CANYON COAL LEASE TRACT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

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.

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 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.

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.

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.

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.

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 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).

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.

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.

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.

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.

- 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).

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.

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 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

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.

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.

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.

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.

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.

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.

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.

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 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.

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.

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

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.

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 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.

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.

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.

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 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 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.

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.

<u>Direct Effects</u>

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).

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.

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.

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 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.

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 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.

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 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 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).

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

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.

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)

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.

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.

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.

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 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.

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".

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 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

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).

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.

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.

The effects described above relative to subsidence would be irretrievable. Measures could be taken to mitigate the effects.

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.

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 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 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 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.

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.

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'.

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.

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 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.

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.

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.

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 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.

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.

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 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.

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.

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.

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.

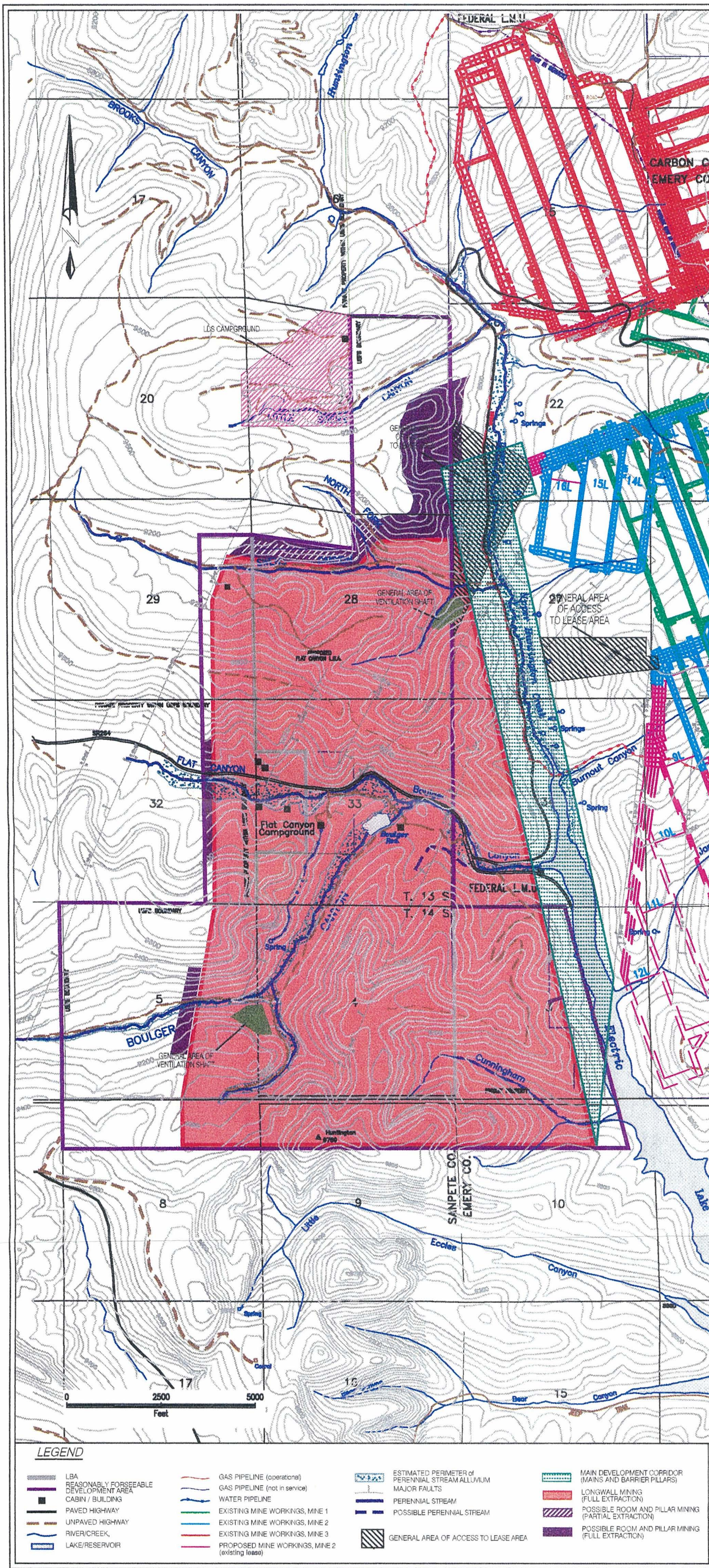
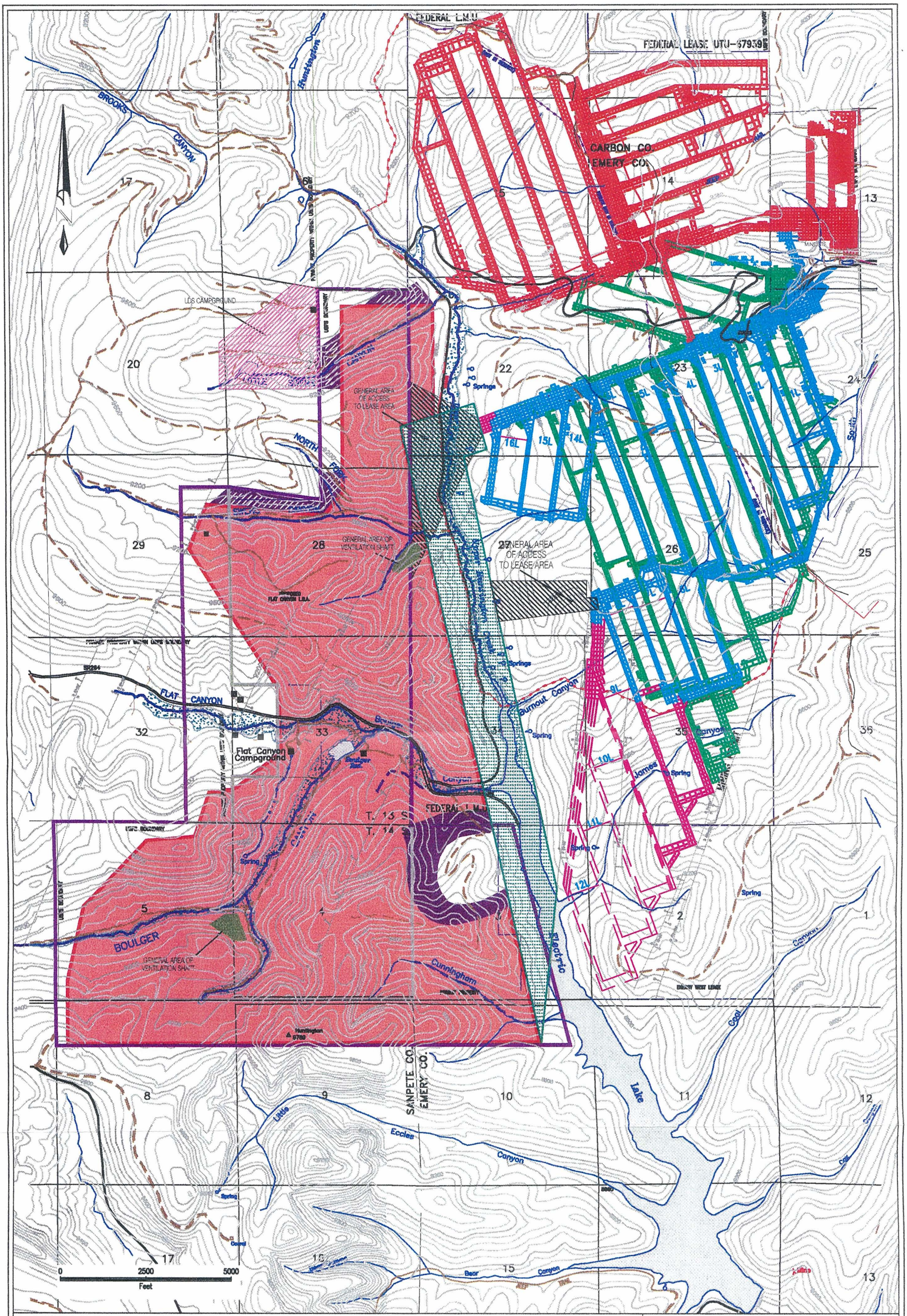


FIGURE 4.1

UPPER SEAM MINING SCENARIO ALTERNATIVE B and B'

FILE: MINING.DWG | SCALE 1" = 2640'
DATE: 10/17/2000



LEGEND

- LBA
- REASONABLY FORSEEABLE 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 lease)
- ESTIMATED PERIMETER of PERENNIAL STREAM ALLUVIUM
- MAJOR FAULTS
- PERENNIAL STREAM
- POSSIBLE PERENNIAL STREAM
- GENERAL AREA OF ACCESS TO LEASE AREA
- MAIN DEVELOPMENT CORRIDOR (MAINS AND BARRIER PILLARS)
- LONGWALL MINING (FULL EXTRACTION)
- POSSIBLE ROOM AND PILLAR MINING (PARTIAL EXTRACTION)
- POSSIBLE ROOM AND PILLAR MINING (FULL EXTRACTION)

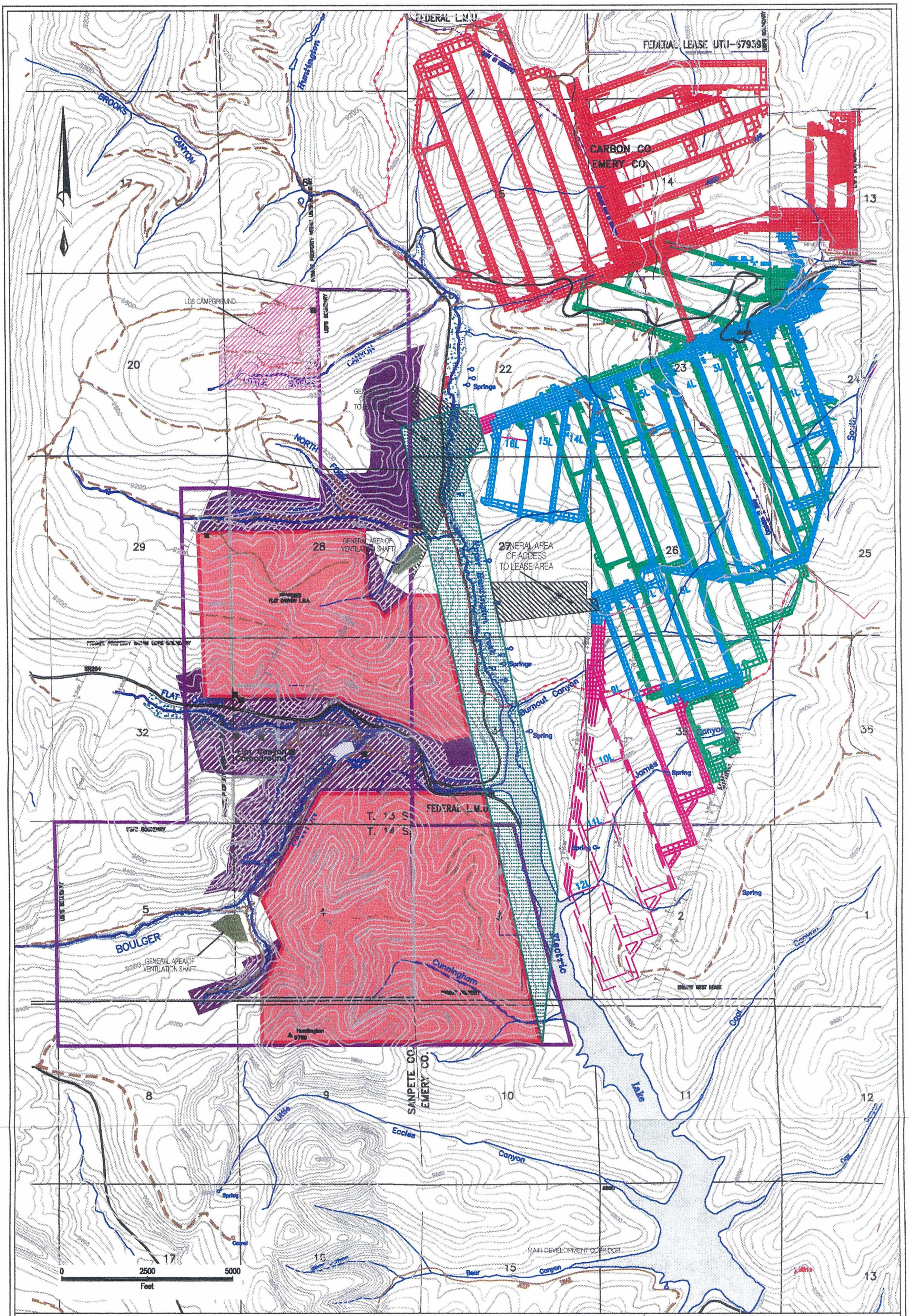
FIGURE 4.2

LOWER SEAM MINING SCENARIO ALTERNATIVE B and B'

FILE: MINING.DWG

DATE: 10/17/2000

SCALE 1" = 2640'



LEGEND

LBA	GAS PIPELINE (operational)
REASONABLY FORSEEABLE DEVELOPMENT AREA	GAS PIPELINE (not in service)
CABIN / BUILDING	WATER PIPELINE
PAVED HIGHWAY	EXISTING MINE WORKINGS, MINE 1
UNPAVED HIGHWAY	EXISTING MINE WORKINGS, MINE 2
RIVER/CREEK,	EXISTING MINE WORKINGS, MINE 3
LAKE/RESERVOIR	PROPOSED MINE WORKINGS, MINE 2 (existing lease)

ESTIMATED PERIMETER of PERENNIAL STREAM ALLUVIUM
MAJOR FAULTS
PERENNIAL STREAM
POSSIBLE PERENNIAL STREAM
GENERAL AREA OF ACCESS TO LEASE AREA

MAIN DEVELOPMENT CORRIDOR (MAINS AND BARRIER PILLARS)
LONGWALL MINING (FULL EXTRACTION)
POSSIBLE ROOM AND PILLAR MINING (PARTIAL EXTRACTION)
POSSIBLE ROOM AND PILLAR MINING (FULL EXTRACTION)

FIGURE 4.3

UPPER SEAM MINING SCENARIO ALTERNATIVE C

FILE: MINING.DWG
DATE: 10/17/2000
SCALE 1" = 2640'

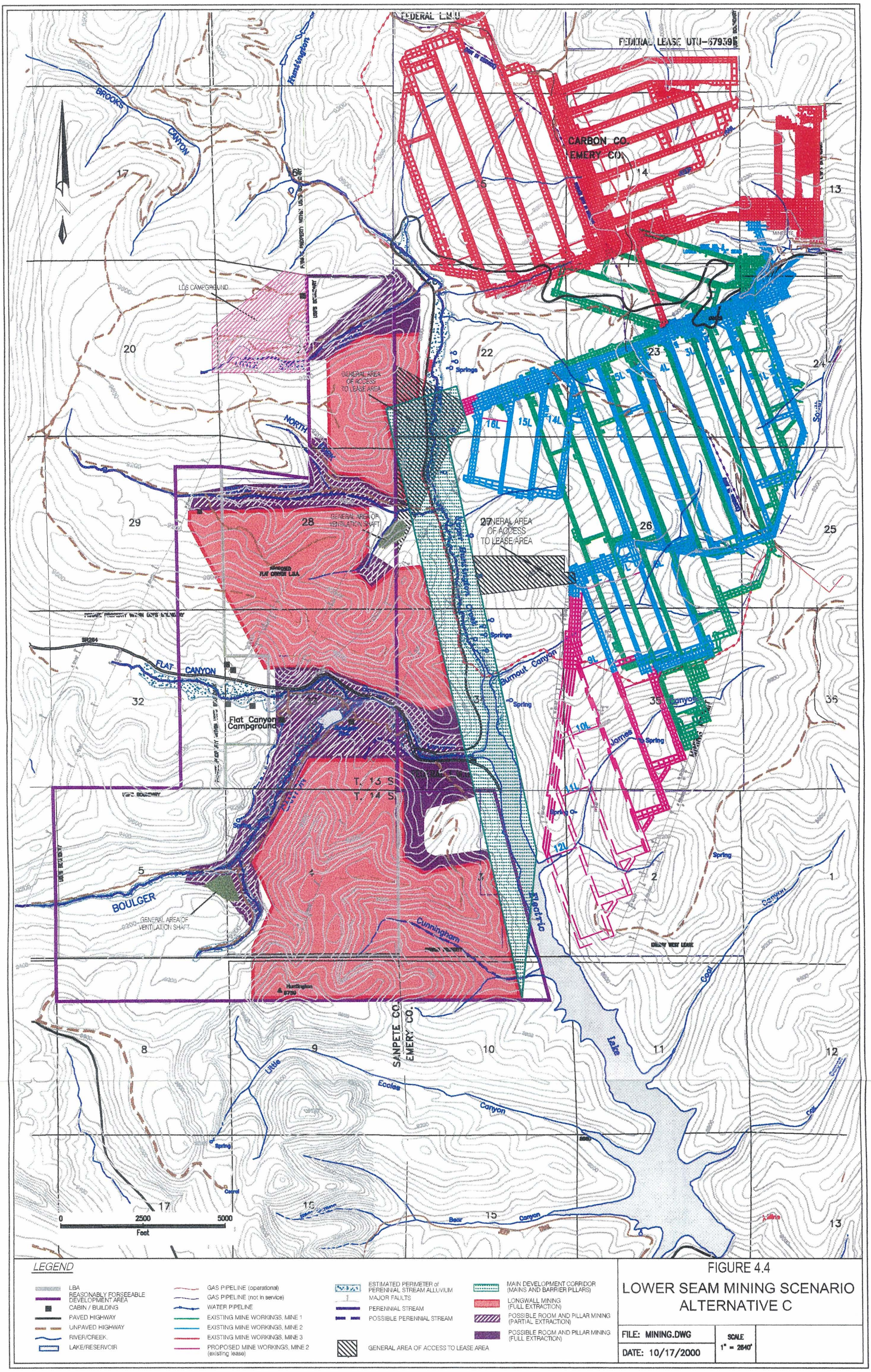
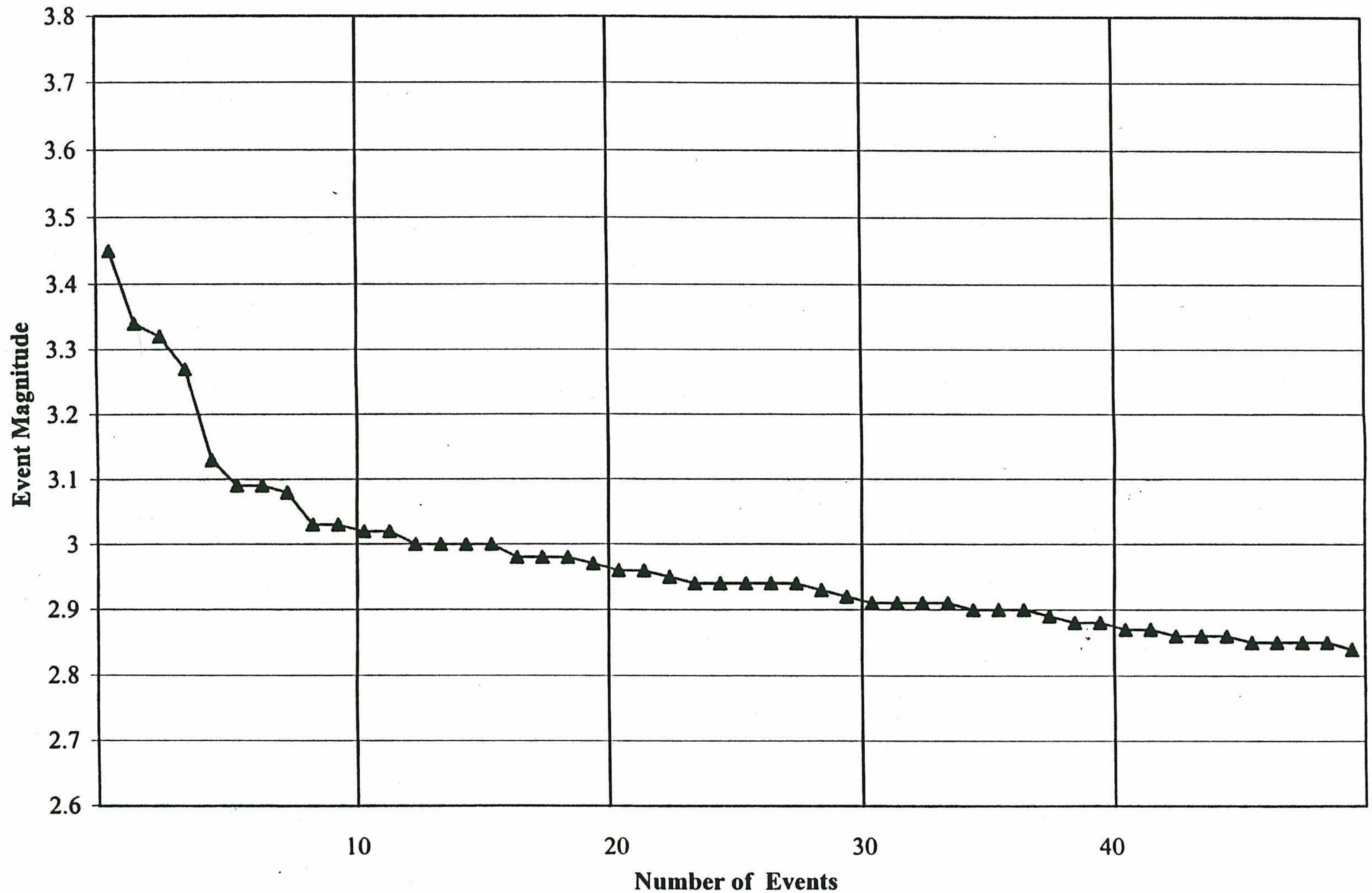


FIGURE 4.4
LOWER SEAM MINING SCENARIO
ALTERNATIVE C

Figure 4.5
Plot of Cummulative Number of Events Versus Event Magnitude for Skyline Mine



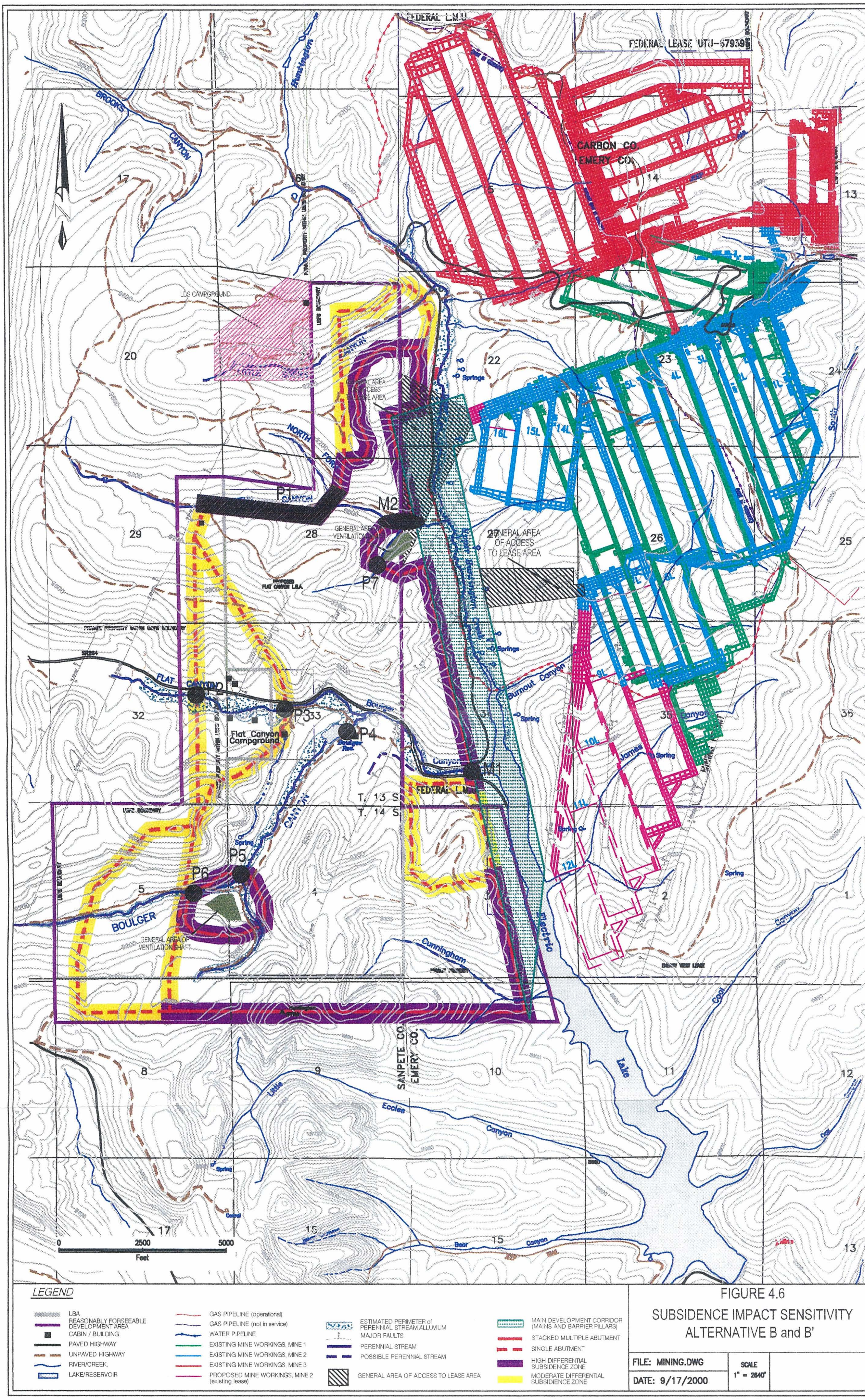
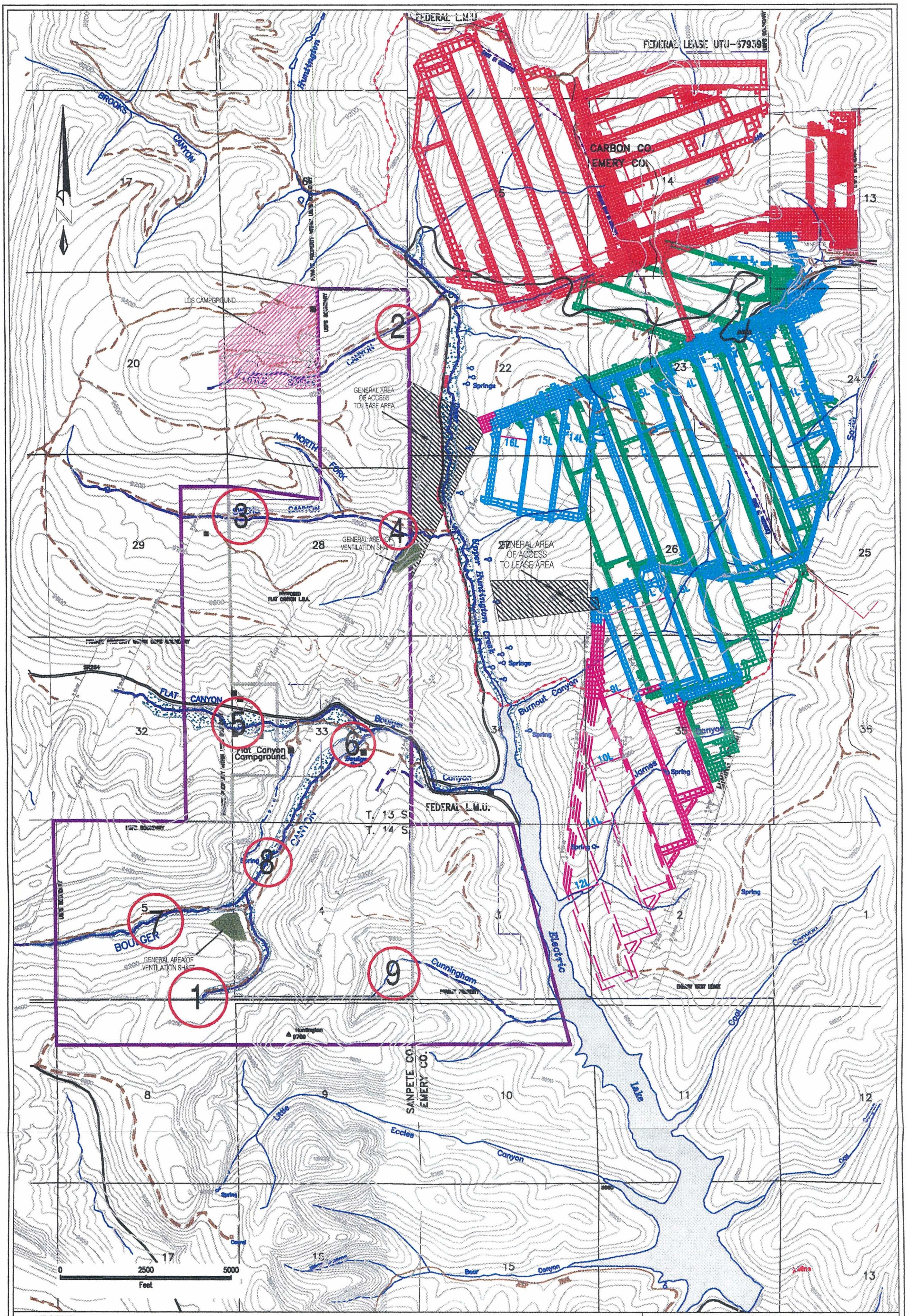


FIGURE 4.6
SUBSIDENCE IMPACT SENSITIVITY
ALTERNATIVE B and B'



LEGEND

Symbol	Description
	LBA
	REASONABLY FORSEEABLE 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 lease)
	GENERAL AREA OF ACCESS TO LEASE AREA
	ESTIMATED PERIMETER of PERENNIAL STREAM ALLUVIUM
	MAJOR FAULTS
	PERENNIAL STREAM
	POSSIBLE PERENNIAL STREAM
1	SUBSIDENCE PREDICTION POINT WITH AREA OF MINING INFLUENCE

FIGURE 4.7
SUBSIDENCE
PREDICTION POINTS
ALTERNATIVE B and B'

FILE: MINING.DWG
DATE: 10/17/2000
SCALE 1" = 2640'

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

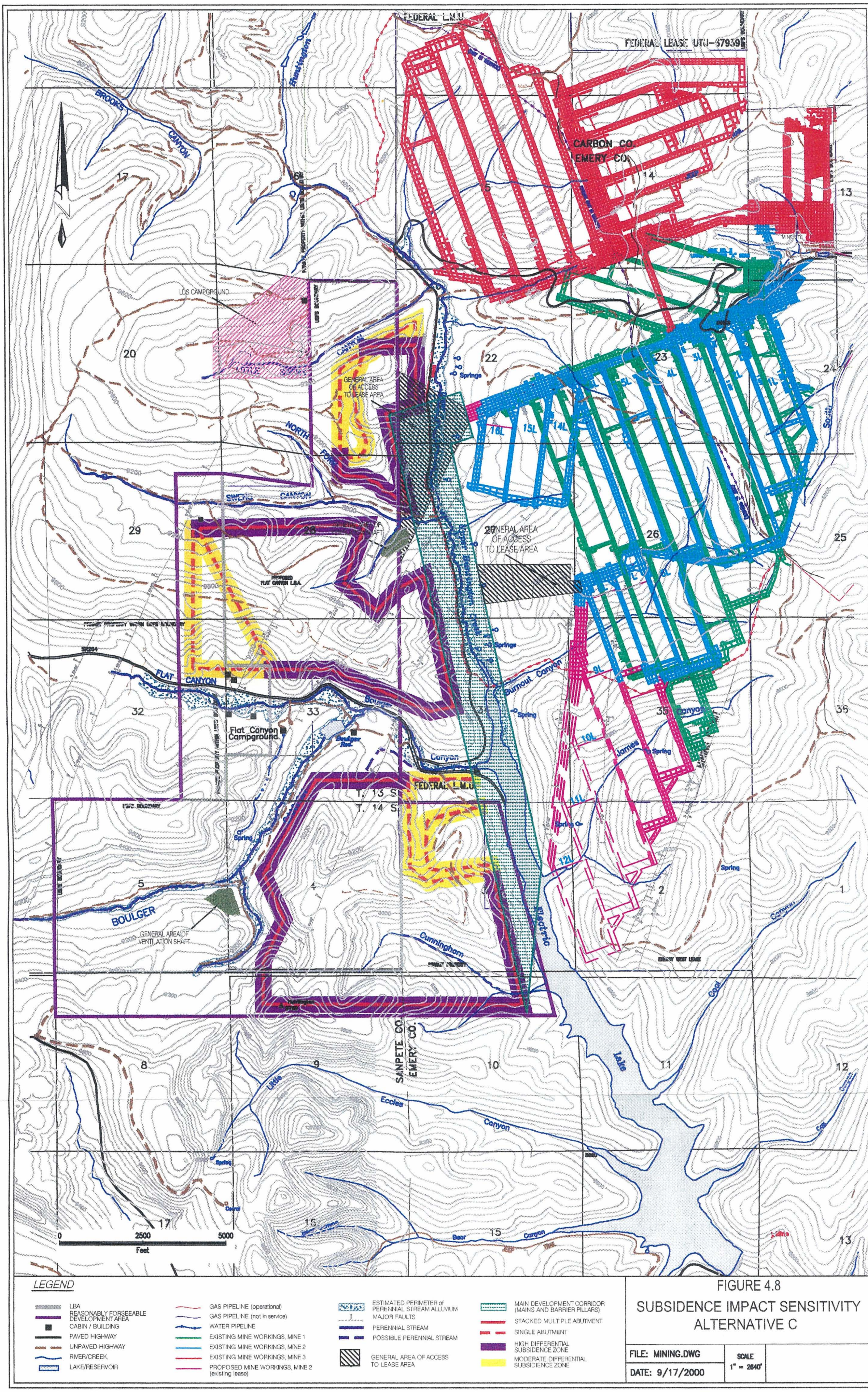
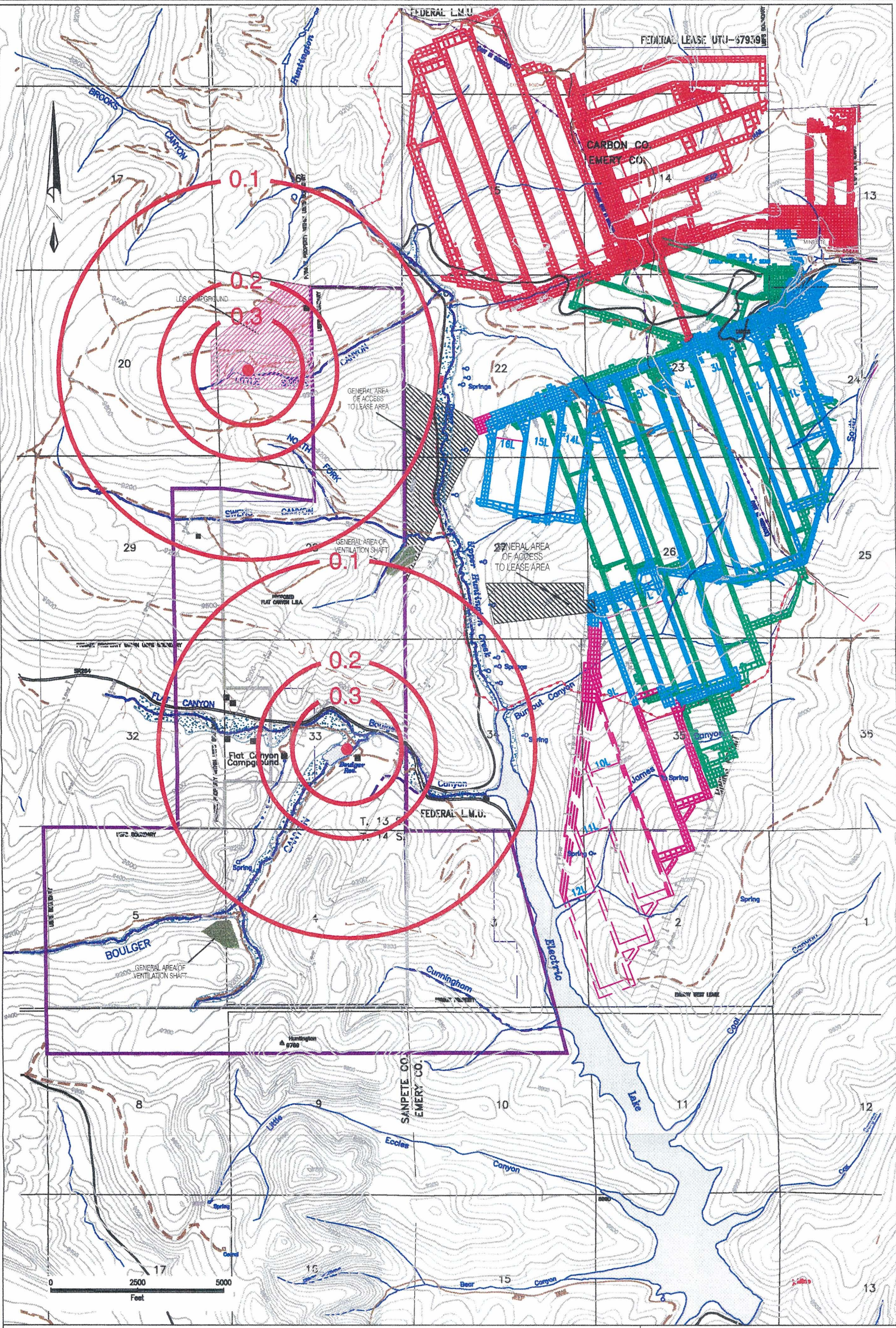


FIGURE 4.8
SUBSIDENCE IMPACT SENSITIVITY
ALTERNATIVE C



LEGEND

LBA	GAS PIPELINE (operational)	ESTIMATED PERIMETER of PERENNIAL STREAM ALLUVIUM
REASONABLY FORSEEABLE DEVELOPMENT AREA	GAS PIPELINE (not in service)	MAJOR FAULTS
CABIN / BUILDING	WATER PIPELINE	PERENNIAL STREAM
PAVED HIGHWAY	EXISTING MINE WORKINGS, MINE 1	POSSIBLE PERENNIAL STREAM
UNPAVED HIGHWAY	EXISTING MINE WORKINGS, MINE 2	MINING LIMITS FROM DAMS FOR DIFFERENT PEAK ACCELERATIONS (g) ALLOWED
RIVER/CREEK	EXISTING MINE WORKINGS, MINE 3	GENERAL AREA OF ACCESS TO LEASE AREA
LAKE/RESERVOIR	PROPOSED MINE WORKINGS, MINE 2 (existing lease)	

FIGURE 4.9

DAM SEISMIC ZONES

FILE: MINING.DWG
DATE: 9/17/2000
SCALE 1" = 2640'

FLAT CANYON COAL LEASE TRACT
DRAFT ENVIRONMENTAL IMPACT STATEMENT

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.

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 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 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.

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

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.

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). .

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 (4.1.13).

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

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.

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.

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

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 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 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.

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.

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.

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.

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.

CF

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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

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.

2.4 Impacts to threatened and 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.

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

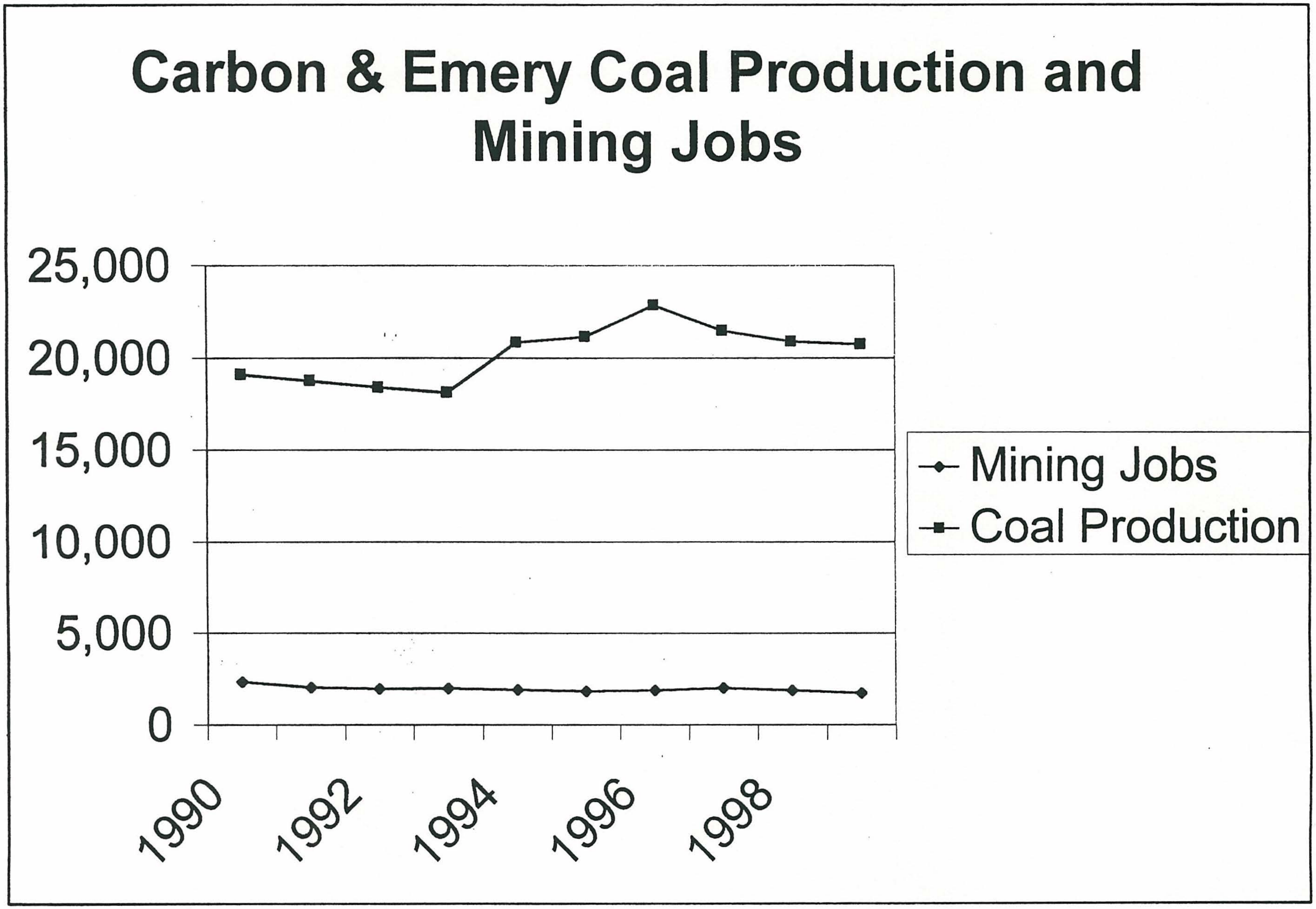
2.13 determine whether or not mine activities are causing a downward trend in specific populations of these plants and animals. Furthermore, the Forest Service must collect water quality data and output data from each spring and stream within the area if it is to successfully determine the affects of 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


Carbon & Emery Coal Production and Mining Jobs
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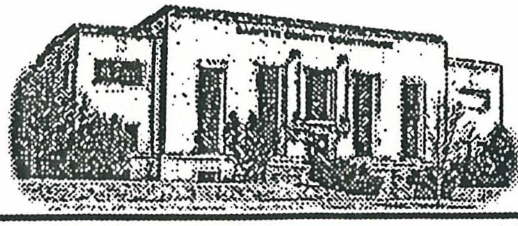

Assessor: Steven B. Kjar
Attorney: Ross C. Blackham
Auditor: Ilene B. Roth
Clerk: Kristine Frischkne
Recorder: Reed D. Hatch
Sheriff: Claude A. Pickett
Treasurer: Earl D. Clark

npete County Courthouse 160 North Main · Manti, Utah 84(

June 15, 2001

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

Letter 3

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

THE CHURCH OF
JESUS CHRIST
OF LATTER-DAY SAINTS

REAL ESTATE DIVISION
Twelfth Floor East
50 East North Temple Street
Salt Lake City, Utah 84150-6320
Phone: 1-801-240-3840
Facsimile: 1-801-240-2913

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

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Denver Federal Center, Building 56, Room 1003
P.O. Box 25007 (D-108)
Denver, Colorado 80225-0007

Letter 5

ER 01/437

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.

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
5.5 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
5.6 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

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

5.8 as fish communities. 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

5.10 example, wintering populations of bald eagle should be addressed in the final EIS. 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.

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.

5.15 The document should 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.

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.

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.

Sincerely,

Robert F. Stewart

Robert F. Stewart
Regional Environmental Officer

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES

Michael O. Leavitt
Governor
Kathleen Clarke
Executive Director
John Kimball
Division Director

1594 West North Temple, Suite 2110
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801-538-4700
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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:

Subsidence of Perennial Drainages

6.1 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.

6.5 Discharge of Produced Mine Water
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.

6.8 Loss of Boulger Reservoir
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.

Elaine J. Zieroth
June 26, 2001
Page 3

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

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

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,

for

Cynthia G. Cody
Chief, NEPA Unit
Office of Ecosystems Protection
and Remediation

Enclosure

cc: Elaine Suriano, EPA HQ

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.

7.3

4. **Stipulations Appendix C-Special Coal Lease Stipulations** —

#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

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.

7.6

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.

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.

7.7

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?

Environmental Protection Agency - Region 8 Comments
Flat Canyon Coal Lease Tract DEIS
June 28, 2001

7.8

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.

7.9

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.

7.10

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

expanded analysis should also include any mitigation, treatment or alternative changes that need to be implemented to achieve the TMDL.

7.11 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.

7.12 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.

7.13 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.

7.14 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.

7.15 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.

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.

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

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Acron ACA

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Jim Kohler
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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:

(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

Cynthia Cody
Director, NEPA Program
Office of Ecosystems Protection
and Remediation

cc: Mike Suflita, DOGM

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
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136 East South Temple, 12th Floor
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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

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

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6.2 Preparers of NorWest Mine Services, Inc. Project Technical Reports

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Conrad (Con) Houser – Co-Project Manager – NorWest;
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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.
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8.0 GLOSSARY

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.

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: T he l ocation o f t he l ongwall m ining m achine a nd a ctive p roduction m ining w ithin 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 l ogical grouping o f h abitat t ypes t o f acilitate r esource p laning a nd 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 f actors t hat inc lude, b ut a re no t l imited t o, b iological, p hysical, 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.

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.

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 feasibly 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.

(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;

(2) not traceable to any discrete or identifiable facility; and
(3) b etter c ontrolled t hrough t he us e o f Be st M anagement P ractices, inc luding 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 © 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.

8.0 GLOSSARY

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 manner consistent with the preservation of existing clean air resources. Specific emission limitations and other measures, by class, are detailed in the Clean Air Act (42 U.S.C. 1875, et seq.).

Production mining: Full-scale mining following the initial mining of access (development) entries; in contrast to development mining.

Project Area: The area of analysis including the Flat Canyon Tract area and adjacent 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.

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.

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.

8.0 GLOSSARY

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 w ould 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 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.

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.

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.

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.

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.

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		

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.	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.
Noxious Weeds: Noxious weed treatment is occurring	Present	Decreased noxious weed species densities and potential for

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.	Present	Year-round human activity. Decreased vegetation density and erosion of some areas where unauthorized motorized vehicle use occurring.
Recreation facilities include Boulger Reservoir, Flat Canyon Campground, and summer homes/cabins on private lands. See Recreation Section in Chapter 3 of EIS.	Present	Surface disturbance and human activity and occupation. Includes year-round use of buildings on private lands.

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.

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.

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.

Form 3400-12
(April 1986)

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.

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

[illegible] 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 [illegible]ing or design of facilities, timing of operations, and specification of [illegible]rim and final reclamation procedures. Lessor reserves to itself the [illegible], to lease, sell, or otherwise dispose of the surface or other mineral [illegible]posits 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 [illegible]der the laws of the State or the United States; accord all employees [illegible]plete freedom of purchase; pay all wages at least twice each month [illegible] lawful money of the United States; maintain a safe working [illegible]vironment in accordance with standard industry practices; restrict [illegible] workday to not more than 8 hours in any one day for underground [illegible]rkers, except in emergencies; and take measures necessary to protect [illegible]e 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. [illegible] (a) TRANSFERS

☒ This lease may be [illegible]ferred 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 -

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.

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.

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

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.

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.

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.

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.

DESCRIPTION OF EXPECTED MINING AND SUBSIDENCE (AFTER NORWEST, 2000)

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.

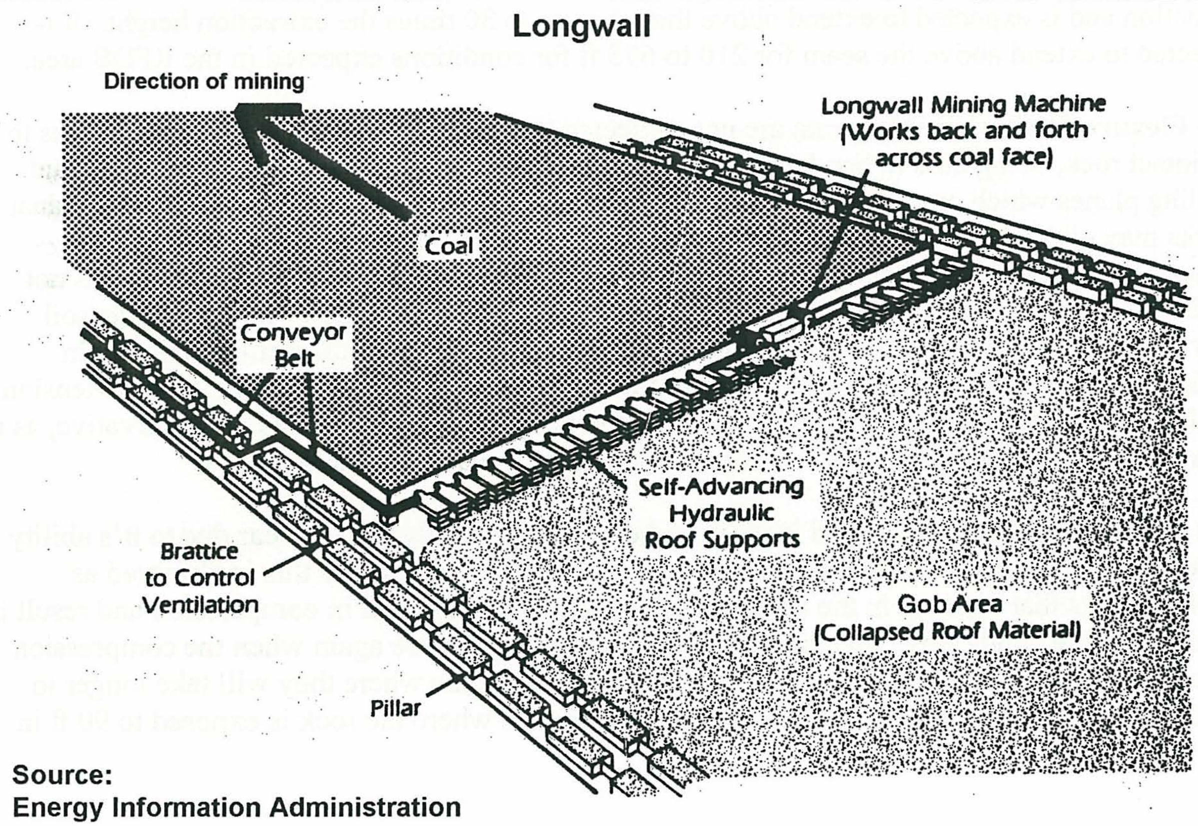
A numerical prediction method has been adopted for this study that enables the major parameters to be modified to simulate the behavior of a wide series of strata characteristics and mining conditions. The ability of this model to simulate more complex mining conditions and multiple seam mining enables 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.

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



Source:
Energy Information Administration

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 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.

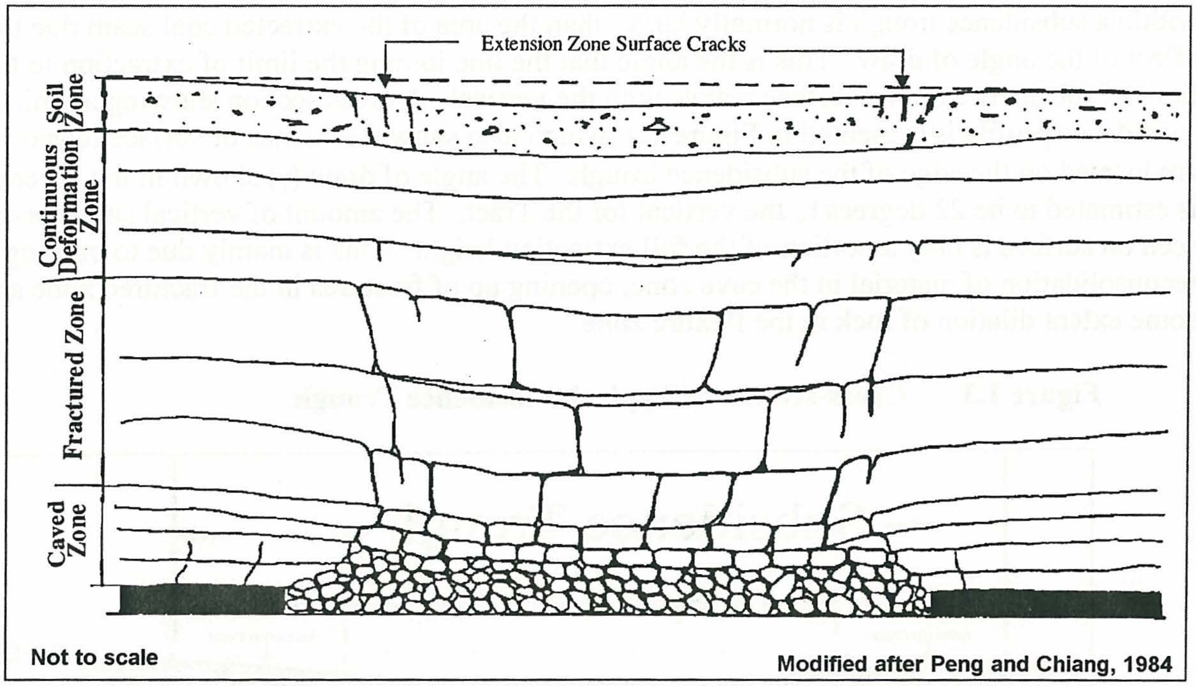
The Cave Zone where the roof rock fail in discrete blocks and fall into the void behind the longwall supports. This is immediate and continues upwards until the bulking of these rocks provides support to the strata above. This height of this zone is dependent upon the bulking ratio and height of extraction 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.

Figure 1.2 Overburden Subsidence Zones above a Longwall Panel



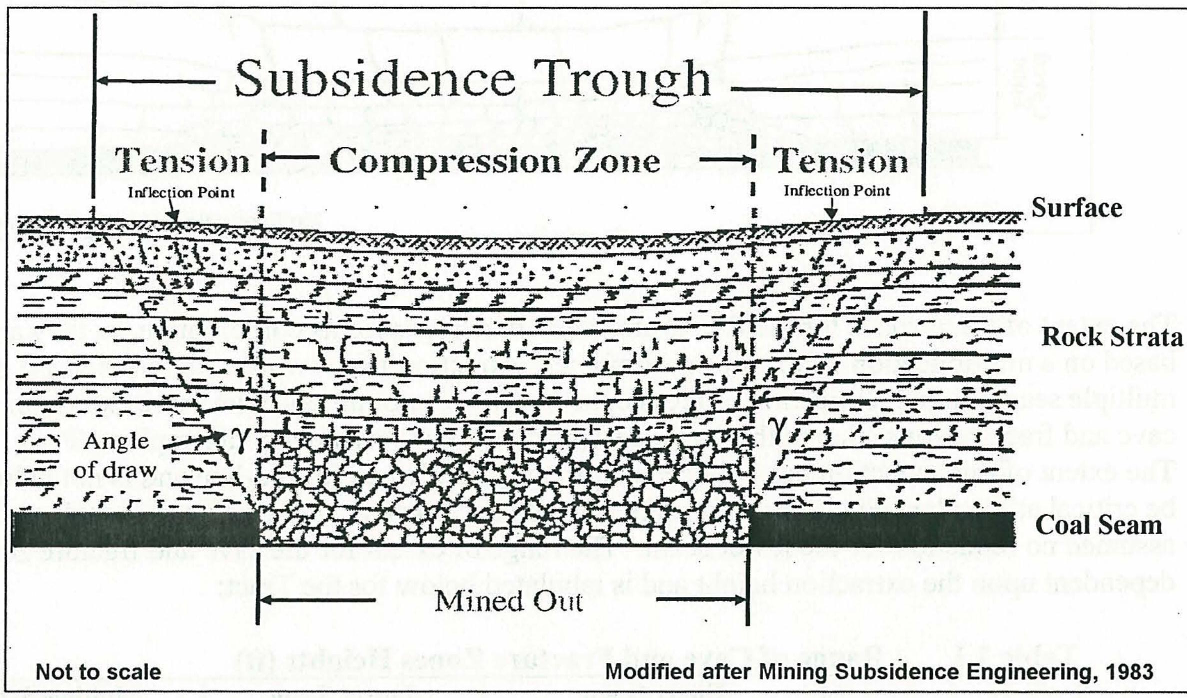
The extent of these zones for the RFDS area should be regarded as conservative, as they are based on a multiplication factor for the combined extraction from two seams. In the case of multiple seam mining, extraction of the second seam does not produce the same extent for the cave and fracture zones 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

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.

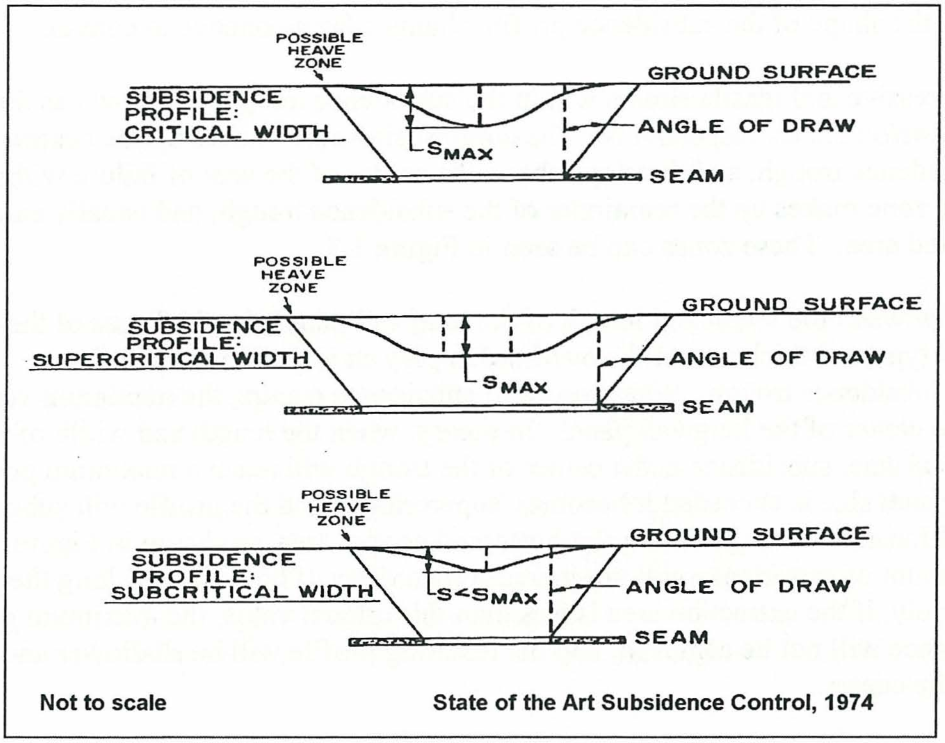
Horizontal movement or displacement also occurs within the subsidence trough, as points on the surface tend to move horizontally toward the center. For adjacent points near the center, the horizontal distance between points is reduced resulting in compressive strains at the surface. The amount of compression 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 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.

Figure 1.4 Critical, Supercritical, and Subcritical Widths

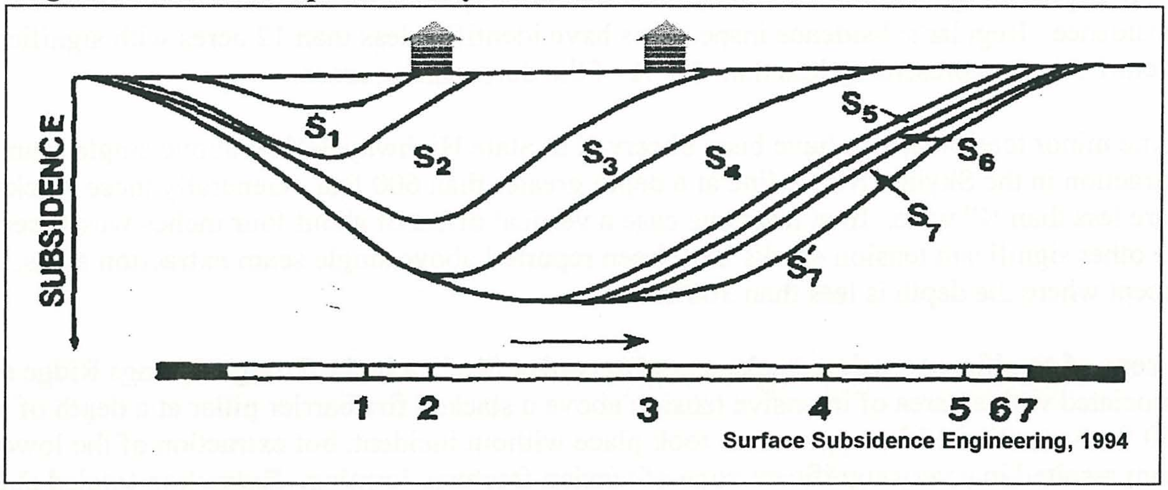


The development of a subsidence trough is a progressive event. When a longwall panel begins operation, initial surface subsidence will result in a subcritical trough. As the panel advances, the trough reaches critical dimensions, and ultimately flattens out as supercritical conditions are reached. A 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.

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 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.

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.

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 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.

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 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.

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:

- 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, 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 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.

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).

Comparison of Skyline Mine Discharge Water Quality to State of Utah Beneficial Use Standards (UAC R317-2)

Parameter	Unit	Beneficial Use Standards: 1C Domestic	2A, 2B Recreation	3A 4-Day Aquatic Wildlife	4 Agriculture	CS-12 n	CS-12 Max	CS-12 Min	CS-12 Average	CS-14 n	CS-14 Max	CS-14 Min	CS-14 Average	UPDES Outfall n	UPDES Outfall Max	UPDES Outfall Min	UPDES Outfall 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	1C Domestic	2A, 2B Recreation	3A 4-Day Aquatic Wildlife	4 Agriculture
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.

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.

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.

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.

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, 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.

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.

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.

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

13 August 2014

Canyon Fuel Company, LLC
Skyline Mine
Helper, Utah

PETERSEN HYDROLOGIC, LLC
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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 contiguous with the existing permit area and located west of Huntington Creek in upper Huntington Canyon.

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.

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).

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:

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.

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.

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.

Groundwater mean residence times were determined using methods described by Pearson and Hanshaw (1970), Fontes (1980), and Mookes (1980).

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 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

Precipitation measured at the Skyline Mine surface facility between 1985 and 2014 has ranged from 17.2 inches to 29.4 inches per year (Canyon Fuel Company, 2014). Monthly average temperatures at the mine site range from 8.0 to 74.4 ºF.

Climatic conditions in the Flat Canyon Tract area 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.

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.

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.

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.

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.

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.

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 is intercepted in Blackhawk Formation sandstone paleochannels in the mine roof in newly opened mining areas. These groundwater inflows are commonly short lived. Much larger inflows were encountered during mining operations in the Mine 3 area 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 the “Diagonal Fault”) 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 communication, Doug Johnson, 2001).

The degree to which the water in the sump may have been contaminated with tritium from other mine floor waters which were observed to be running into 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

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).

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:

$$CO_2 + H_2O = H_2CO_3 \text{ (carbonic acid)} \qquad \text{(Equation 1)}$$

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:

$$CaCO_3 \text{ (calcite)} + H^+ = Ca^{2+} + HCO_3^- \qquad \text{(Equation 3)}$$

And

$$CaMg(CO_3)_2 \text{ (dolomite)} + 2H^+ = Ca^{2+} + Mg^{2+} + 2\,HCO_3^- \qquad \text{(Equation 4)}$$

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:

$CaSO_4 \cdot 2H_2O_{\text{(gypsum)}} = Ca^{2+} + 2H_2O$ (Equation 5)

$NaCl_{\text{(halite)}} = Na^{+} + Cl^{-}$ (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:

$Ca^{2+} + \text{Na-clay} = 2Na^{+} + \text{Ca-Clay}$ (Equation 7)

Ion exchange may also occur on zeolite minerals such as the sodium zeolite analcime according to:

$2NaAlSi_2O_6 \cdot H_2O + Ca^{2+} = Ca(AlSi_2O6)_2 \cdot H_2O + 2Na^{+}$ (Equation 8)

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).

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 (Mine 3, 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).

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. 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, it is generally not possible to create meaningful potentiometric surface contour maps of the perched 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.

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 5). 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 W-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.

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.

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 flows into the upper Gooseberry Creek drainage, which is part of the Price River drainage (Figure 2).

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

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 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, ongoing frequent discharge measurements have been taken 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 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.

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.

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

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.

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.

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 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) substantial fault-related groundwater inflows could occur where mine openings intersect faults or fracture systems. 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. Based on the magnitude of historic fault-related inflows at the Skyline Mine, there is the potential for inflows in the Flat Canyon Tract to be as large or perhaps even larger than those encountered to date in the Skyline Mine.

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 portion of Mine 3 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 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 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, <u>is an area of no significant increase in vertical hydraulic conductivity</u>. 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 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 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 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).

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 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 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.

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.

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.

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 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 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.

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.

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.

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.

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
32-278	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)

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

Table 7 Recommended groundwater operational water quality parameters.

Field Measurements	Reported as
pH	pH units
Specific Conductivity	µS/cm @ 25ºC
Temperature	ºC
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

Table 8 Recommended surface water operational water quality parameters.

Field Measurements	**Reported as**
pH	pH units
Specific Conductivity	µS/cm @ 25ºC
Temperature	ºC
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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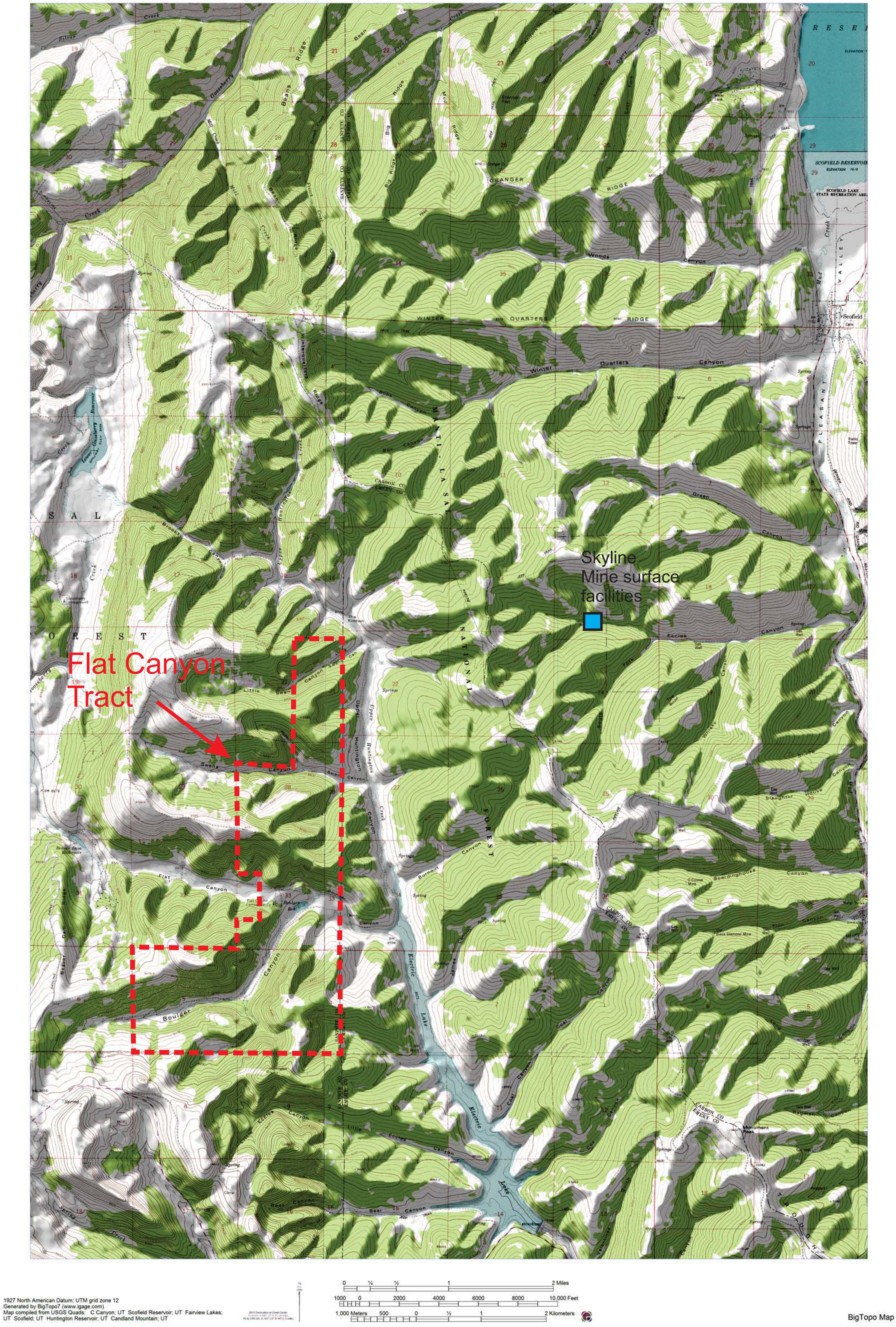


Figure 1 Locations of the Skyline Mine and Flat Canyon area.

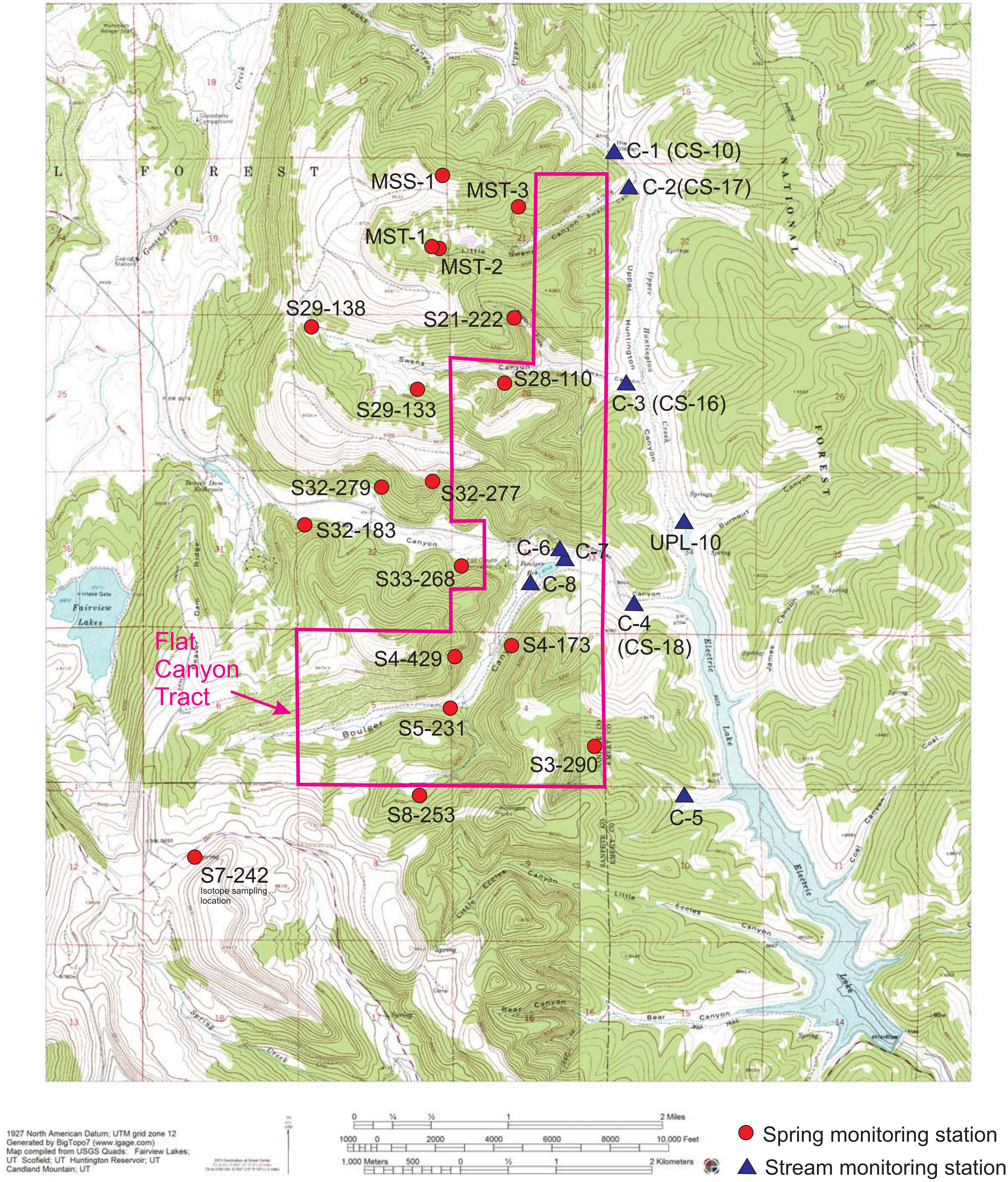
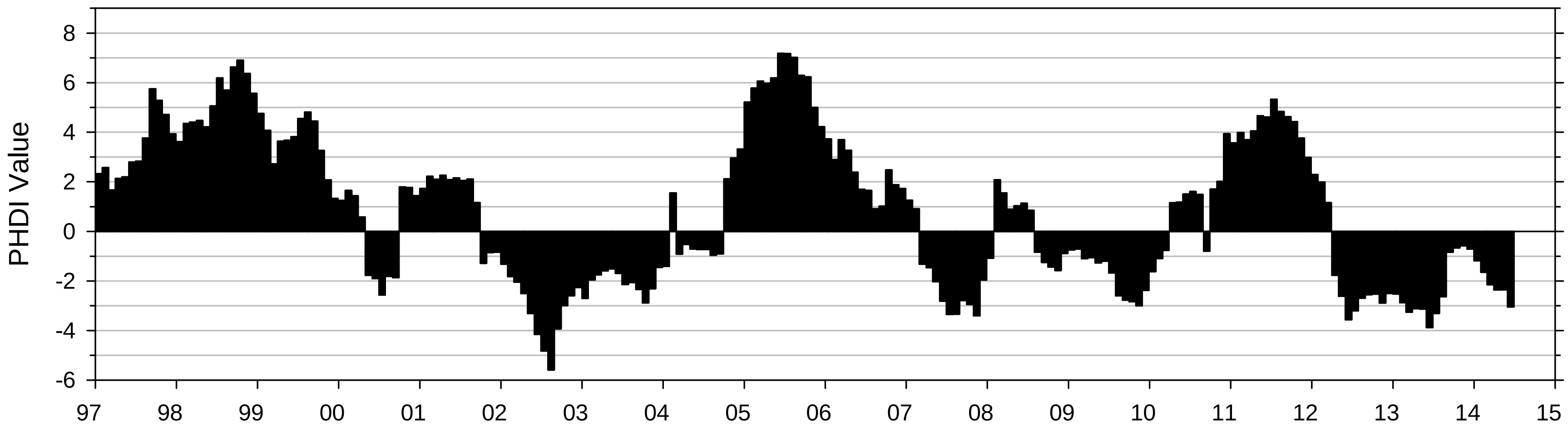
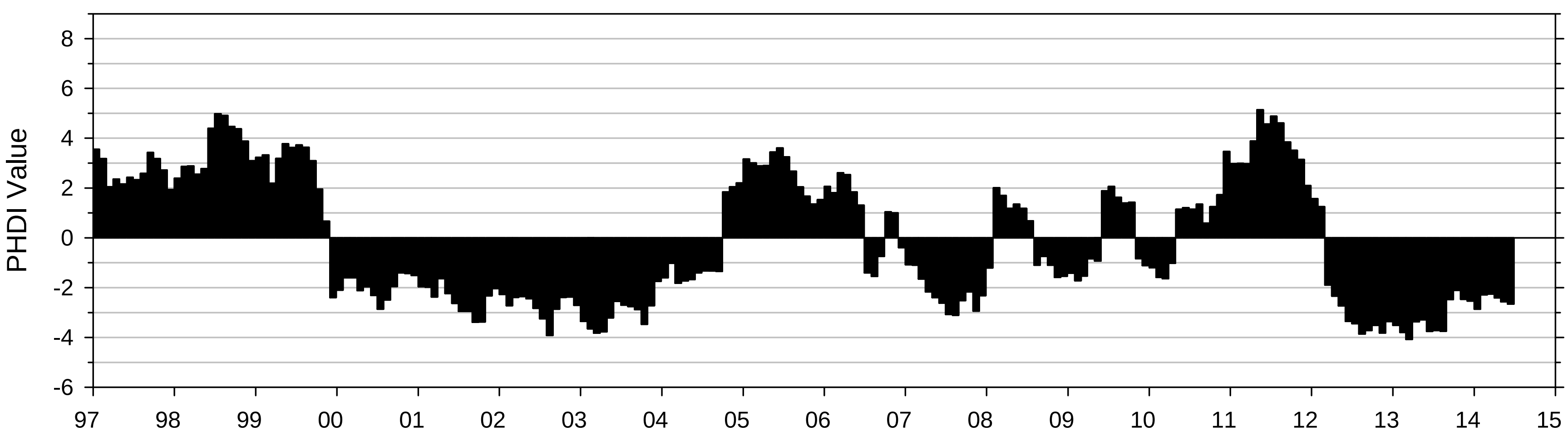


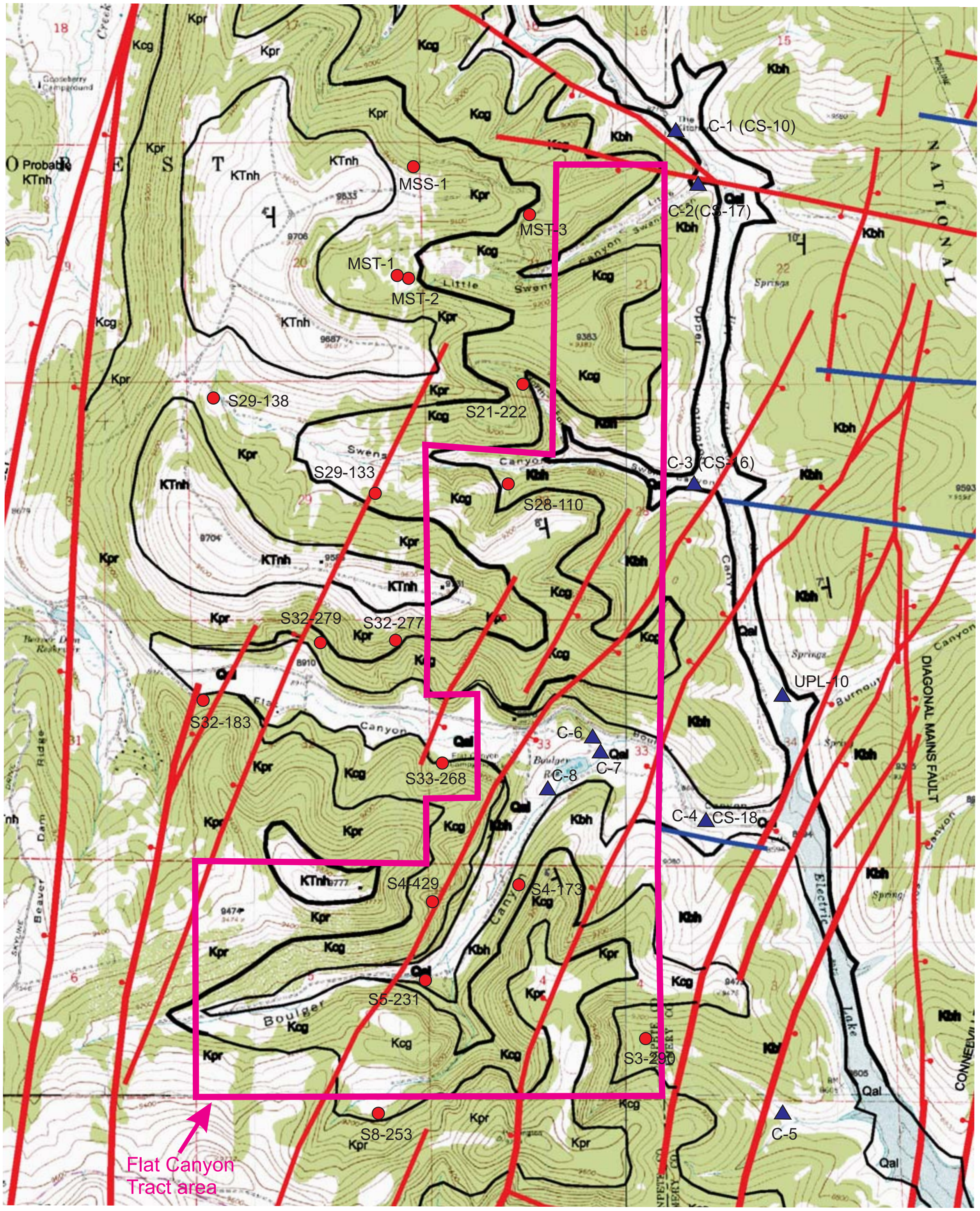
Figure 2 Baseline monitoring station locations.





-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

Figure 3 Plots of Palmer Hydrologic Drought Index for Utah Regions 4 and 5.



Qal - Quaternary alluvium
Tknh - North Horn Formation (Cretaceous/Tertiary)
Kpr - Price River Formation (Cretaceous)
Kc - Castlegate Sandstone (Cretaceous)
Kbh - Blackhawk Formation (Cretaceous)

down up Fault

North

0 0.5 1.0
1 mile

Figure 4 Generalized geologic map of the Flat Canyon area.

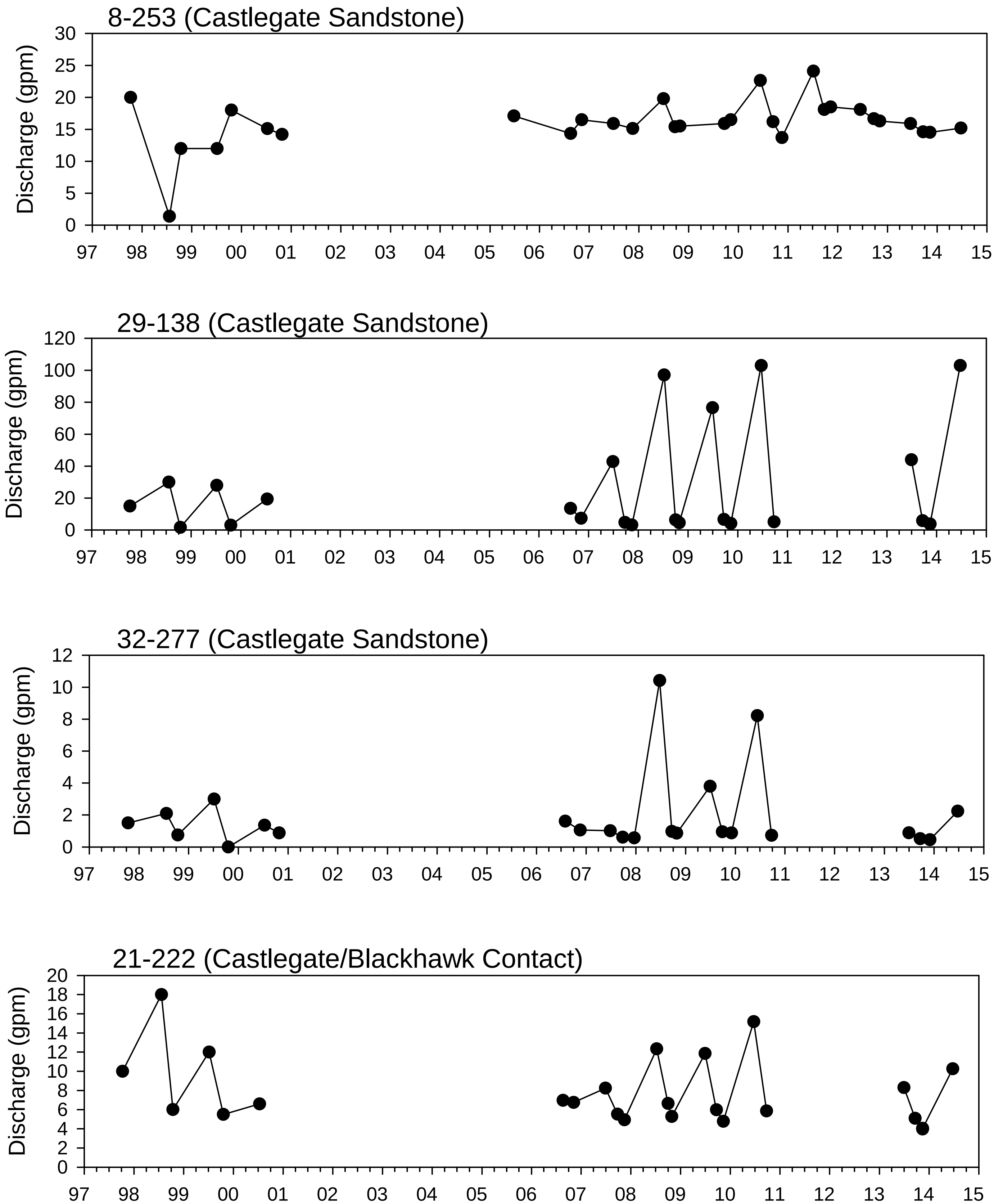
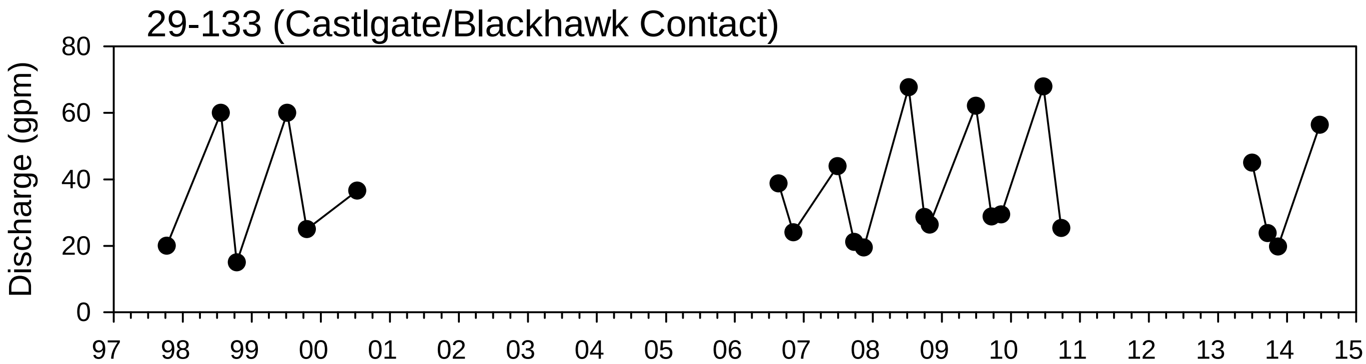
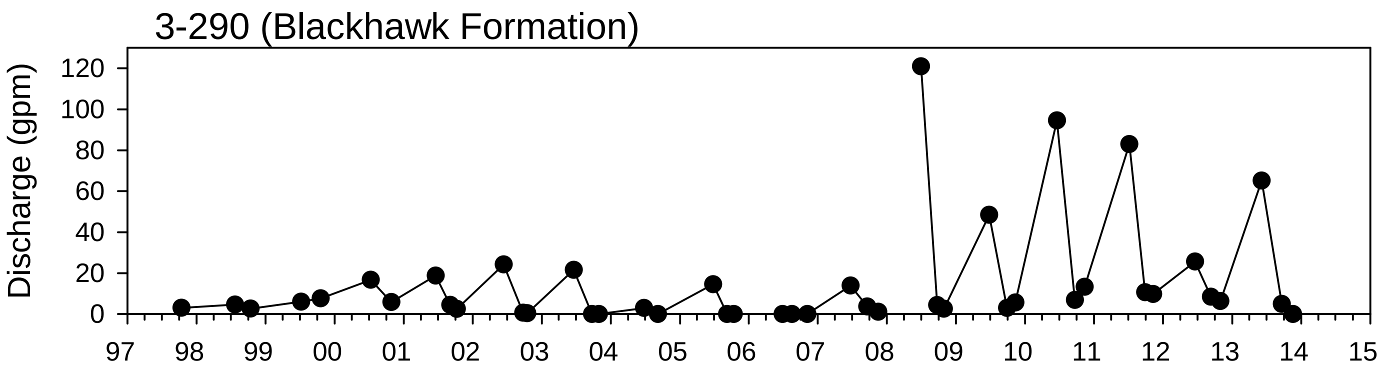
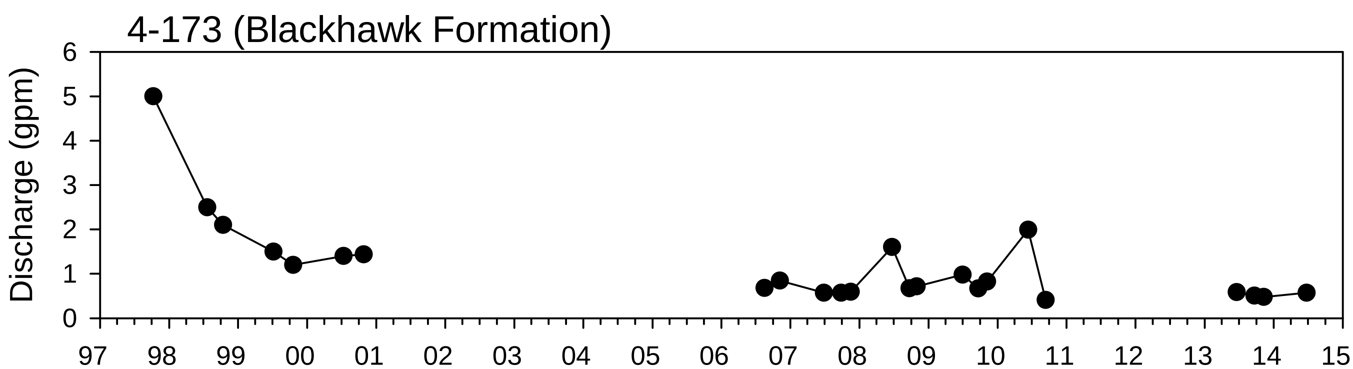


Figure 5 Discharge hydrographs for springs in the Flat Canyon area.





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.



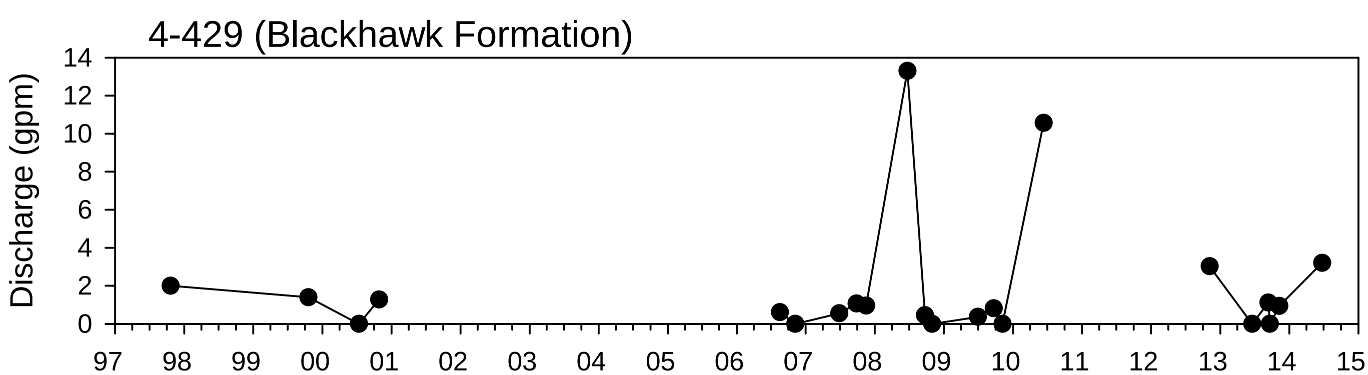
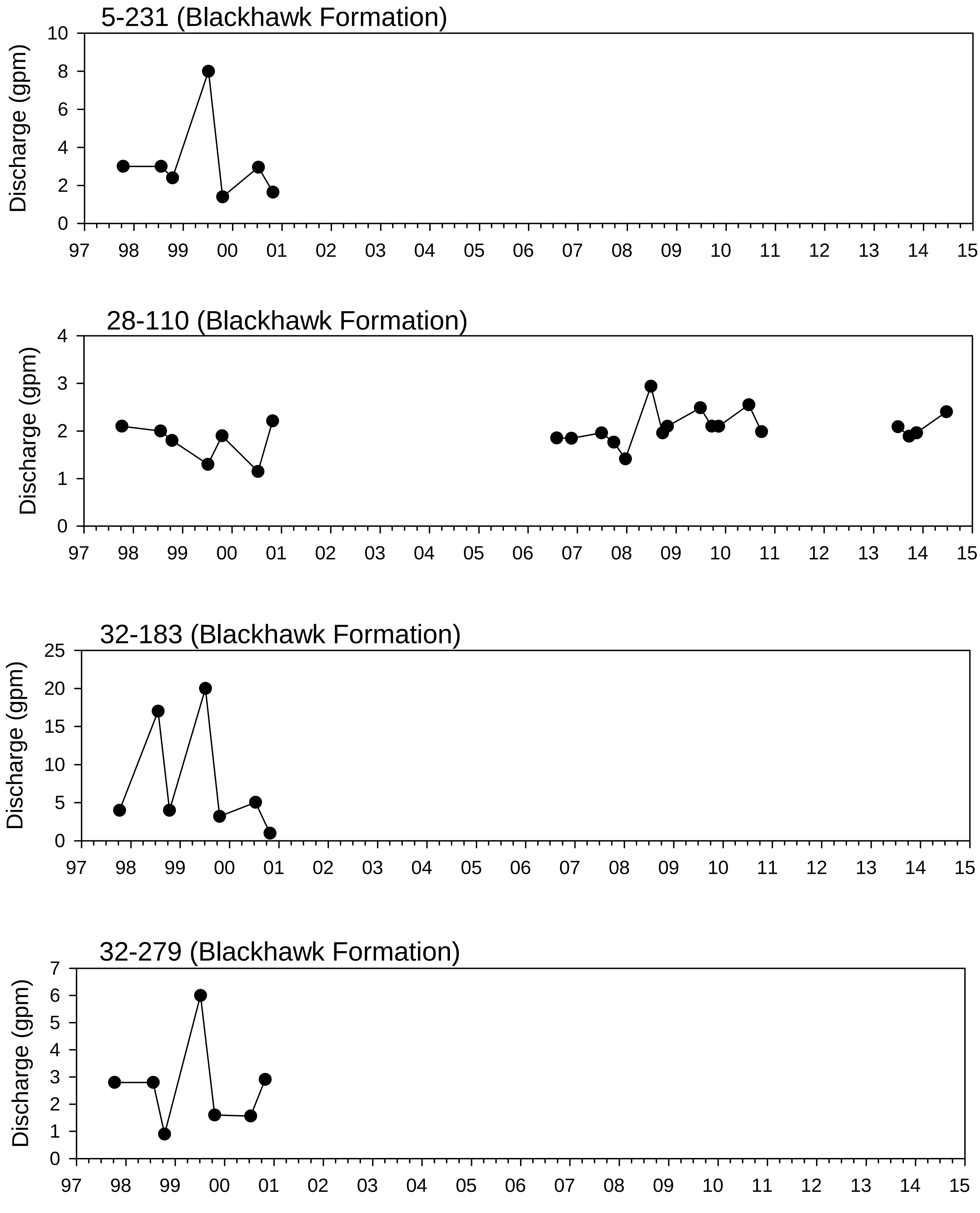


Figure 5 (continued).



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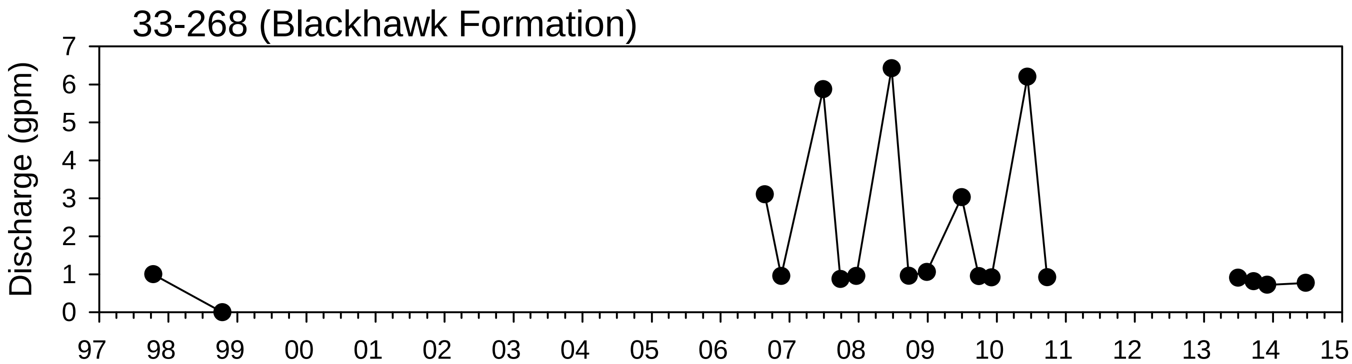


Figure 5 (continued).

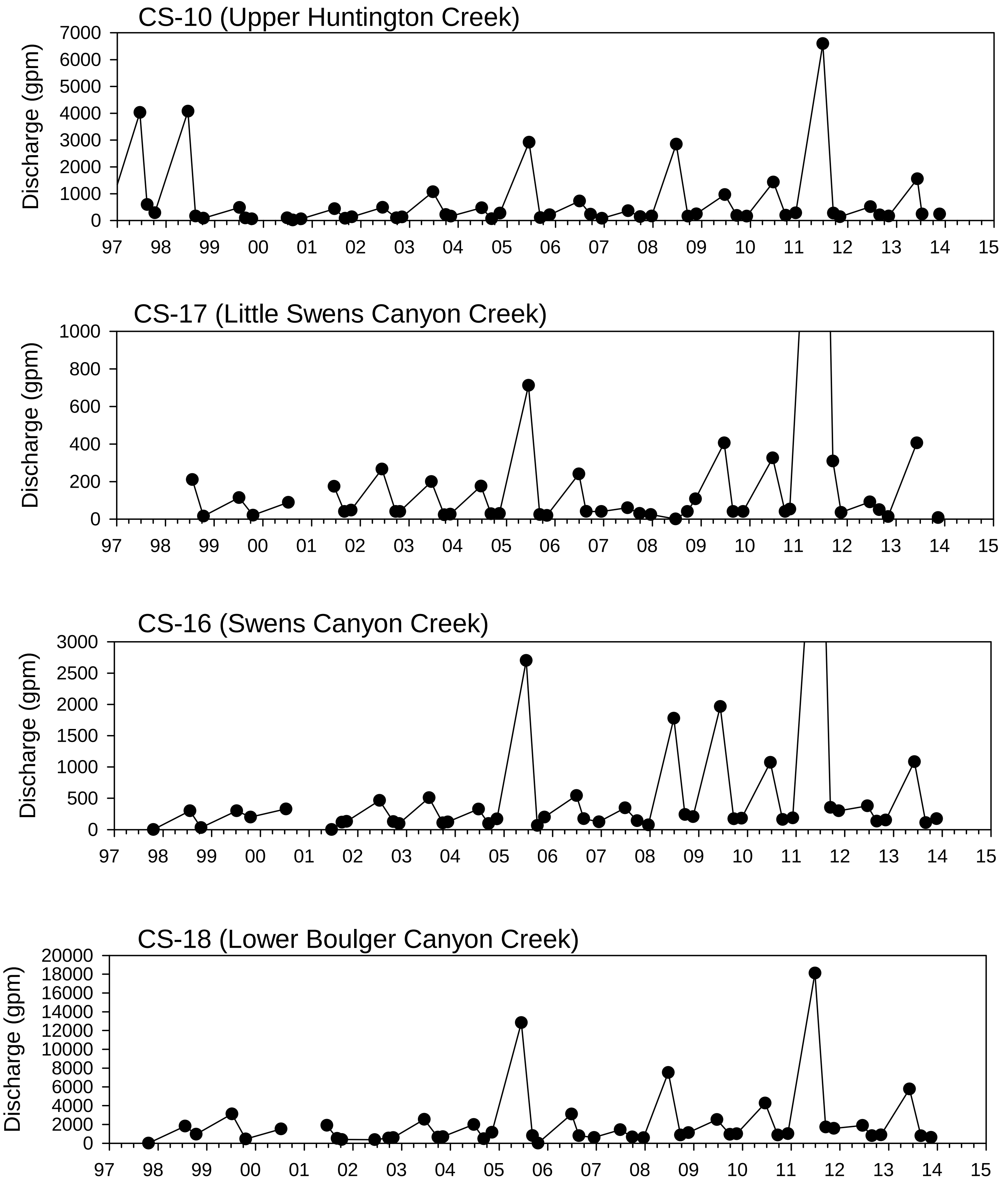
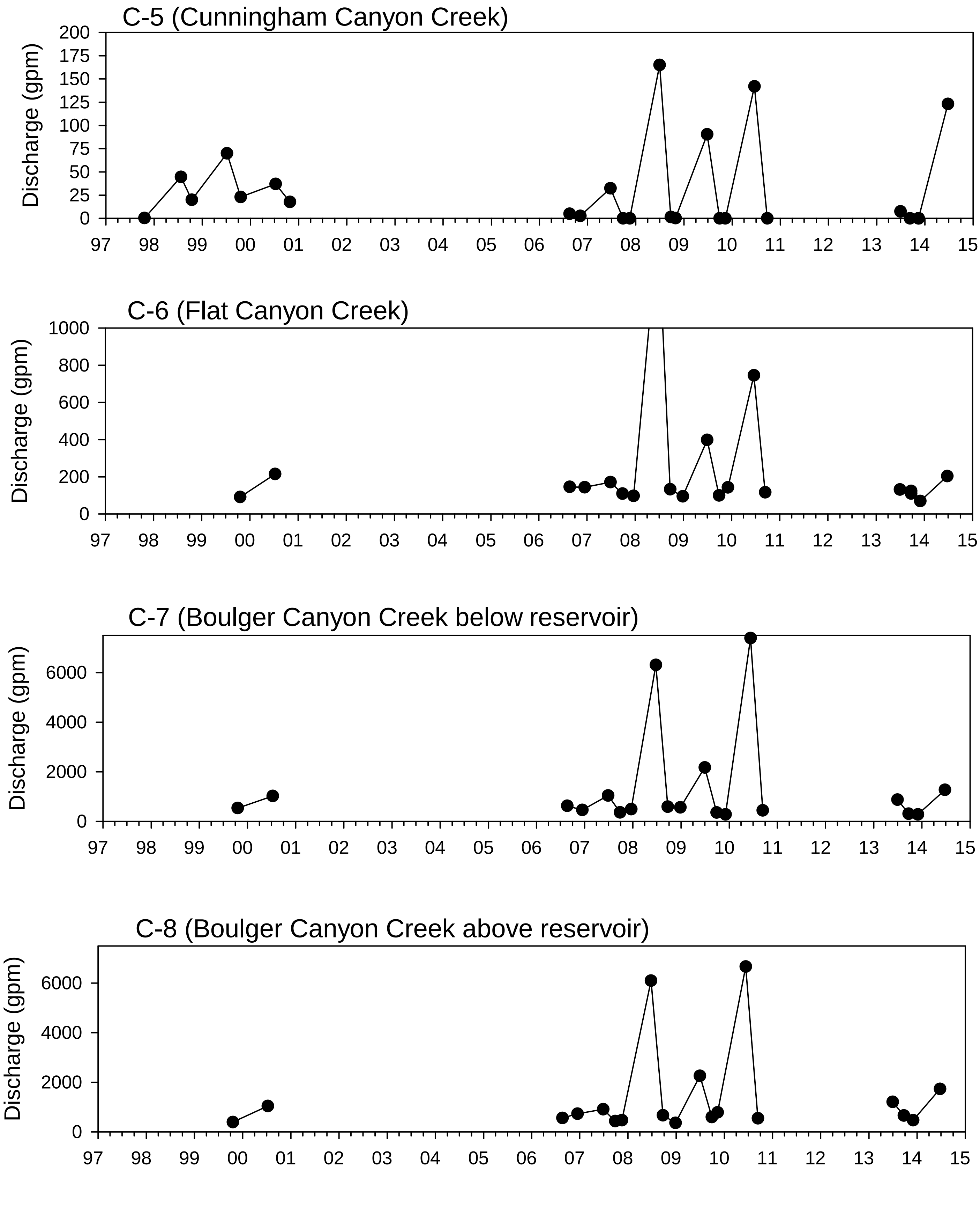


Figure 6 Discharge hydrographs for streams in the Flat Canyon area.



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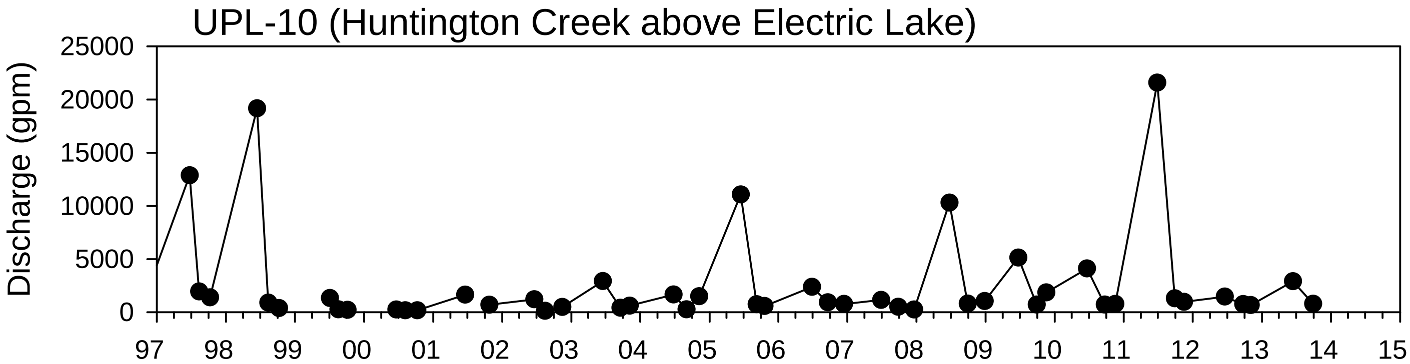

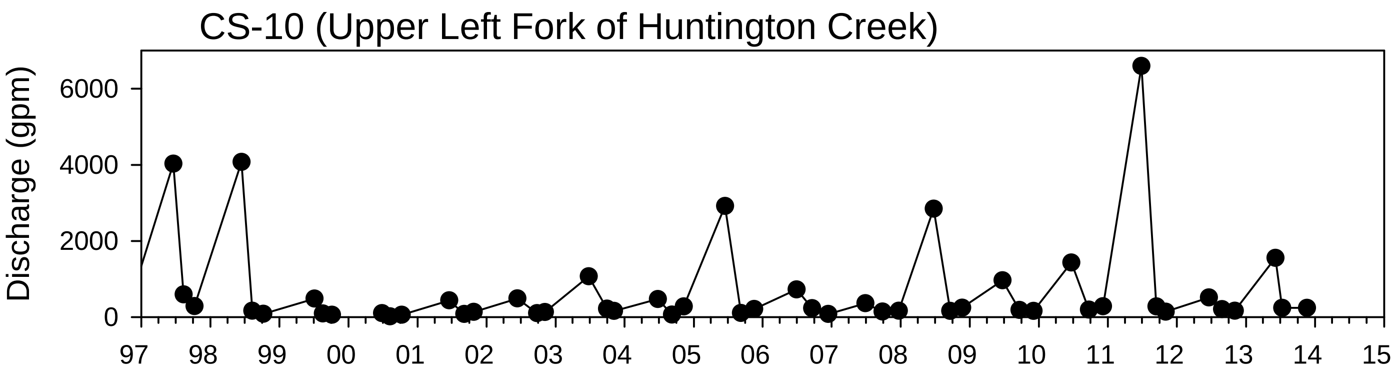

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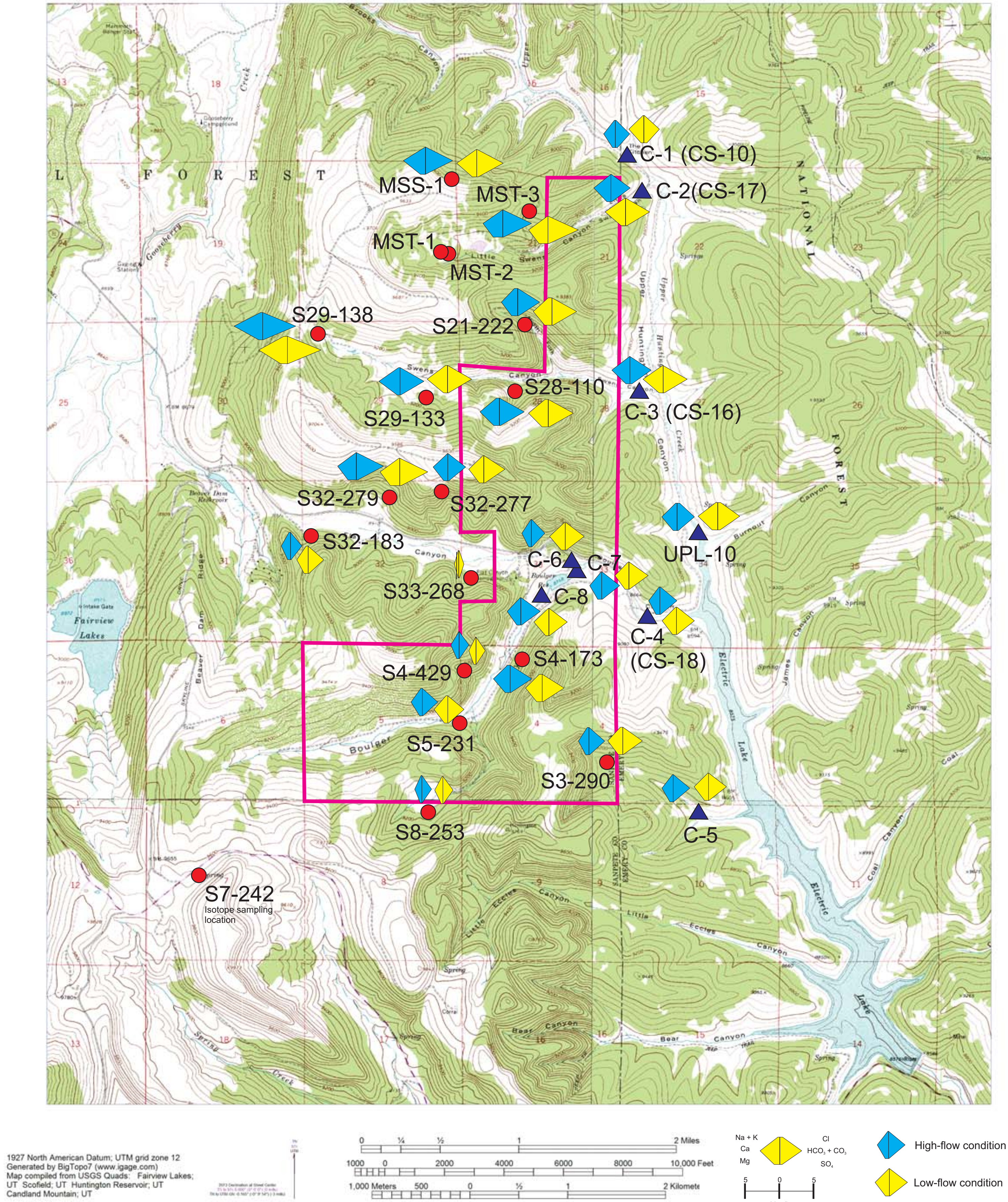


Figure 7 Stiff diagrams for high-flow and low-flow conditions.

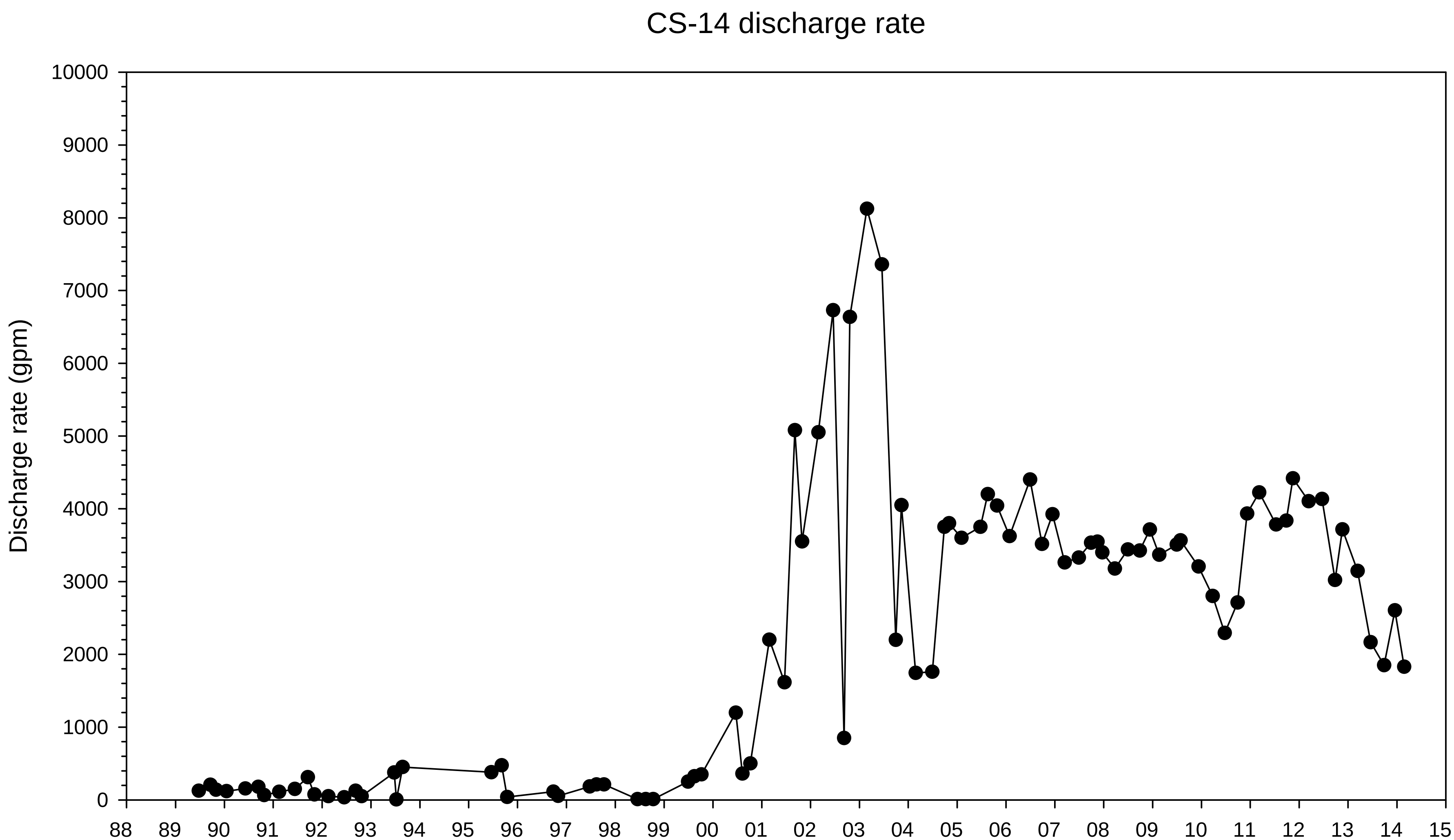


Figure 8 Discharge rates from CS-14 at the Skyline Mine.

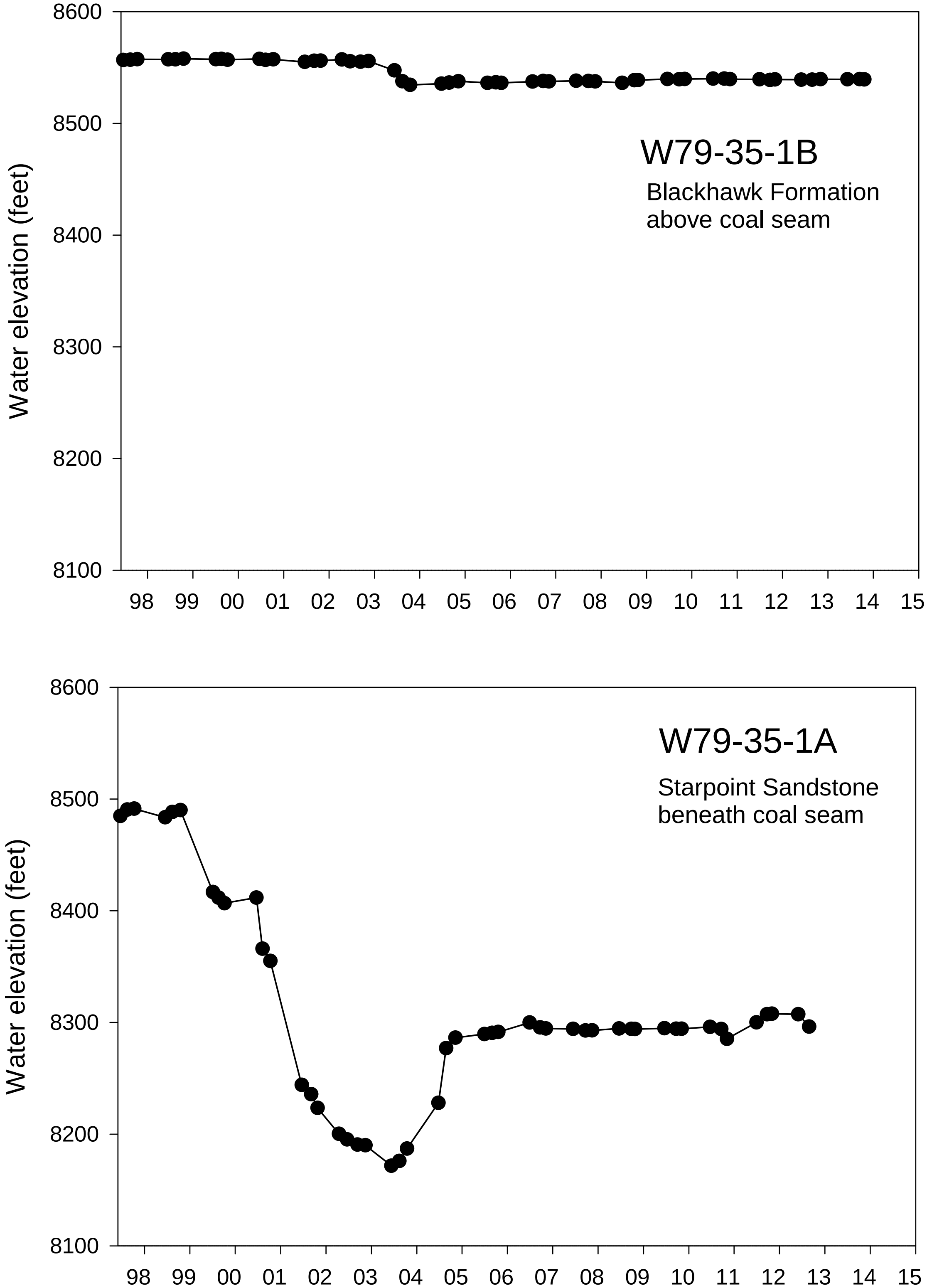


Figure 9 Comparison of water level declines at the nested piezometers at W79-35-1.

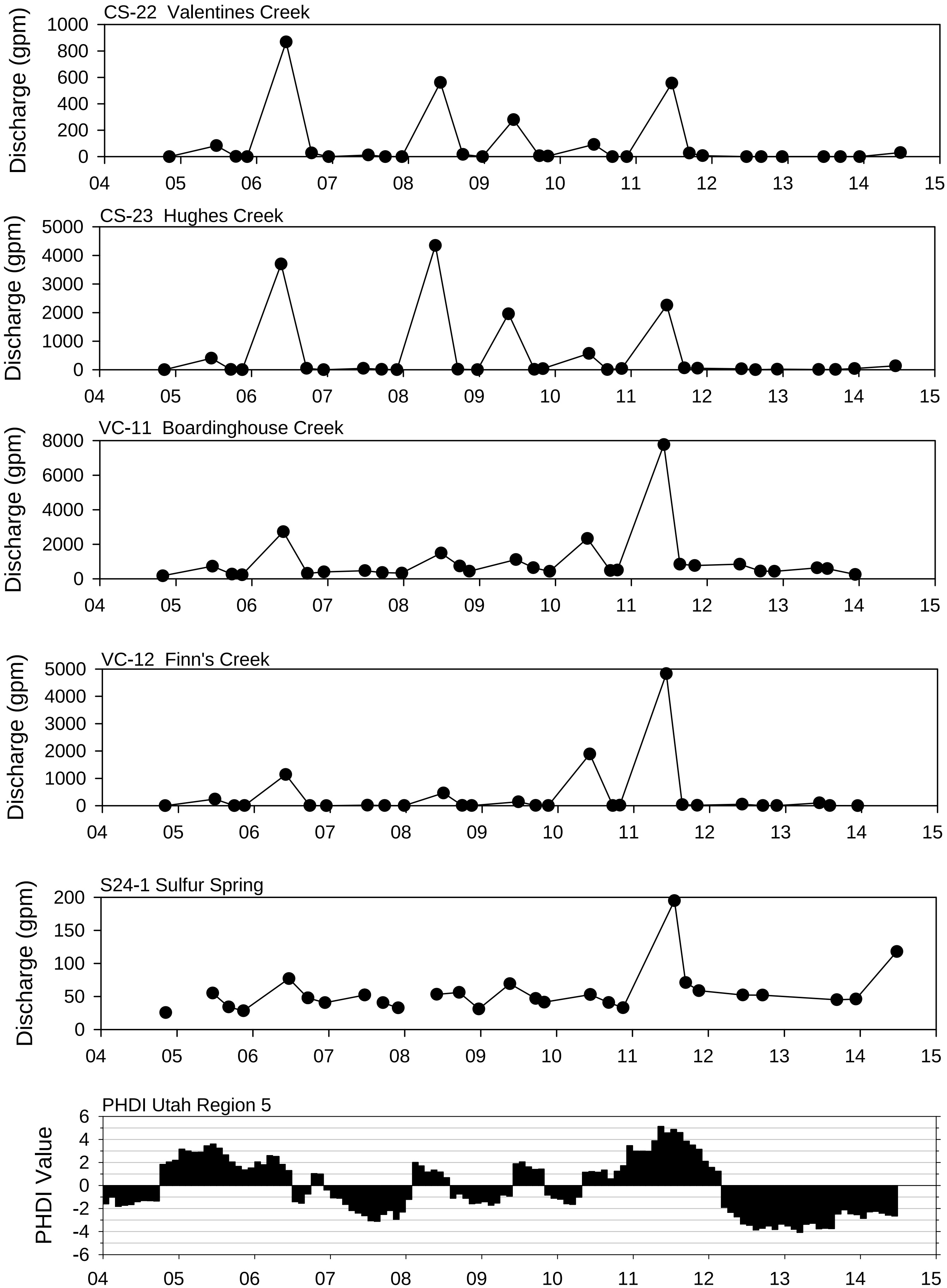


Figure 10 Discharge hydrographs for Star Point Sandstone monitoring locations.

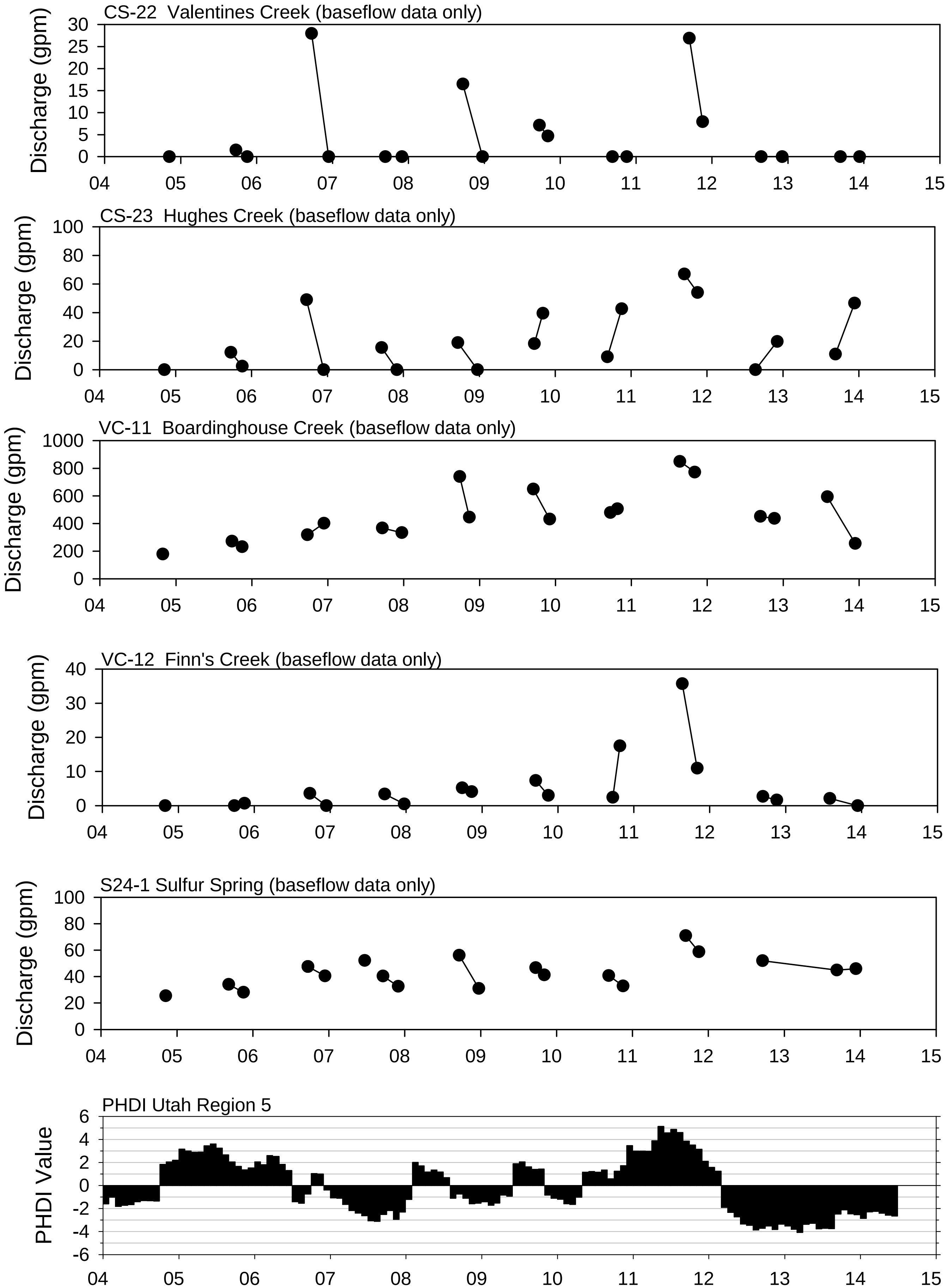


Figure 11 Discharge hydrographs for Star Point Sandstone monitoring locations under baseflow conditions..

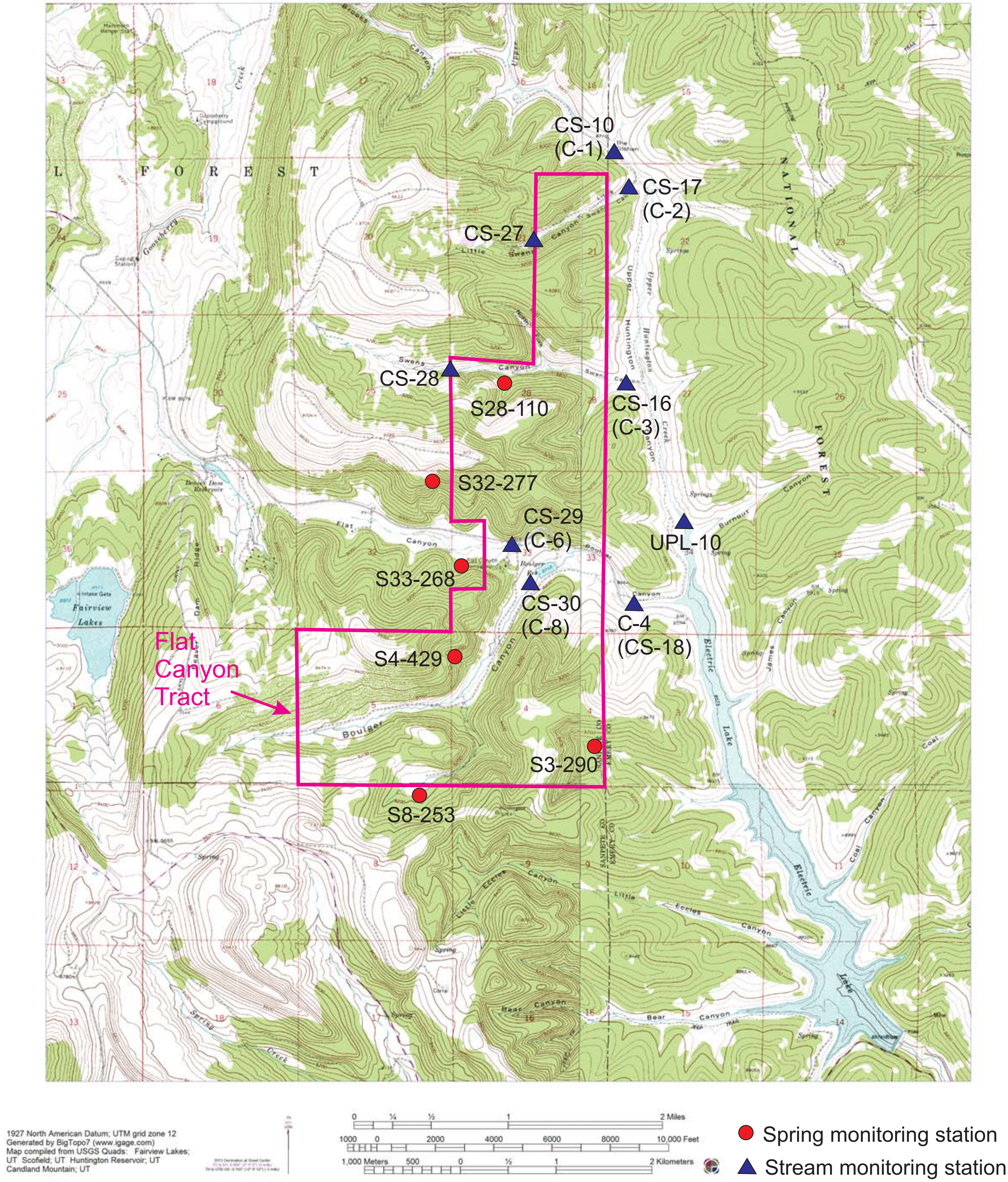


Figure 2 Proposed groundwater and surface-water monitoring station locations.

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

Table 2 Discharge and water quality data for springs and streams.

Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS 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	Metals: 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	Nutrients: 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	

										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	6	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	88	<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																											

										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	

										Major Ions								Metals										Nutrients				
		Temp.		Cond.	Flow	Turb	D.O.	TDS	TSS	Ca	Mg	Na	K	HCO3	CO3	SO4	Cl	As (D)	B (D)	Cd (D)	Fe (D)	Fe (T)	Pb (D)	Mn (D)	Mn (T)	Hg (D)	Se	NO3	NO2	NO3+NO2	PO4	O&G
Site	Date	°C	pH	µS/cm	gpm	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	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	6.64																											
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																											

Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS 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	Metals 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	Nutrients 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				
		Temp.		Cond.	Flow	Turb	D.O.	TDS	TSS	Ca	Mg	Na	K	HCO3	CO3	SO4	Cl	As (D)	B (D)	Cd (D)	Fe (D)	Fe (T)	Pb (D)	Mn (D)	Mn (T)	Hg (D)	Se	NO3	NO2	NO3+NO2	PO4	O&G
Site	Date	°C	pH	µS/cm	gpm	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	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	8	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

										Major Ions								Metals										Nutrients				
		Temp.		Cond.	Flow	Turb	D.O.	TDS	TSS	Ca	Mg	Na	K	HCO3	CO3	SO4	Cl	As (D)	B (D)	Cd (D)	Fe (D)	Fe (T)	Pb (D)	Mn (D)	Mn (T)	Hg (D)	Se	NO3	NO2	NO3+NO2	PO4	O&G
Site	Date	°C	pH	µS/cm	gpm	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	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																									

Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS 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	Metals: 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	Nutrients: 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																									

										Major Ions								Metals										Nutrients				
		Temp.		Cond.	Flow	Turb	D.O.	TDS	TSS	Ca	Mg	Na	K	HCO3	CO3	SO4	Cl	As (D)	B (D)	Cd (D)	Fe (D)	Fe (T)	Pb (D)	Mn (D)	Mn (T)	Hg (D)	Se	NO3	NO2	NO3+NO2	PO4	O&G
Site	Date	°C	pH	µS/cm	gpm	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	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		7.6	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		8	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																											

Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS 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	Metals: 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	Nutrients: 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							
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	

										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-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																											

										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						< .05	
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																											

Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS 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	Metals 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	Nutrients 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																											

Site	Date	Temp. °C	pH	Cond. µS/cm	Flow gpm	Turb NTU	D.O. mg/L	TDS mg/L	TSS 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	Metals 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	Nutrients 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			0.11				
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	0.02			0.07	< .02			

										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	587	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			218	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	776			219	< 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			170	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	518			240	< 5.	57.8	9.94	7.8	1.12	180	3	17	20					0.34			0.01					2.29		

										Major Ions								Metals										Nutrients				
		Temp.		Cond.	Flow	Turb	D.O.	TDS	TSS	Ca	Mg	Na	K	HCO3	CO3	SO4	Cl	As (D)	B (D)	Cd (D)	Fe (D)	Fe (T)	Pb (D)	Mn (D)	Mn (T)	Hg (D)	Se	NO3	NO2	NO3+NO2	PO4	O&G
Site	Date	°C	pH	µS/cm	gpm	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	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		

Table 3 Average discharge rates and solute geochemical compositions for springs and streams.

						Major Ions							
Site	Temp. °C	pH	Cond. µS/cm	Flow gpm	TDS 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
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

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

Tables 5, 6, 7, and 8

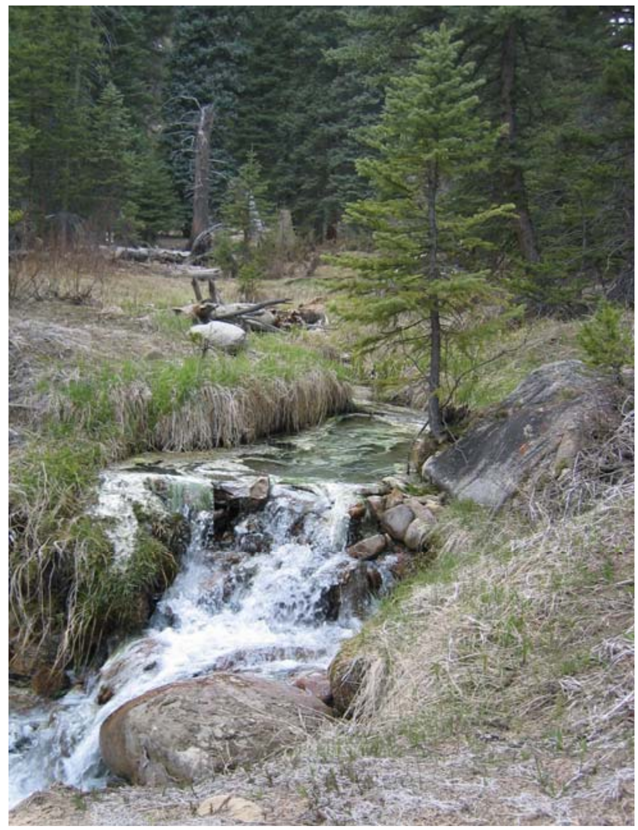
Are included in Section 9.0 of this report.

(pages 43-46)

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



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
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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.

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.

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.

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 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 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.

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.

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.

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 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).

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 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.

- 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.

- 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.

- 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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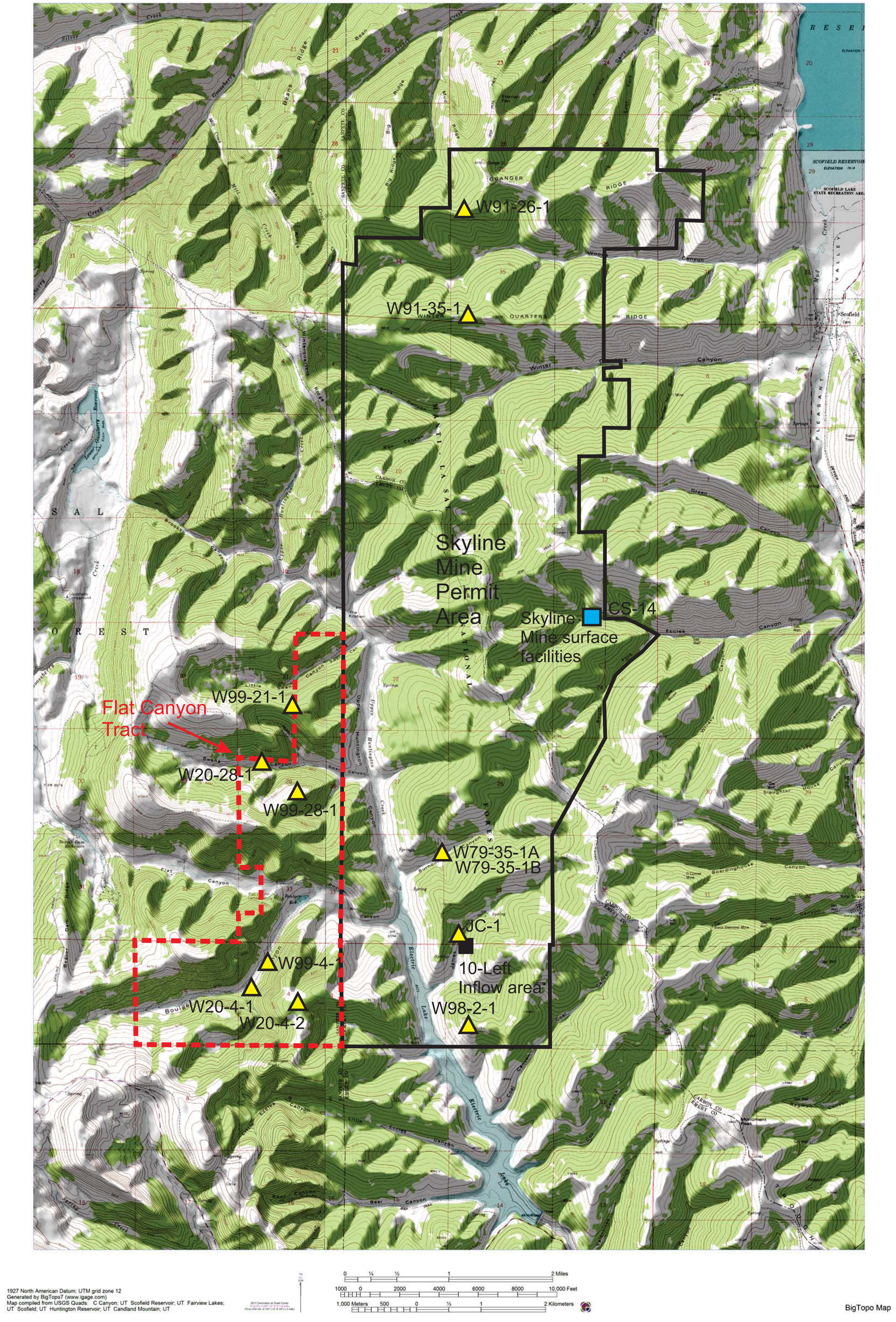
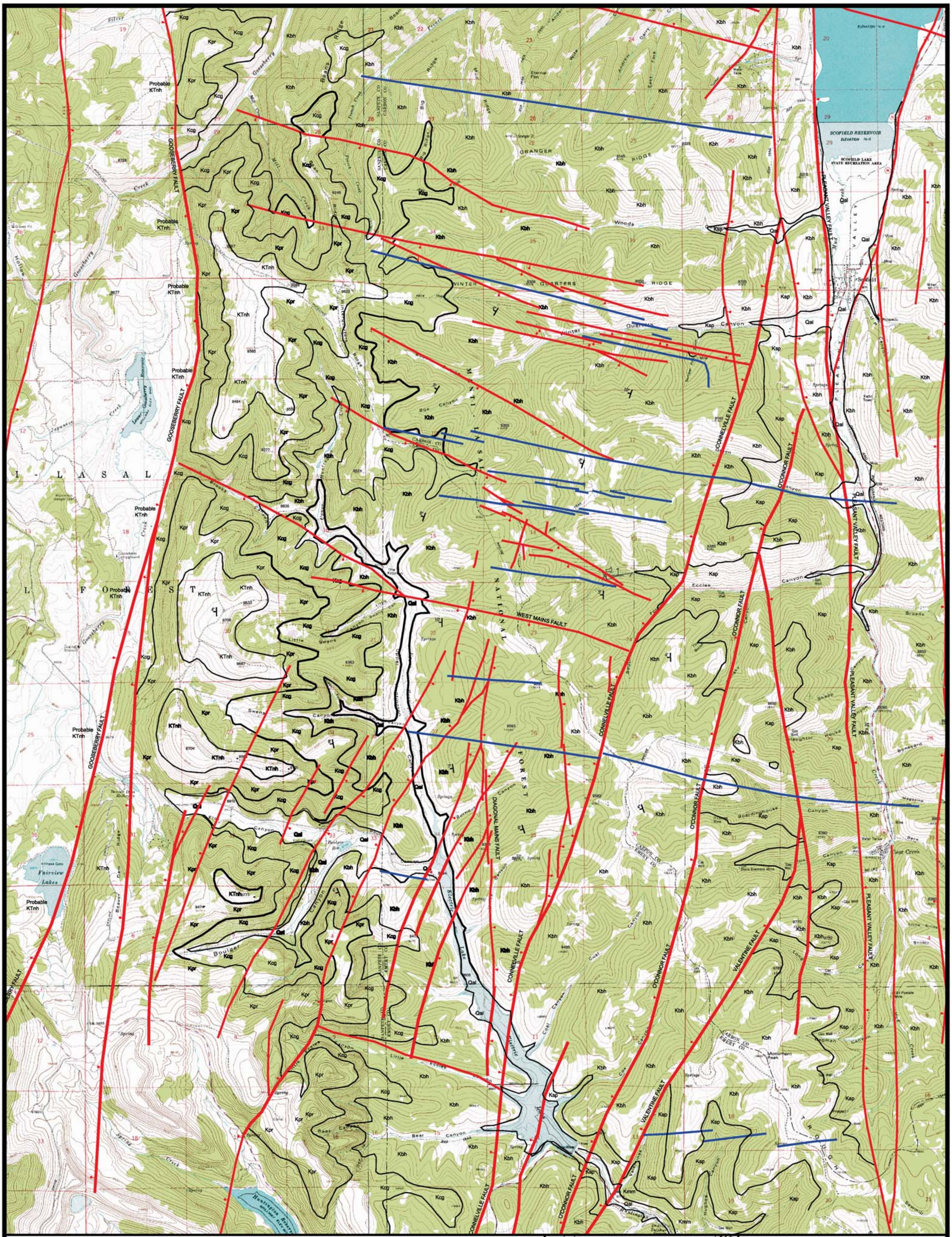


Figure 1 Locations of monitoring wells at the Skyline Mine area.



SEE PLATE 1.6–3 FOR PERMIT AND ADJACENT AREAS

FAULT

IGNEOUS DIKE

FORMATION CONTACT

TKnh North Horn Formation
Kpr Price River Formation
Kbh Blackhawk Formation
Ksp Star Point Sandstone (Formation)
Kmm Mancos Shale (Masuk Member)
Qal Quaternary Alluvium

Note:
The Star Point Sandstone in this area consists of numerous tongues of sandstone that intertongue with the lower portion of the Blackhawk Fm. and upper portion of the Masuk mbr. of the Mancos Shale.

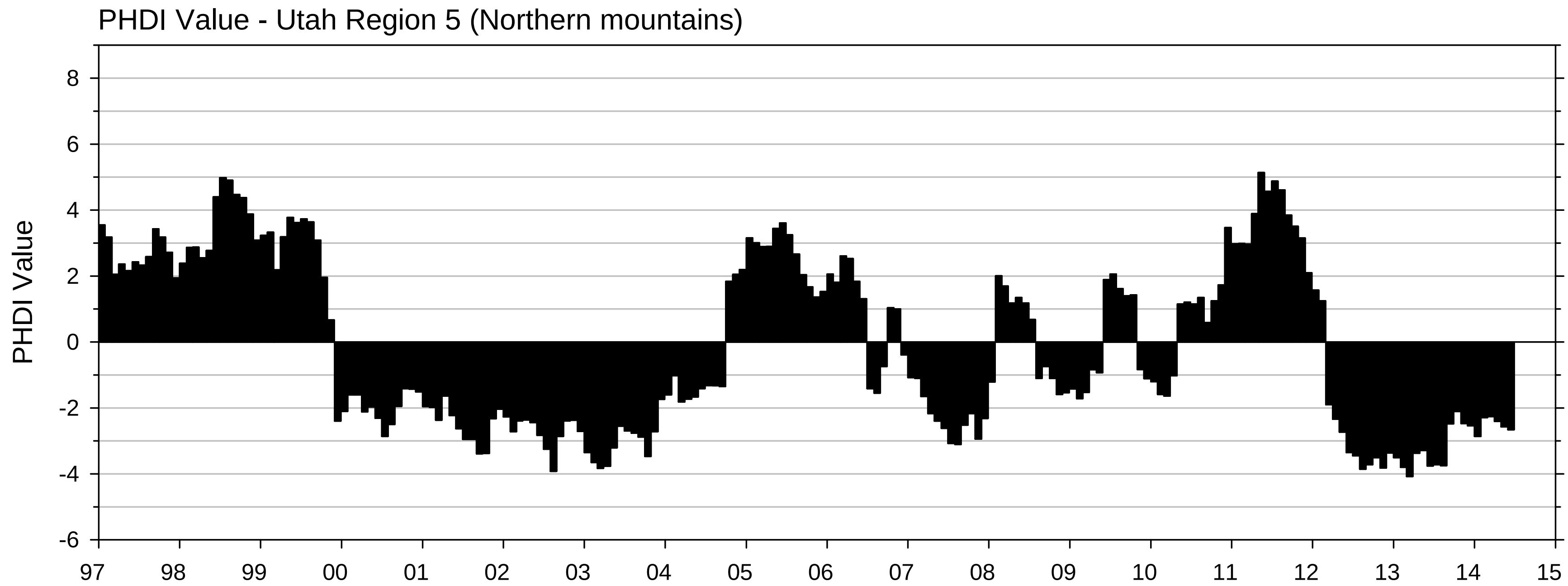
Sources:
Knowles, S.P., 1996, Interim Geologic Map of the Scofield Quadrangle, Carbon, Emery, and Sanpete Counties, Utah, Open-File Report 341, Utah Geological Survey.
Doelling, H.H., 1972, Central Utah Coal Fields: Sevier-Sanpete, Wasatch Plateau, Book Cliffs and Emery, Monograph Series No. 3, Utah Geological and Mineral Survey, p. 76, 219, 235.
Bunnell, M.D., 2002, Personal mapping notes and mine map archives at Skyline Mine.

DATE	No.	REVISIONS
06/07	1	Incidental Boundary Changes/minor geologic updates
10/07	2	Added degree of dip
12/09	3	Modified Permit Boundary
07/10	4	REMOVED PERMIT BOUNARY, ADDED LOCATION NOTE
08/10	5	REMOVED DRILL HOLES AND COAL SEAM CONTOURS

Figure 2
General geologic map of the Skyline Mine area.

Canyon Fuel Company, LLC
Skyline Mines
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463

SCALE: 1"=2000' | DATE: 11/08/02 | CK.BY: M. BUNNELL | REVISION: 5
DWG. NO.: 2.2.1–1 | DR.BY: M. BUNNELL | 8/20/2010
CAD FILE: 2.2.1–1REV.5



-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

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

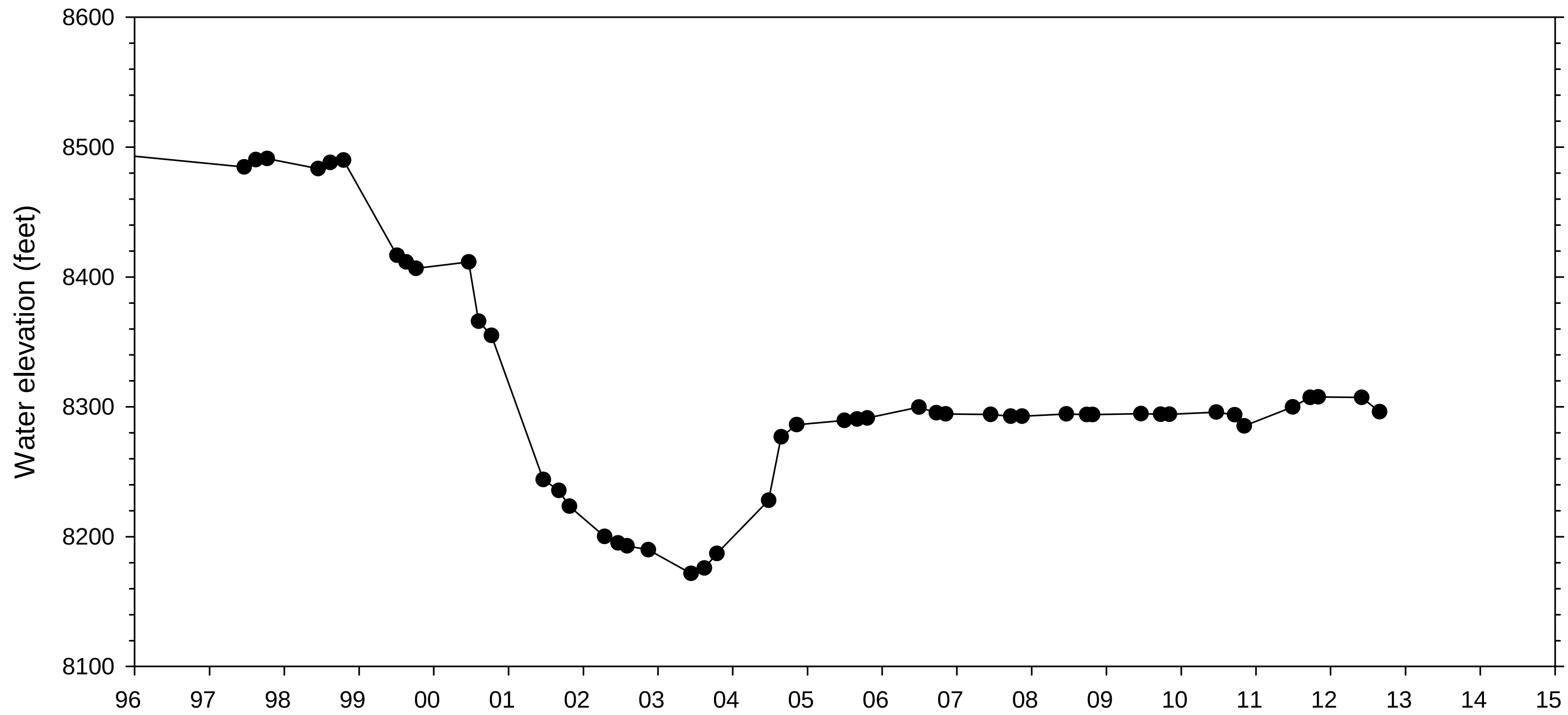
W99-28-1

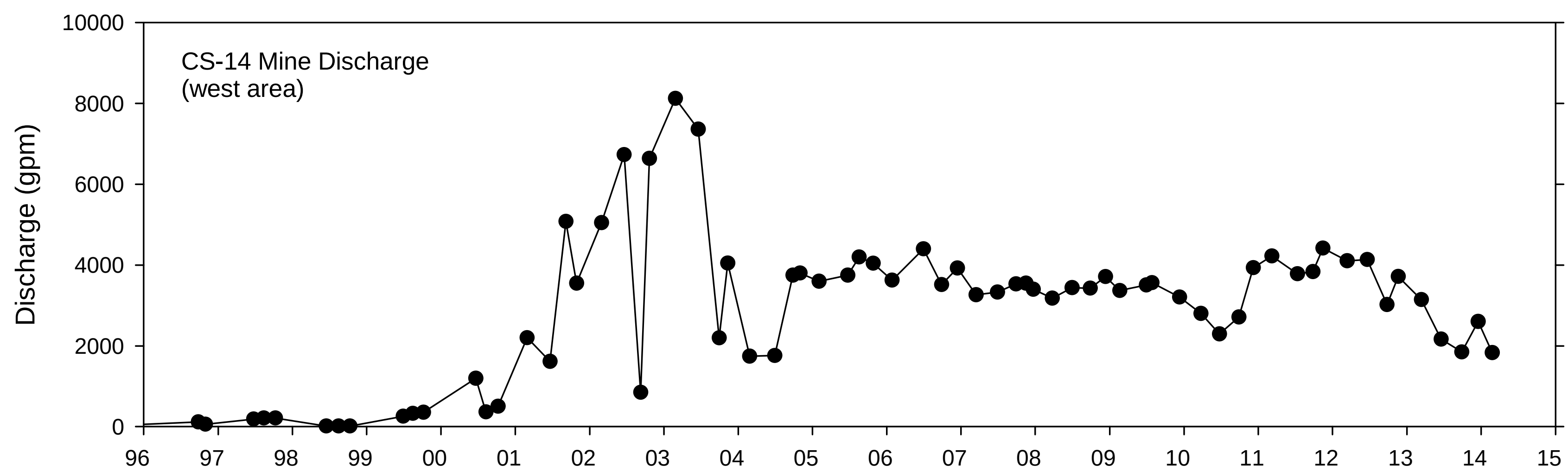
W20-4-1

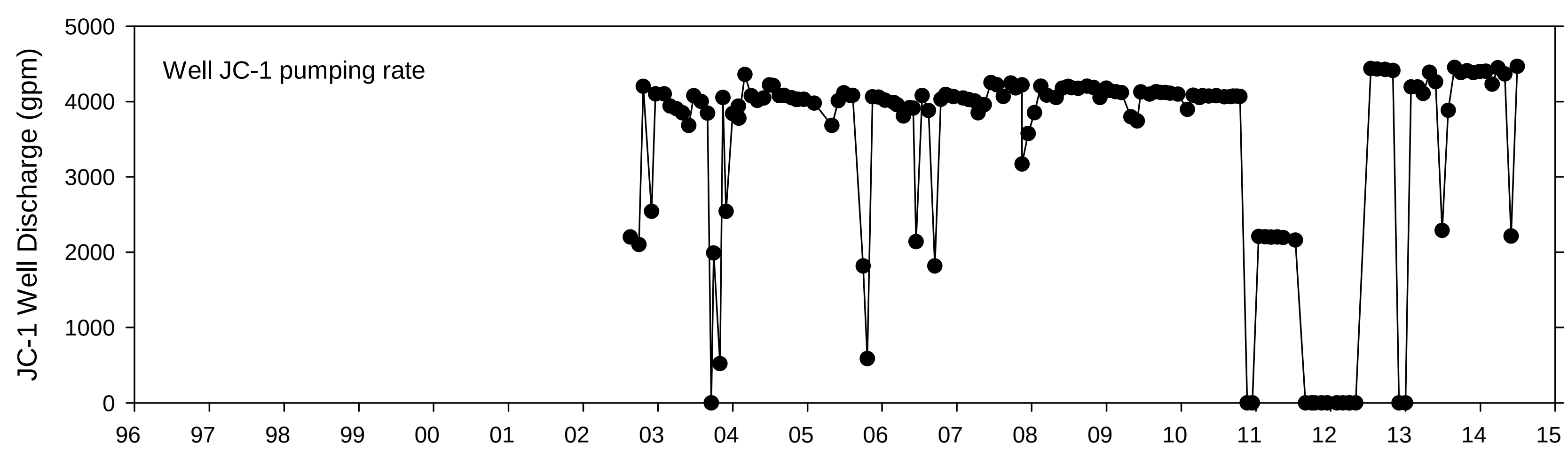
W20-4-2

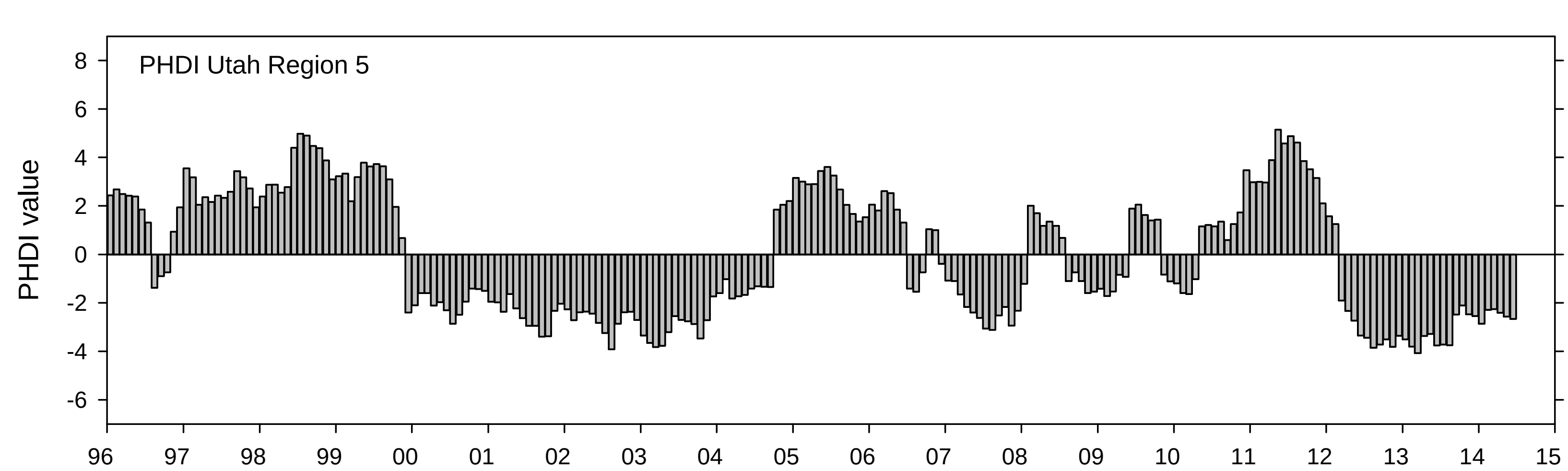
W20-28-1

W79-35-1A

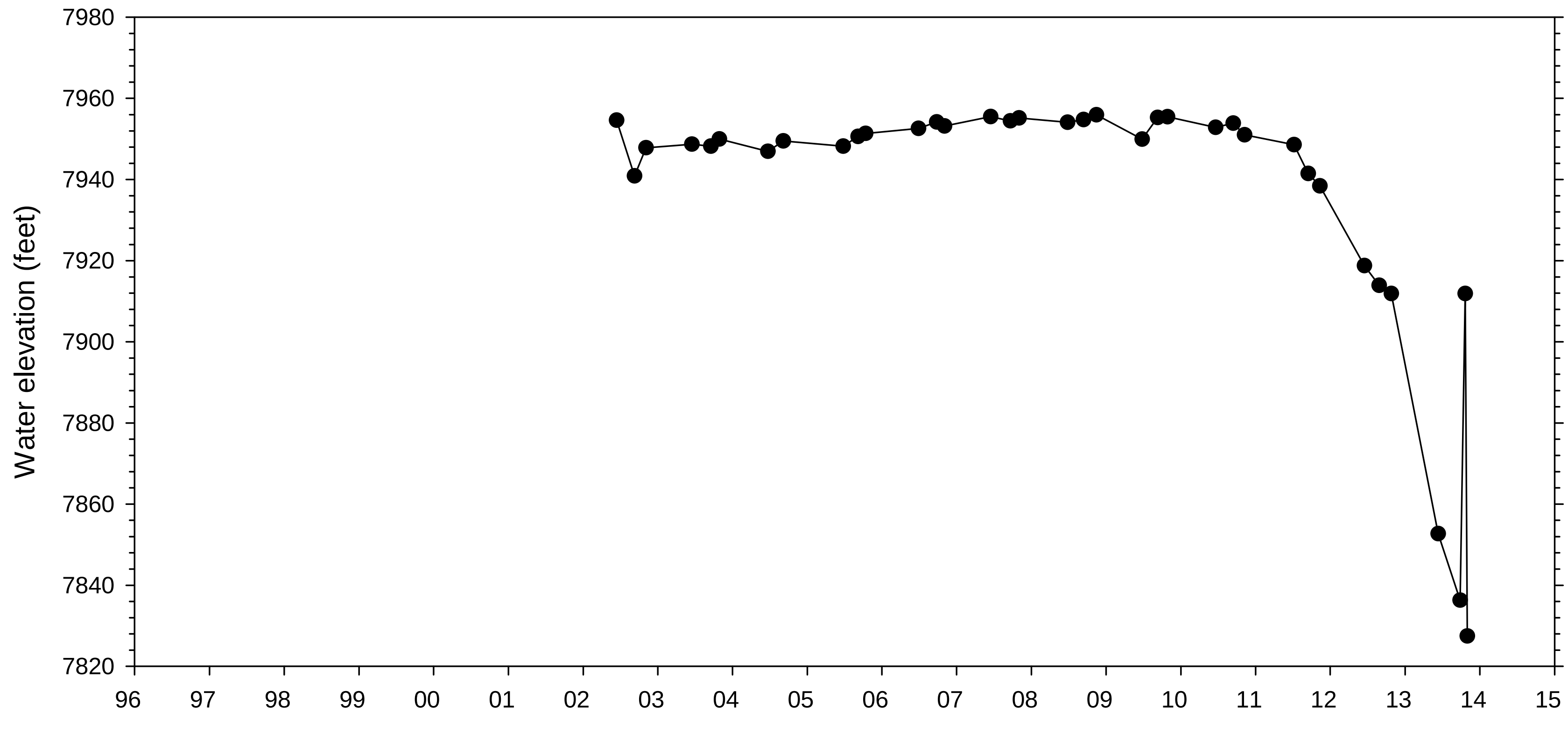

Water elevation (feet)
8600
8500
8400
8300
8200
8100
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

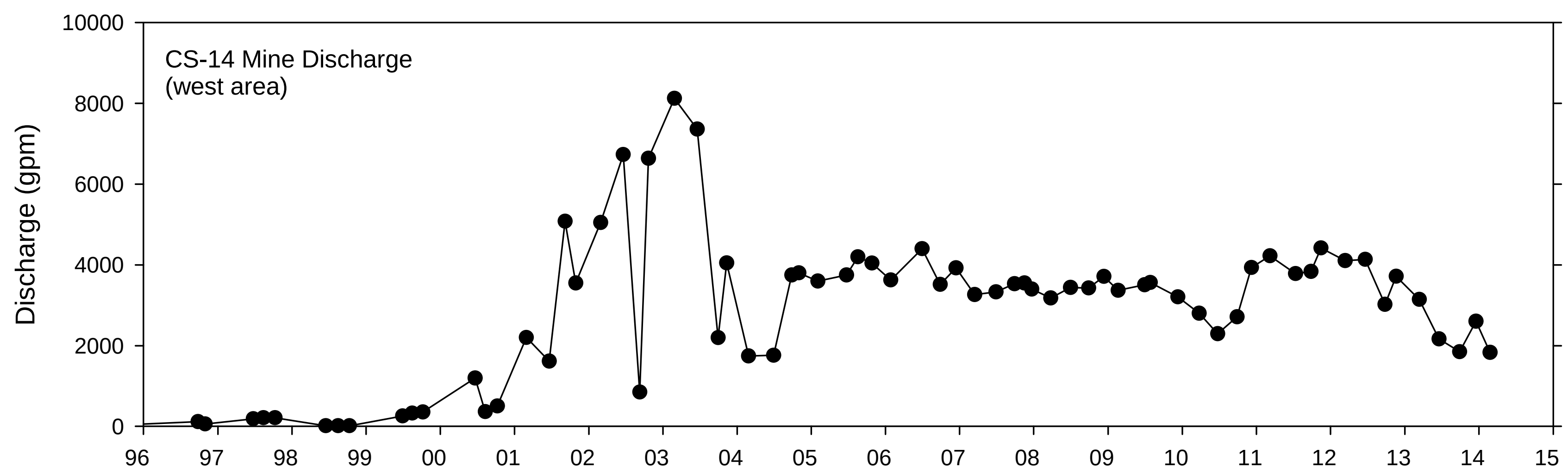

CS-14 Mine Discharge
(west area)
Discharge (gpm)
10000
8000
6000
4000
2000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

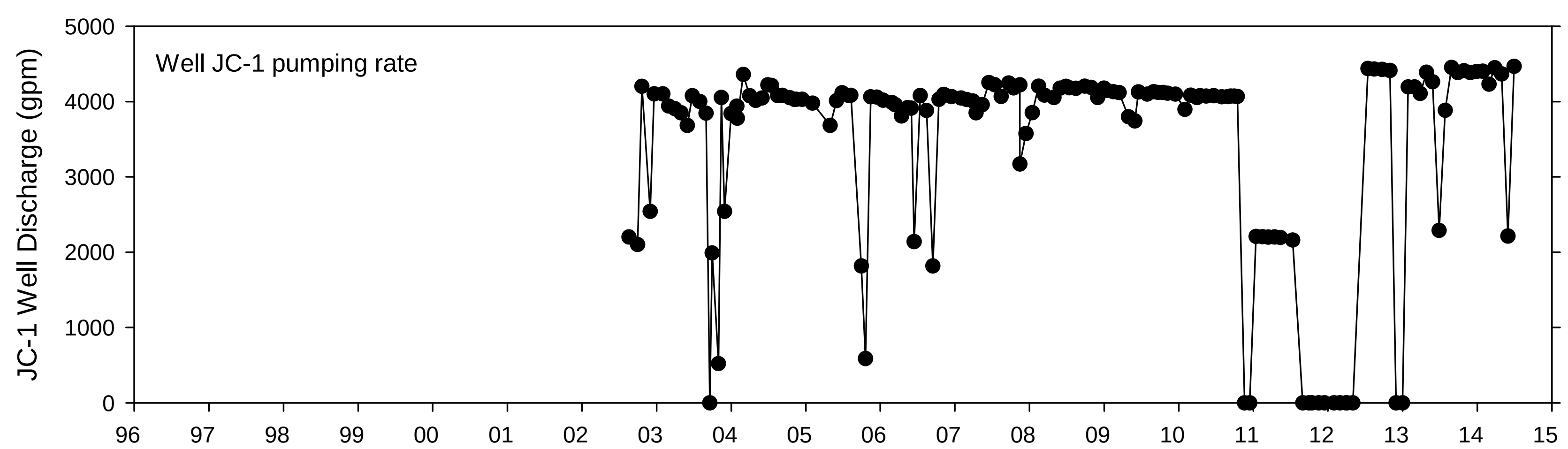

Well JC-1 pumping rate
JC-1 Well Discharge (gpm)
5000
4000
3000
2000
1000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

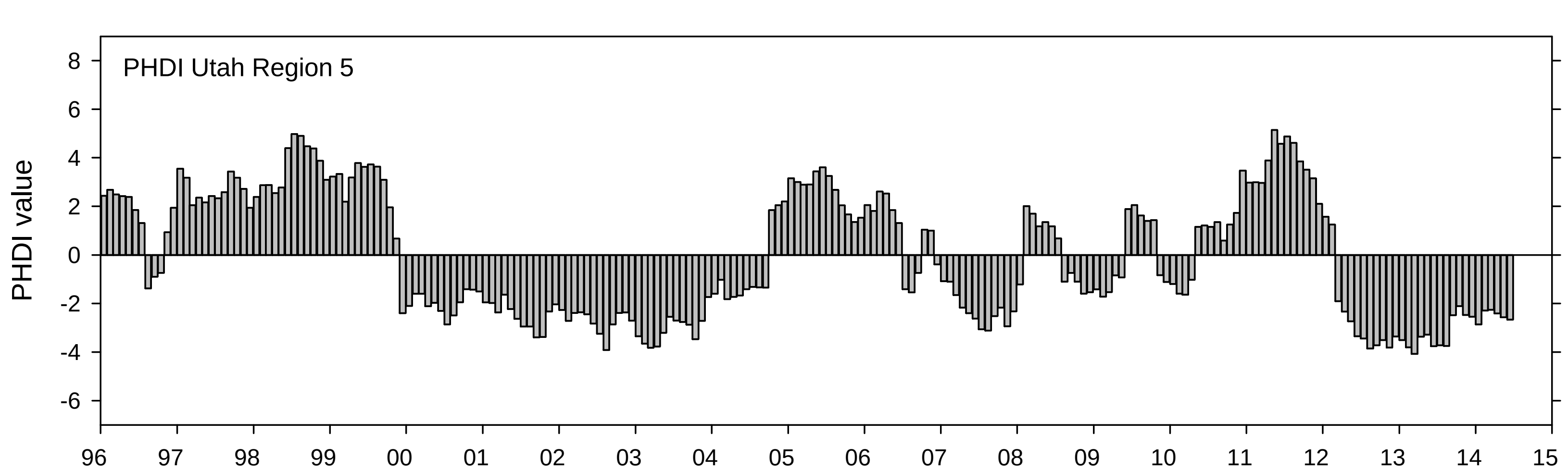

PHDI Utah Region 5
PHDI value
8
6
4
2
0
-2
-4
-6
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

W91-26-1

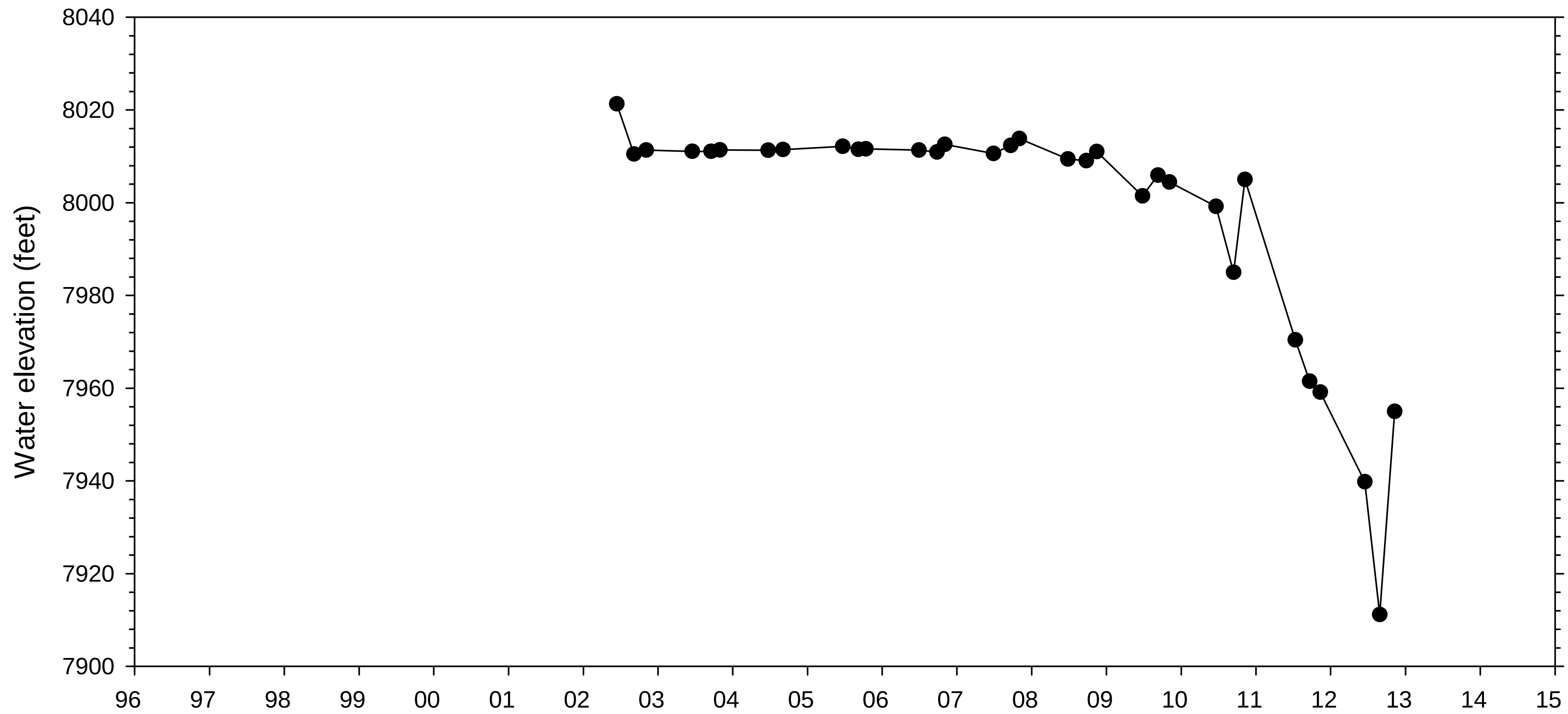

Water elevation (feet)
7980
7960
7940
7920
7900
7880
7860
7840
7820
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15


CS-14 Mine Discharge
(west area)
Discharge (gpm)
10000
8000
6000
4000
2000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

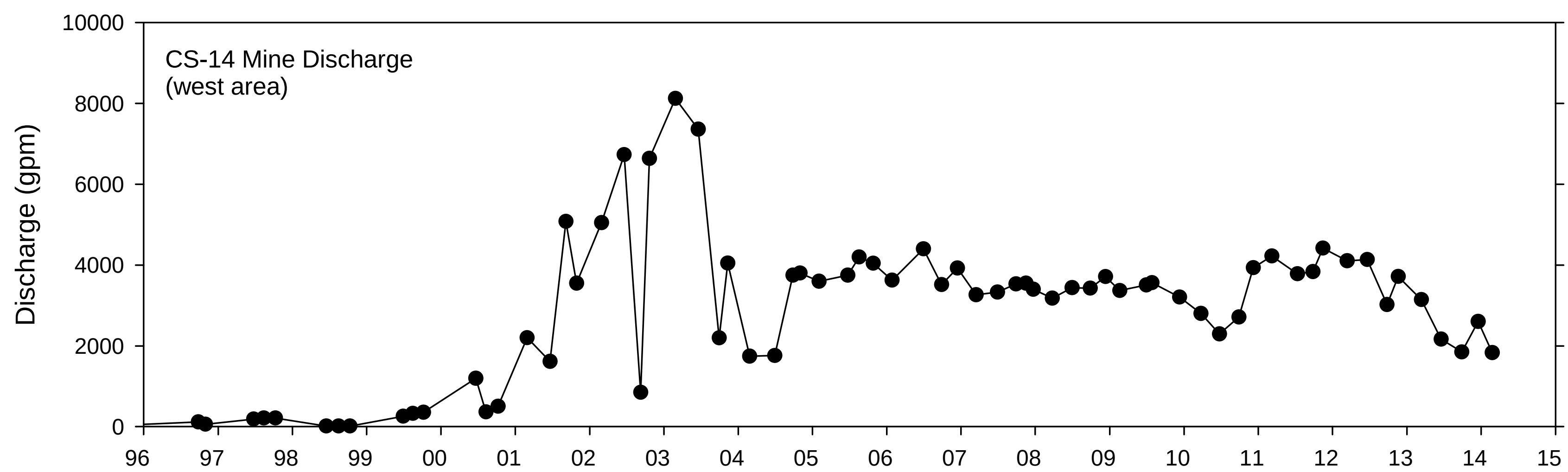

Well JC-1 pumping rate
JC-1 Well Discharge (gpm)
5000
4000
3000
2000
1000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15


PHDI Utah Region 5
PHDI value
8
6
4
2
0
-2
-4
-6
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

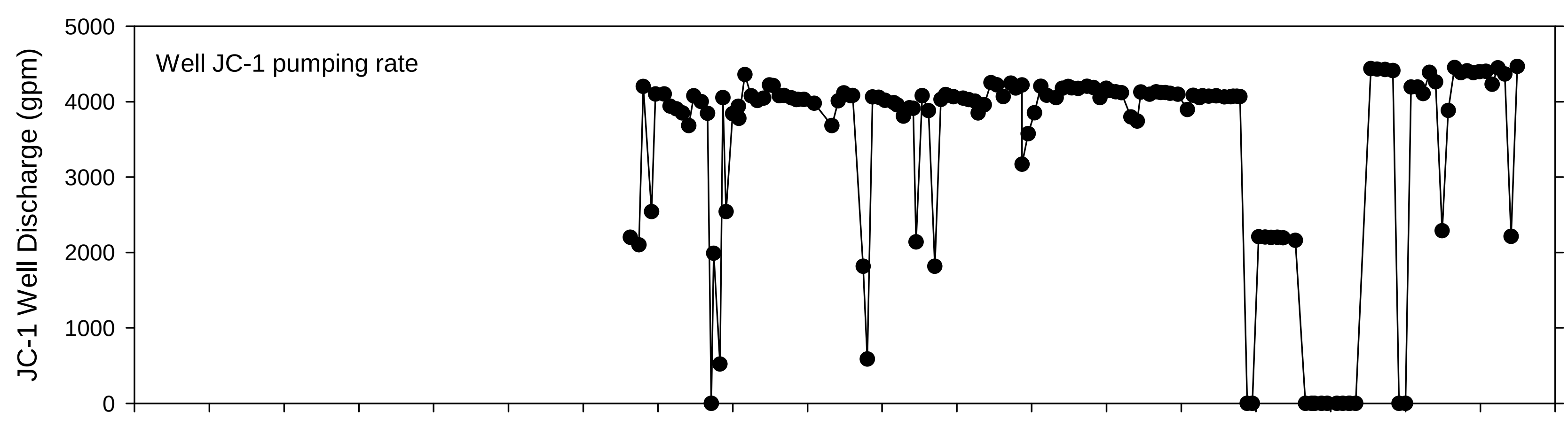
W91-35-1



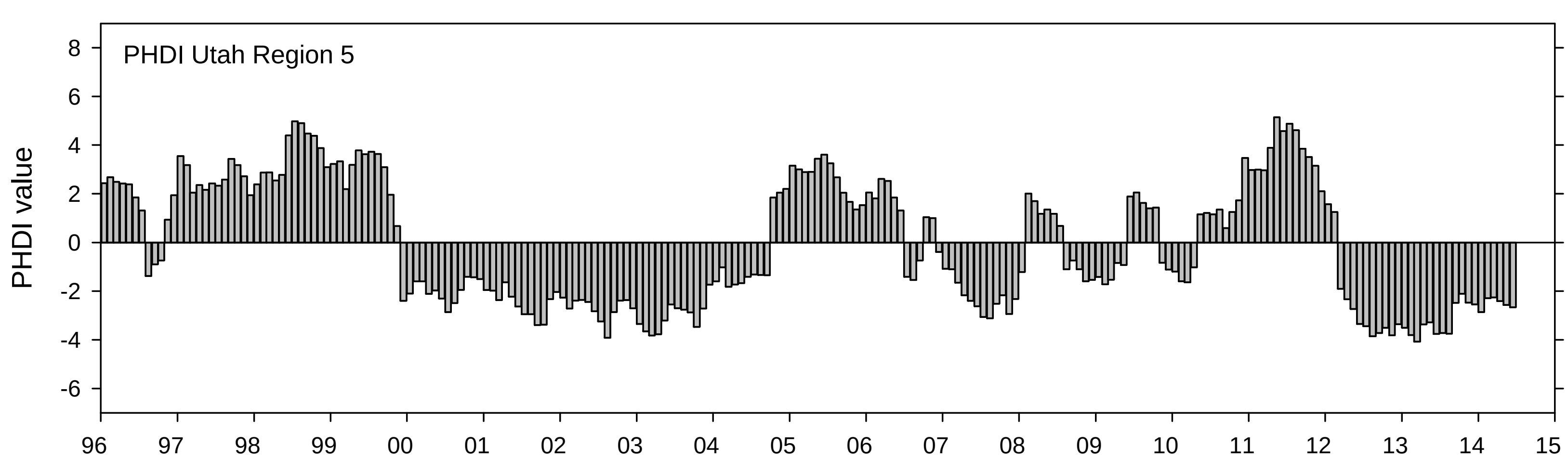
Water elevation (feet)
8040
8020
8000
7980
7960
7940
7920
7900
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15



CS-14 Mine Discharge
(west area)
Discharge (gpm)
10000
8000
6000
4000
2000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

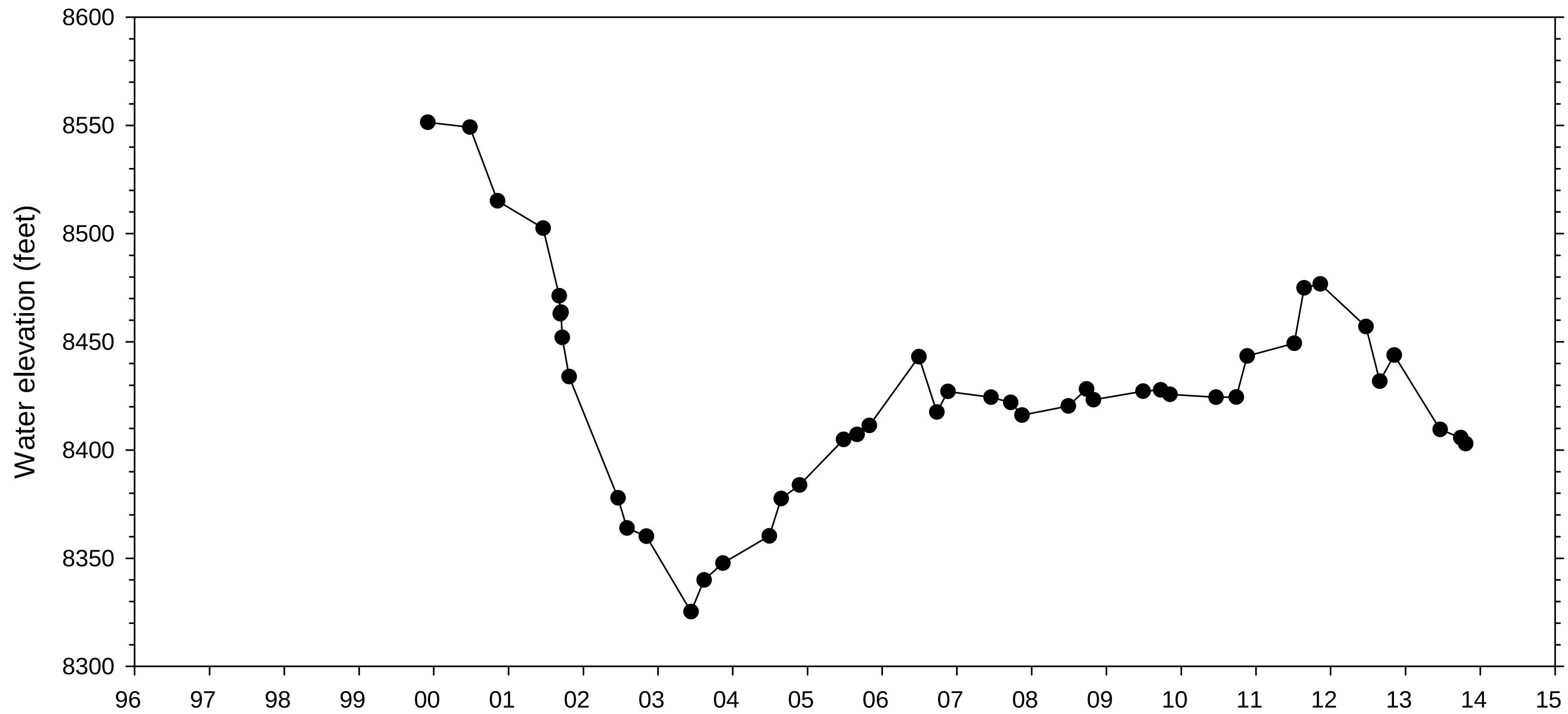


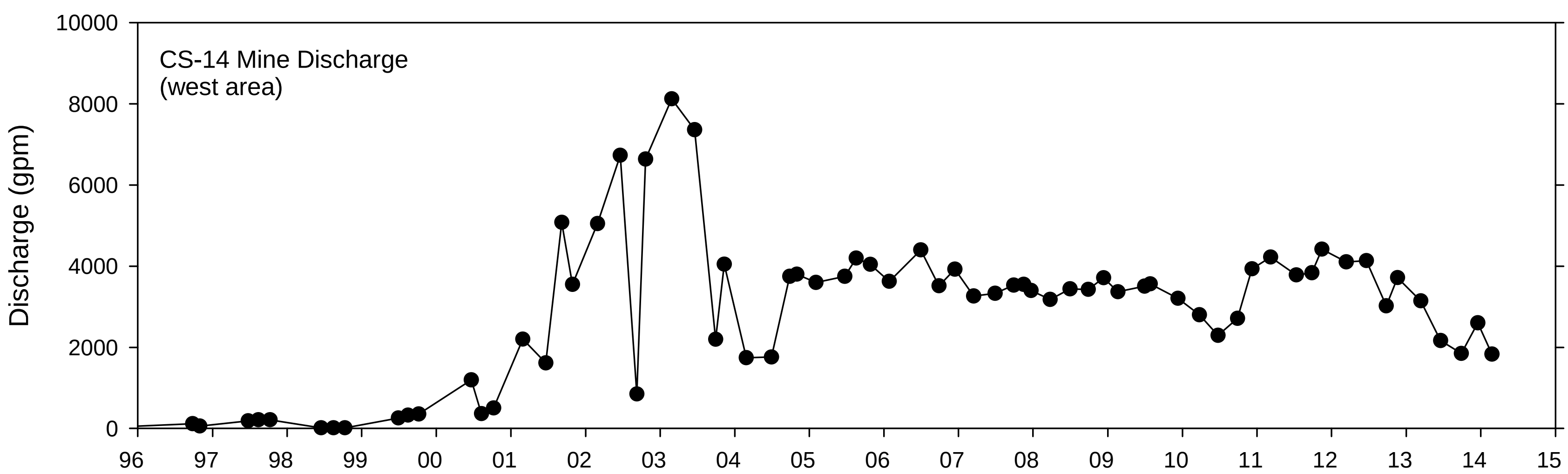
Well JC-1 pumping rate
JC-1 Well Discharge (gpm)
5000
4000
3000
2000
1000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

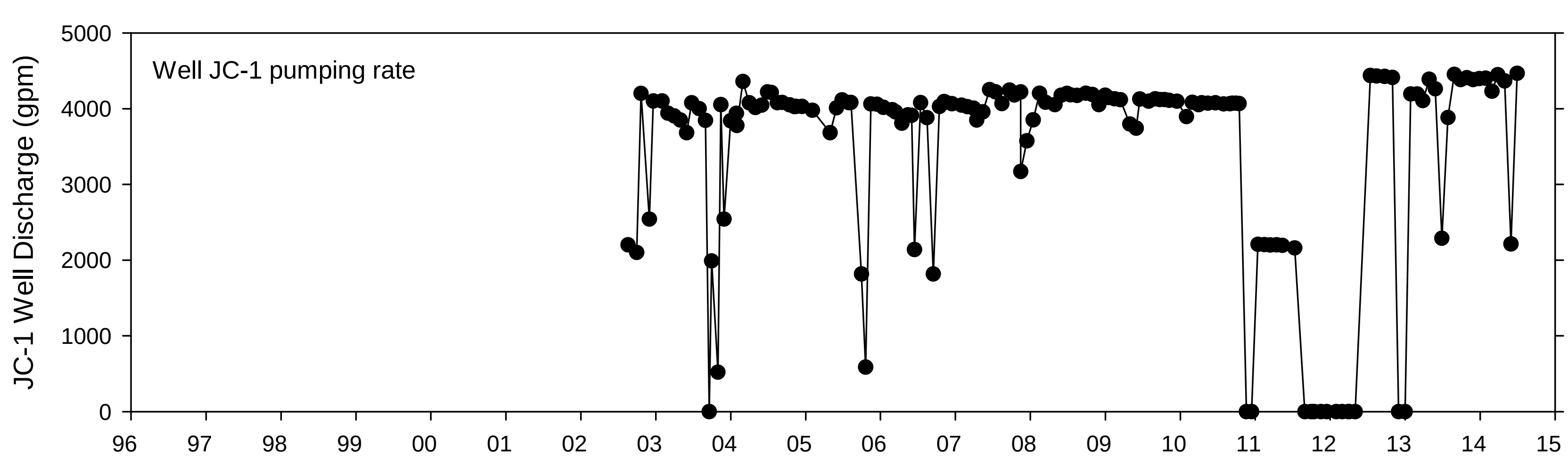


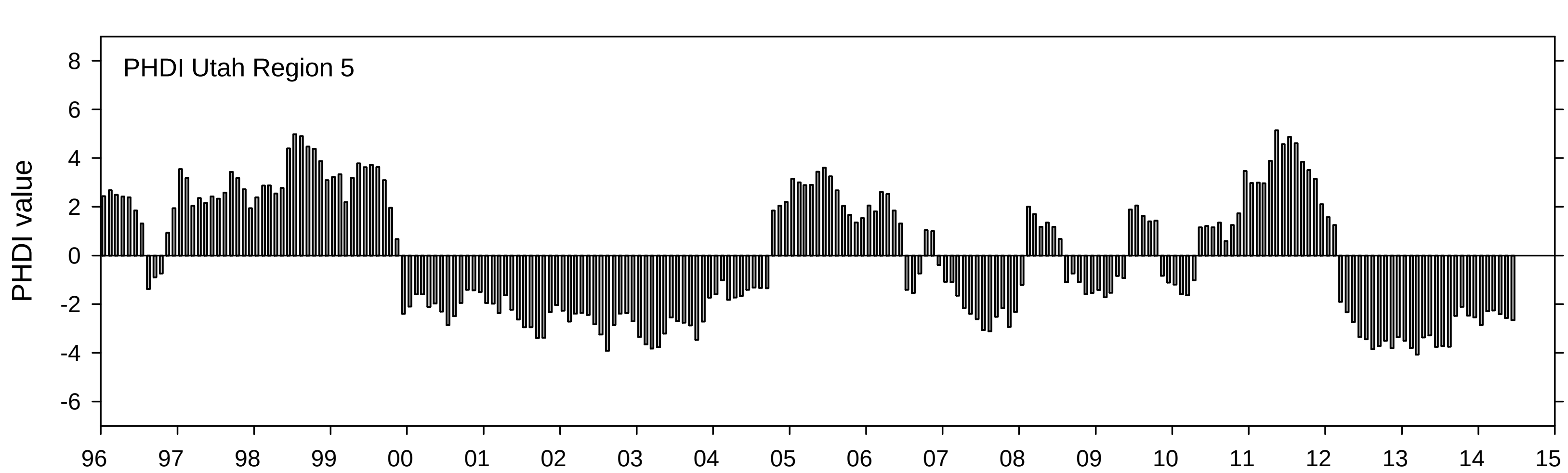
PHDI Utah Region 5
PHDI value
8
6
4
2
0
-2
-4
-6
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

W98-2-1

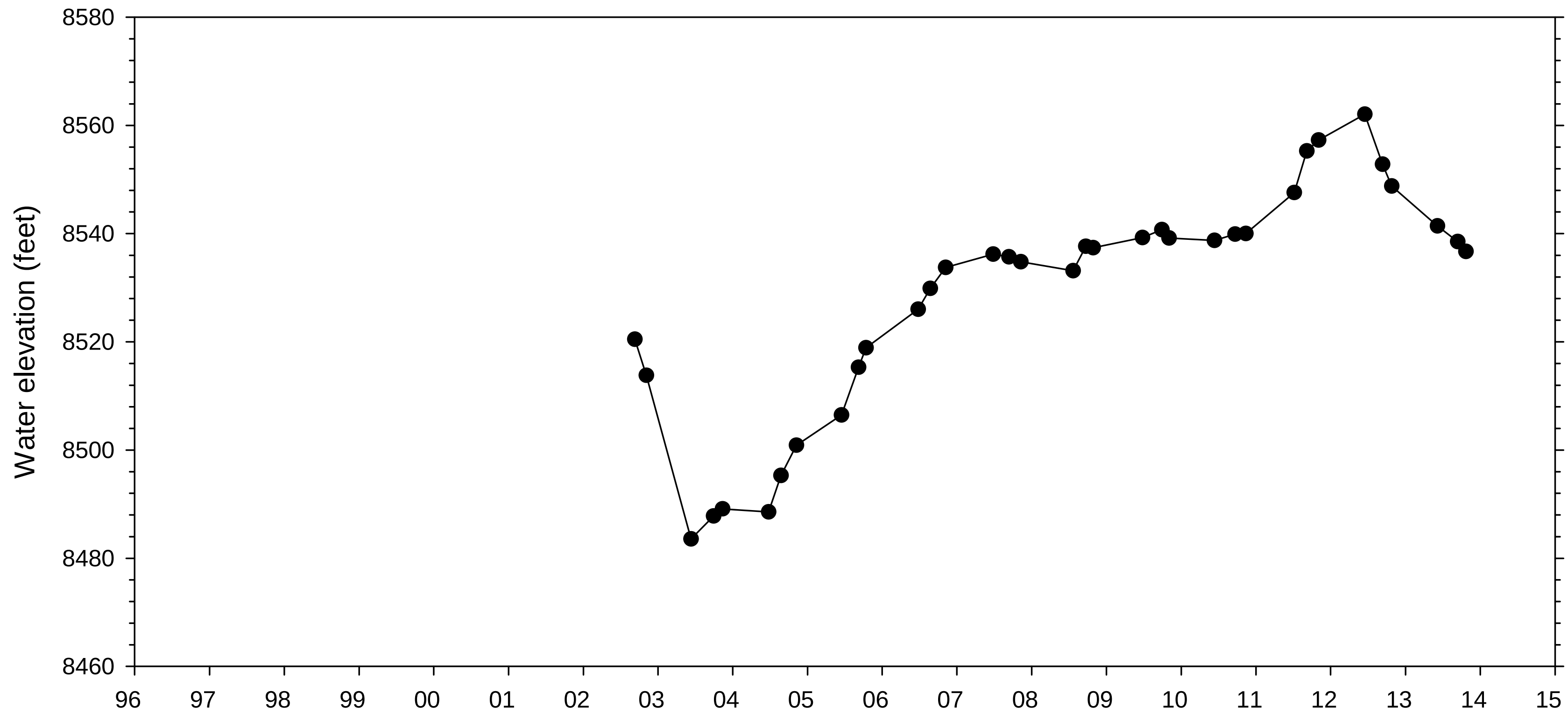

Water elevation (feet)
8600
8550
8500
8450
8400
8350
8300
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

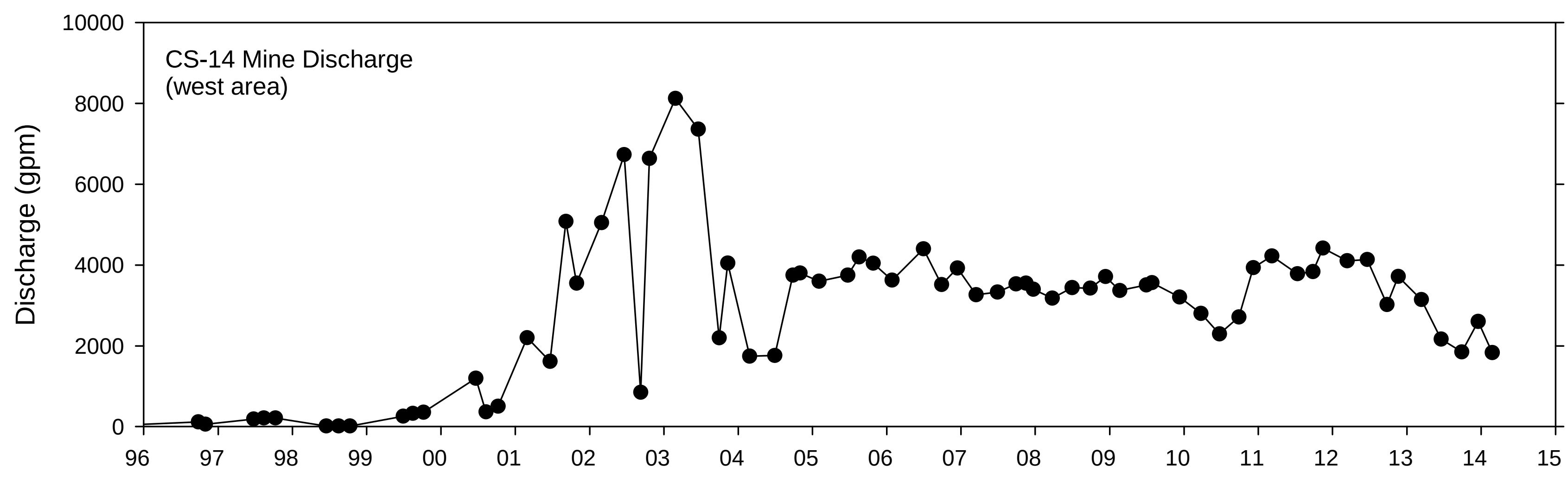

CS-14 Mine Discharge
(west area)
Discharge (gpm)
10000
8000
6000
4000
2000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

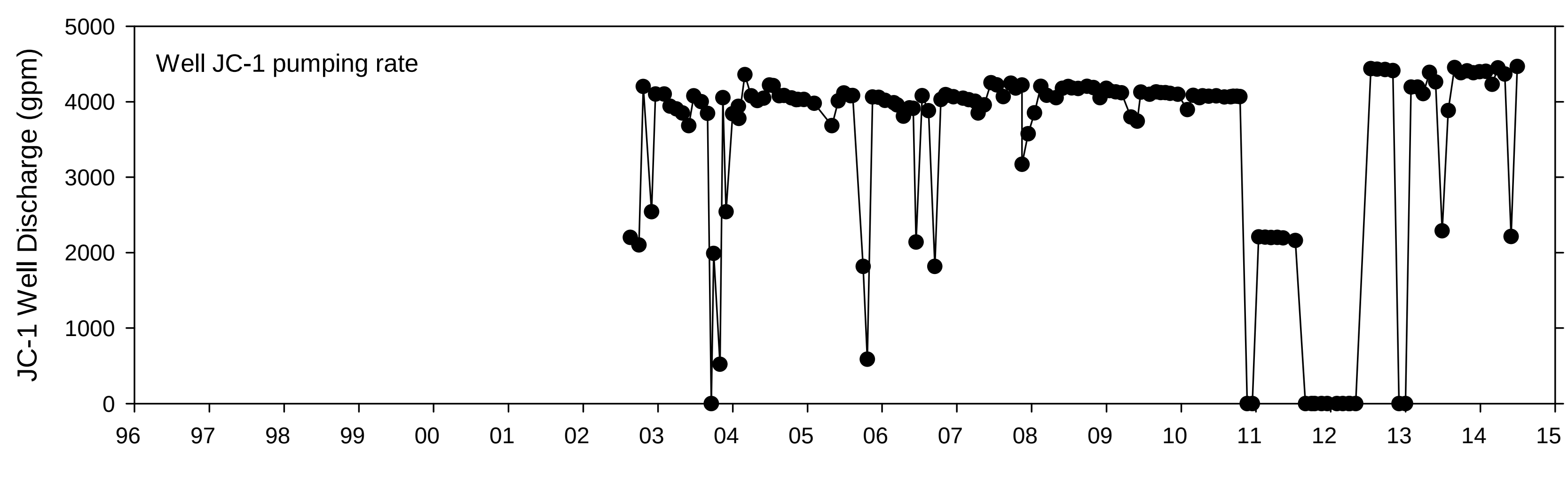

Well JC-1 pumping rate
JC-1 Well Discharge (gpm)
5000
4000
3000
2000
1000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

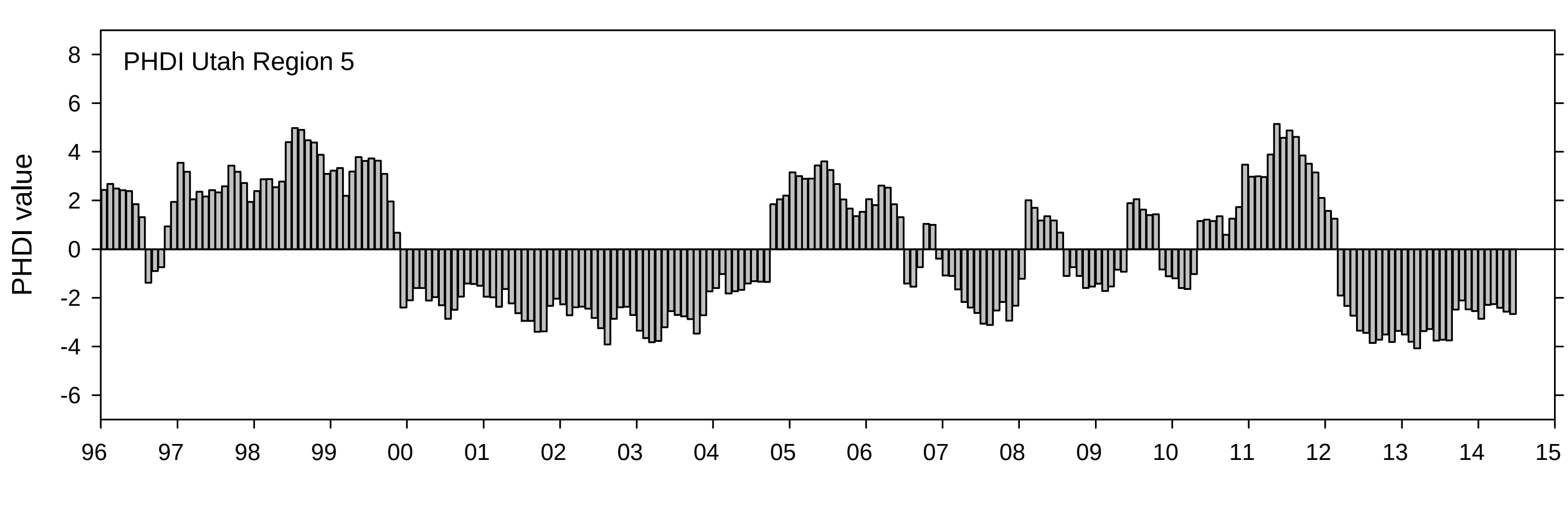

PHDI Utah Region 5
PHDI value
8
6
4
2
0
-2
-4
-6
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

W99-4-1

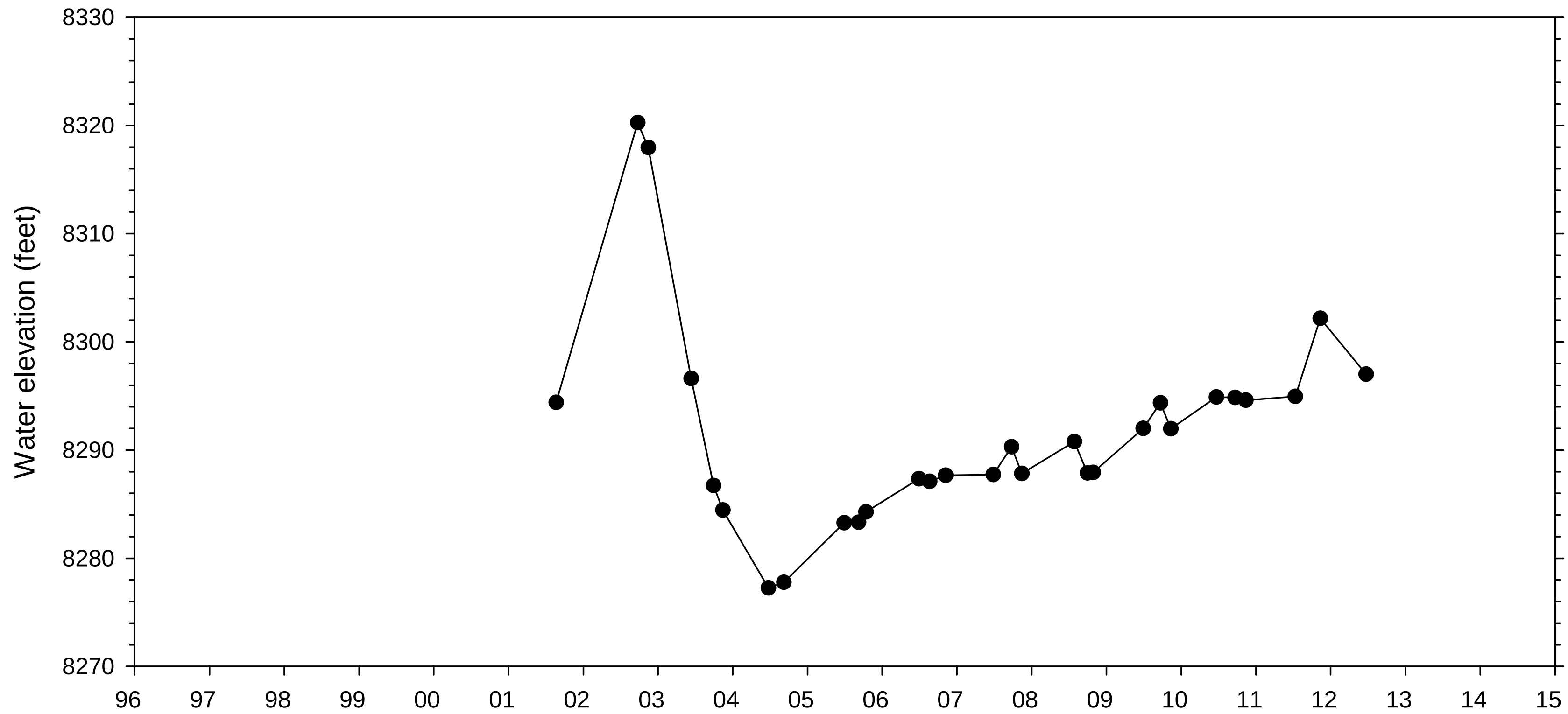

Water elevation (feet)
8580
8560
8540
8520
8500
8480
8460
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15


CS-14 Mine Discharge
(west area)
Discharge (gpm)
10000
8000
6000
4000
2000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15


Well JC-1 pumping rate
JC-1 Well Discharge (gpm)
5000
4000
3000
2000
1000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15


PHDI Utah Region 5
PHDI value
8
6
4
2
0
-2
-4
-6
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

W99-21-1



Water elevation (feet)
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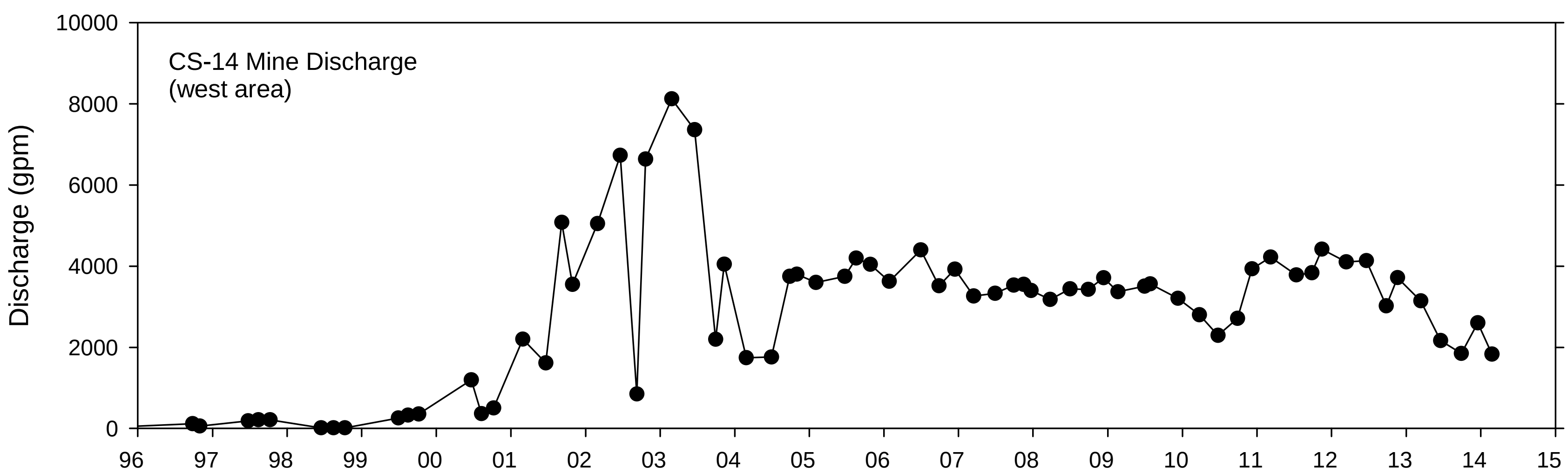
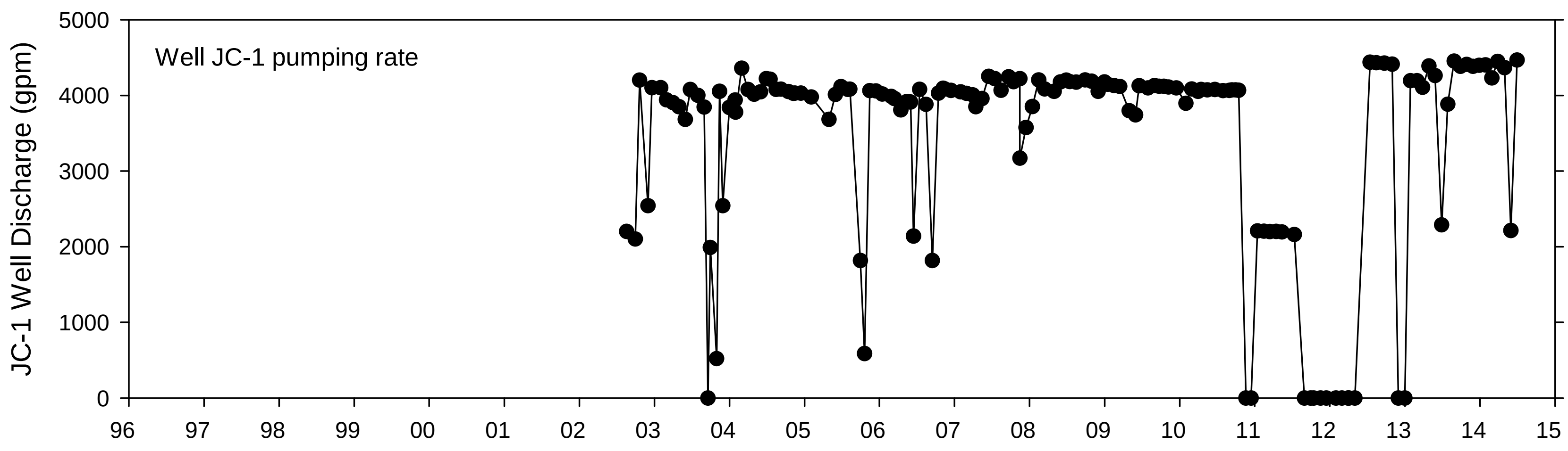
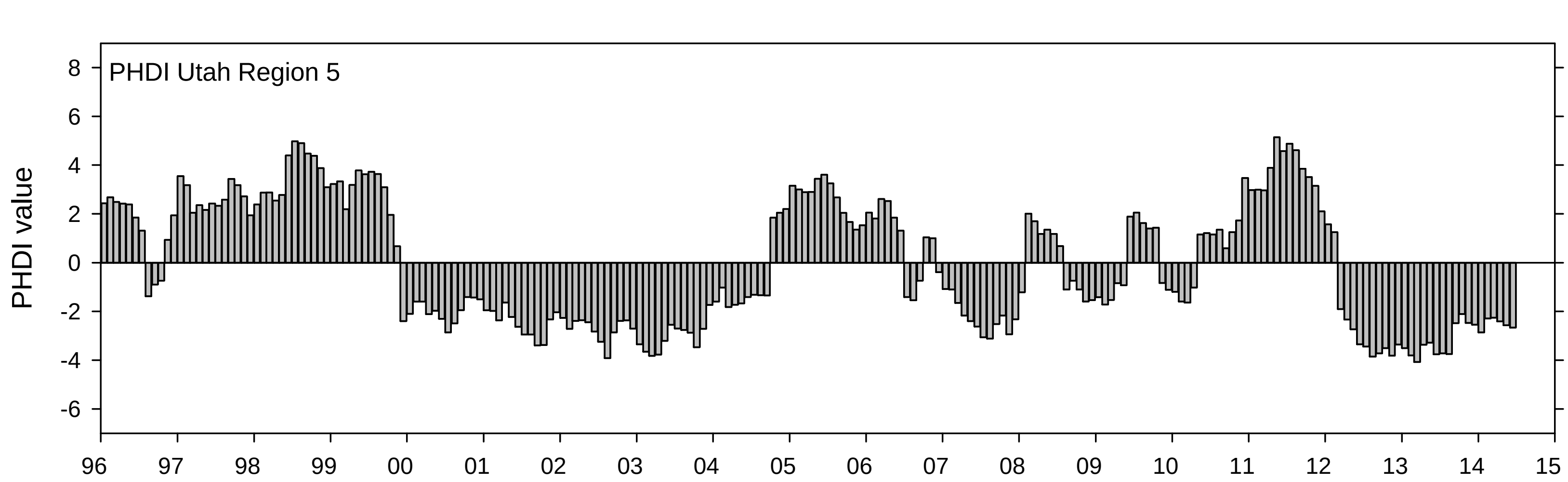
8320
8310
8300
8290
8280
8270
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15



CS-14 Mine Discharge
(west area)
Discharge (gpm)
10000
8000
6000
4000
2000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

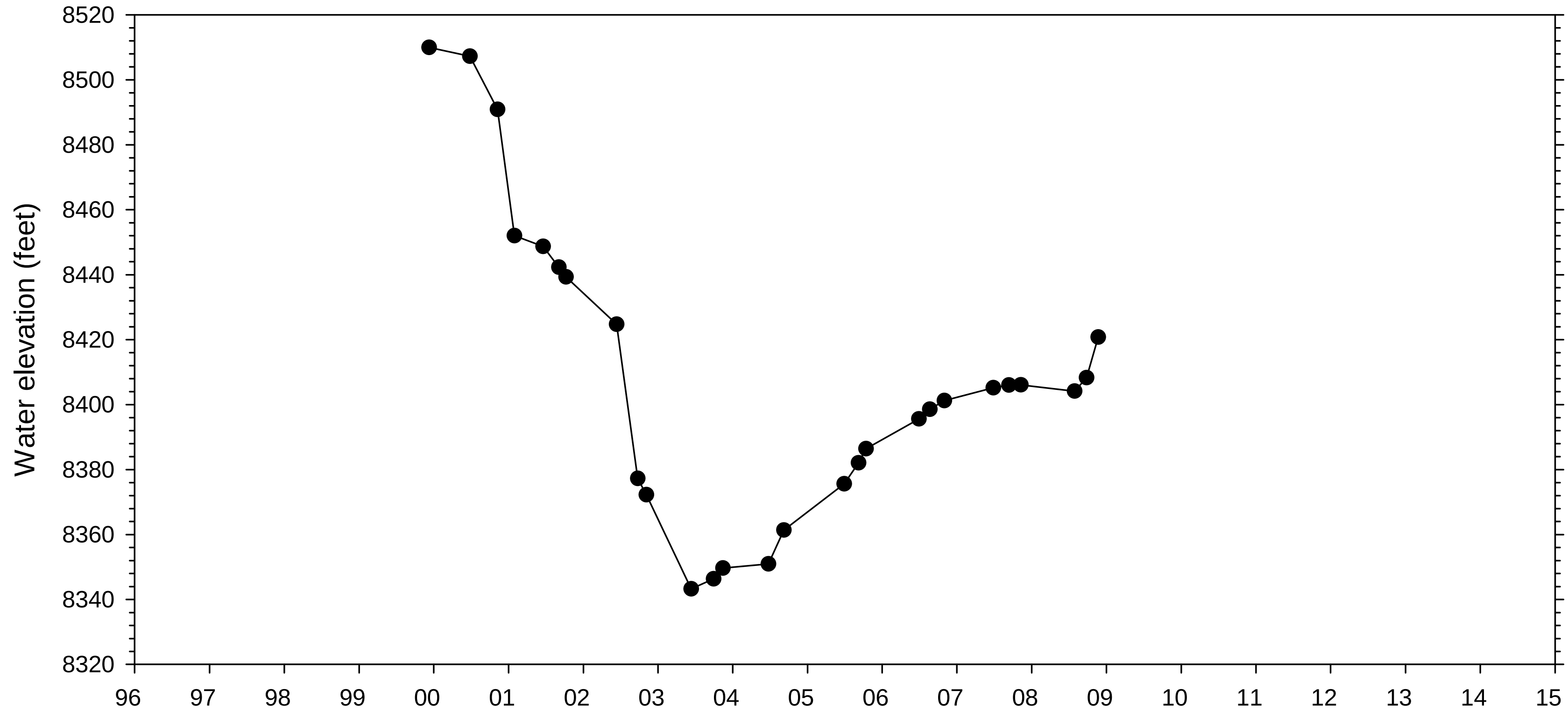


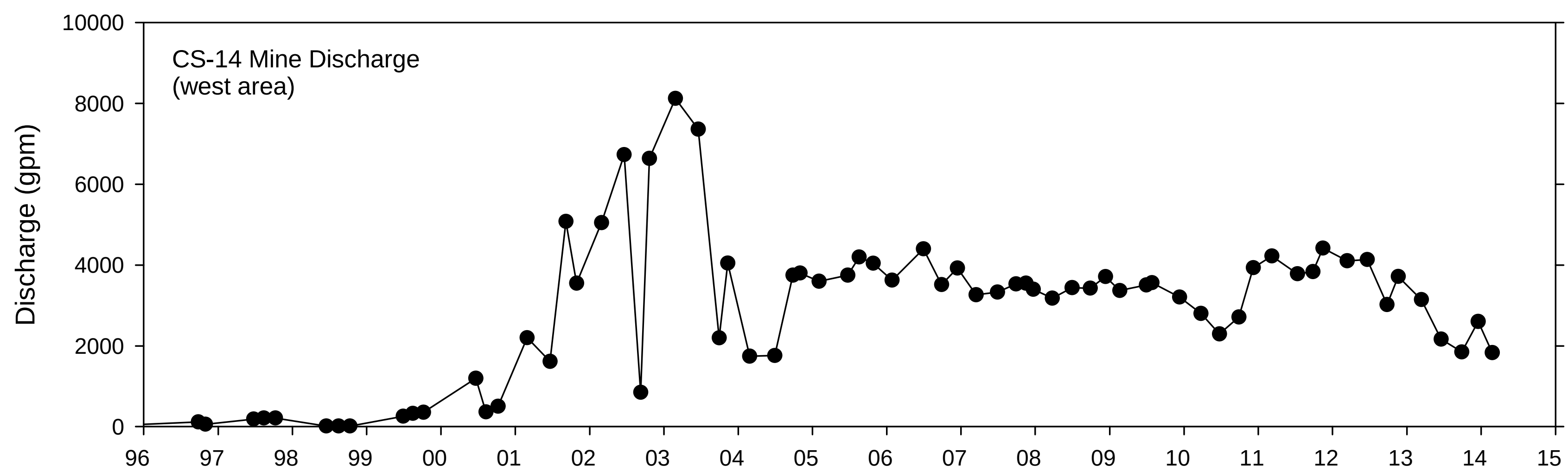
Well JC-1 pumping rate
JC-1 Well Discharge (gpm)
5000
4000
3000
2000
1000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

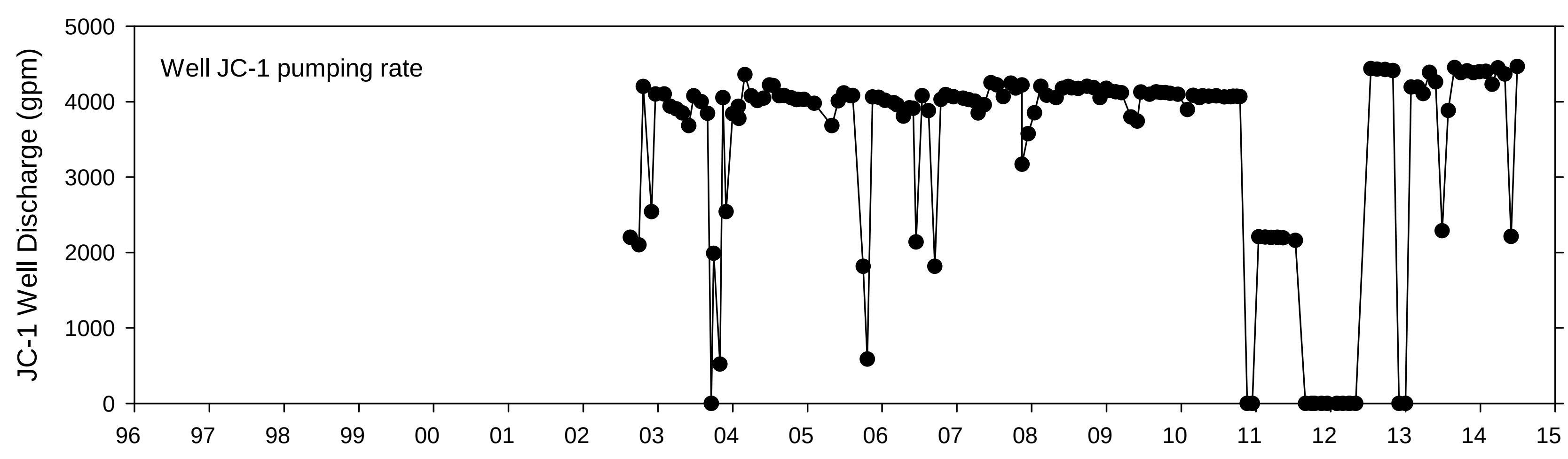


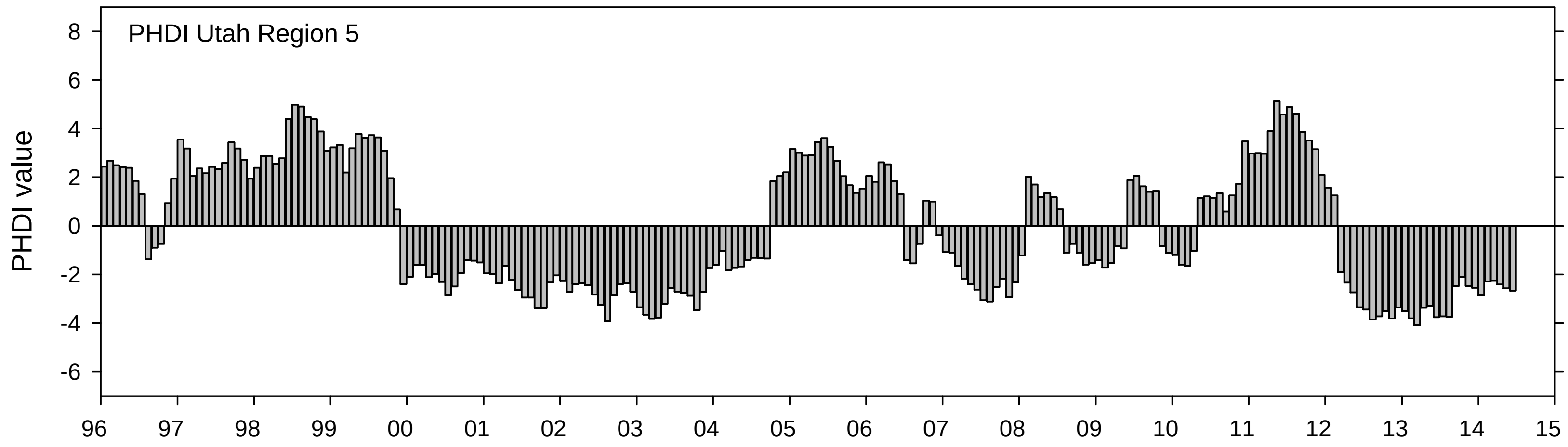
PHDI Utah Region 5
PHDI value
8
6
4
2
0
-2
-4
-6
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

W99-28-1

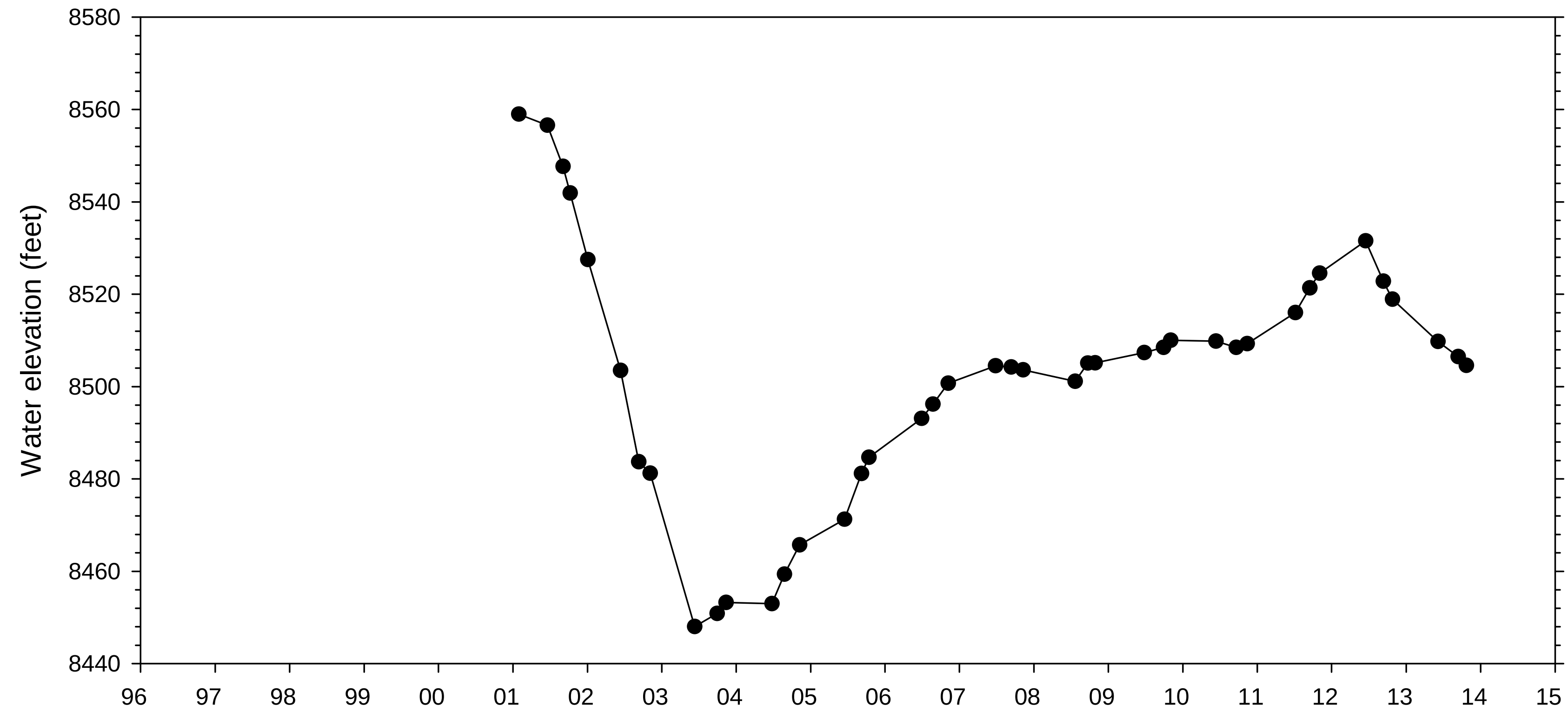

Water elevation (feet)
8520
8500
8480
8460
8440
8420
8400
8380
8360
8340
8320
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

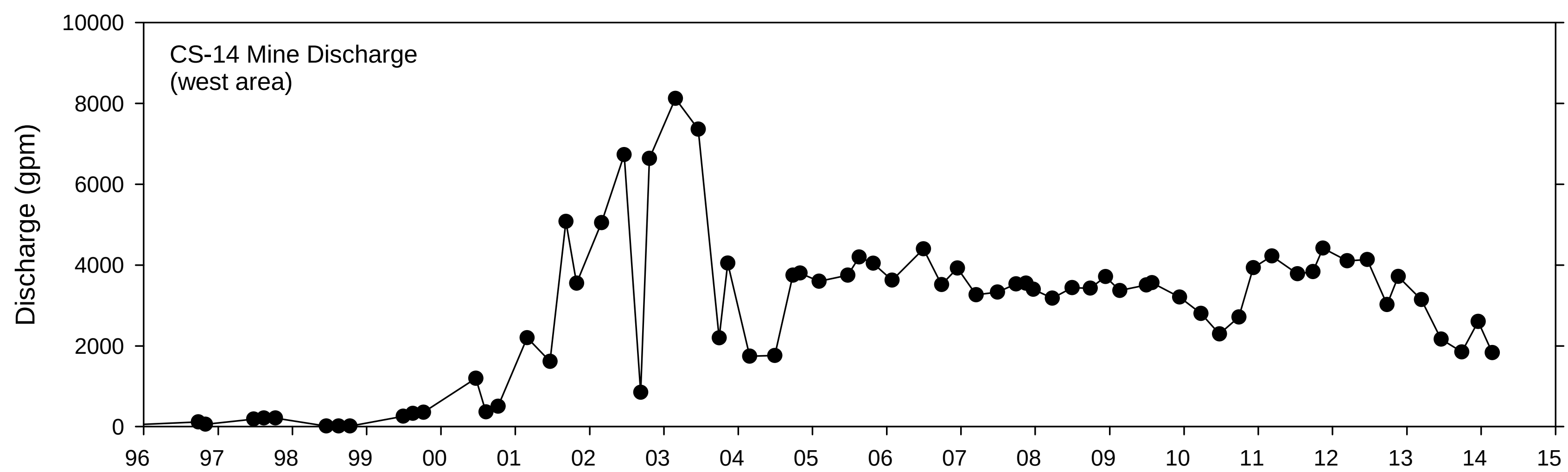

CS-14 Mine Discharge
(west area)
Discharge (gpm)
10000
8000
6000
4000
2000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

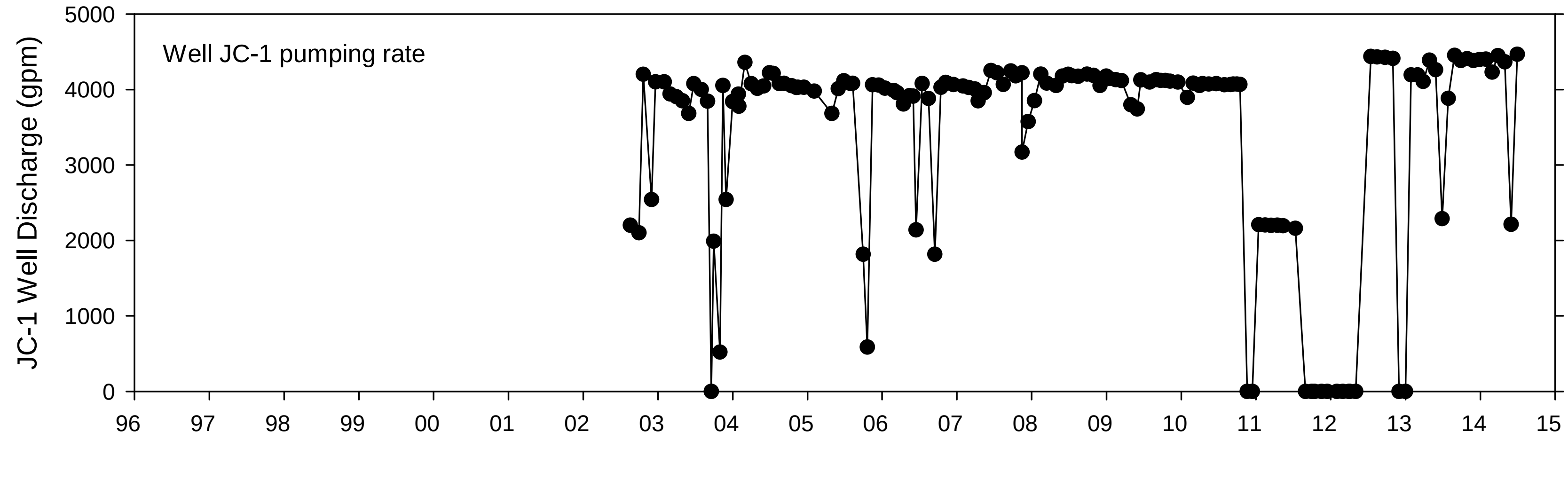

Well JC-1 pumping rate
JC-1 Well Discharge (gpm)
5000
4000
3000
2000
1000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

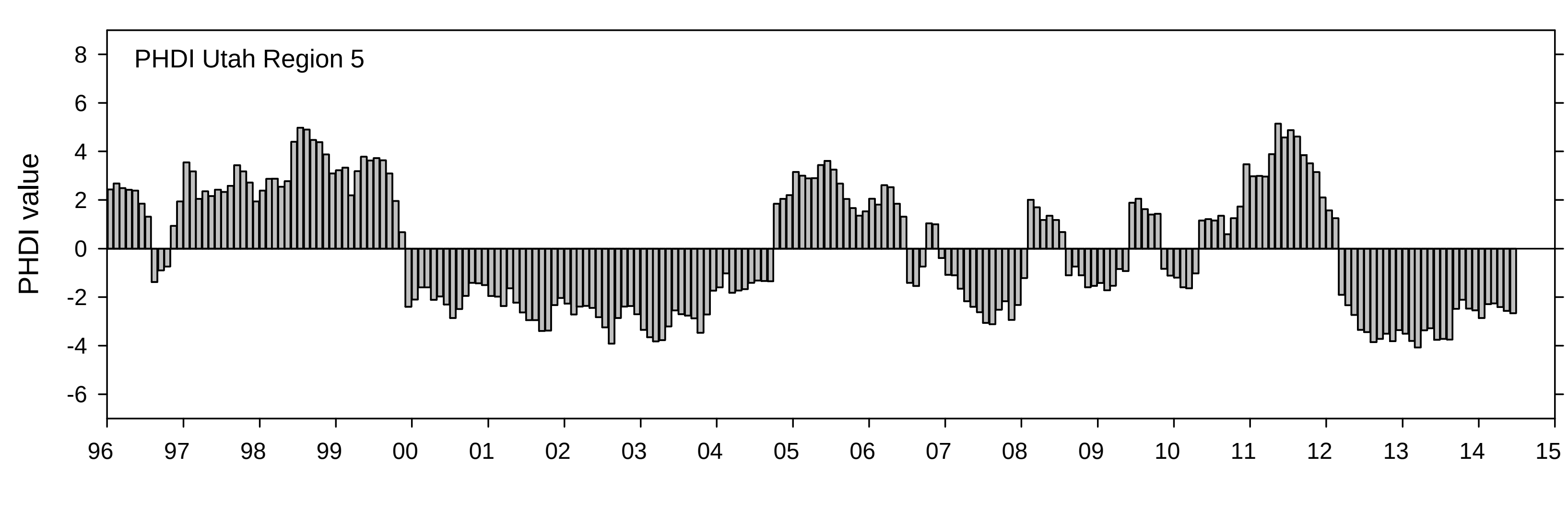

PHDI Utah Region 5
PHDI value
8
6
4
2
0
-2
-4
-6
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

W20-4-1

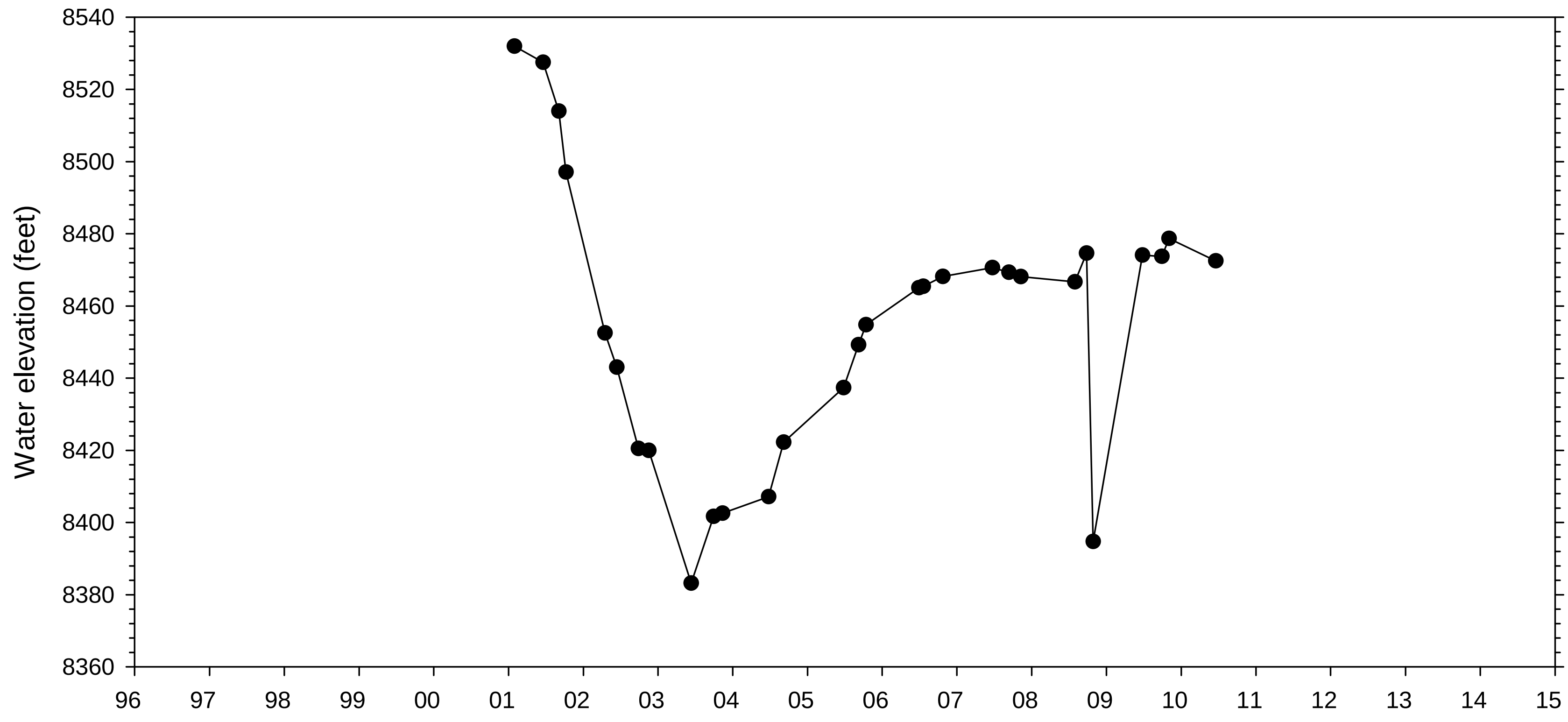

Water elevation (feet)
8580
8560
8540
8520
8500
8480
8460
8440
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15


CS-14 Mine Discharge
(west area)
Discharge (gpm)
10000
8000
6000
4000
2000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

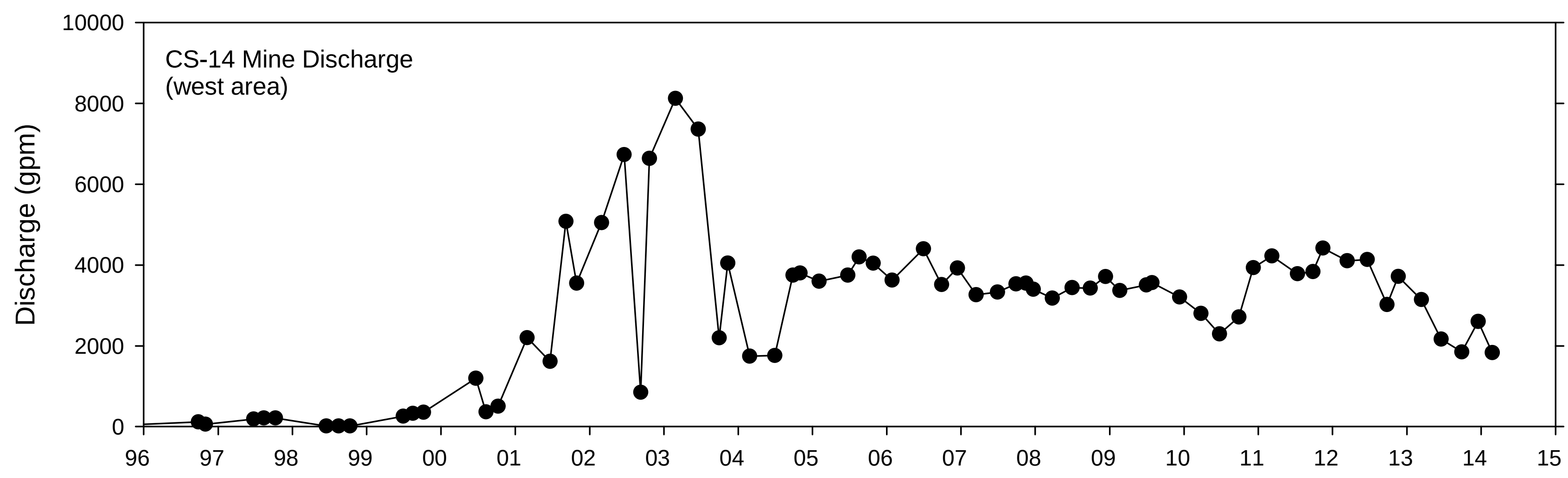

Well JC-1 pumping rate
JC-1 Well Discharge (gpm)
5000
4000
3000
2000
1000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15


PHDI Utah Region 5
PHDI value
8
6
4
2
0
-2
-4
-6
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

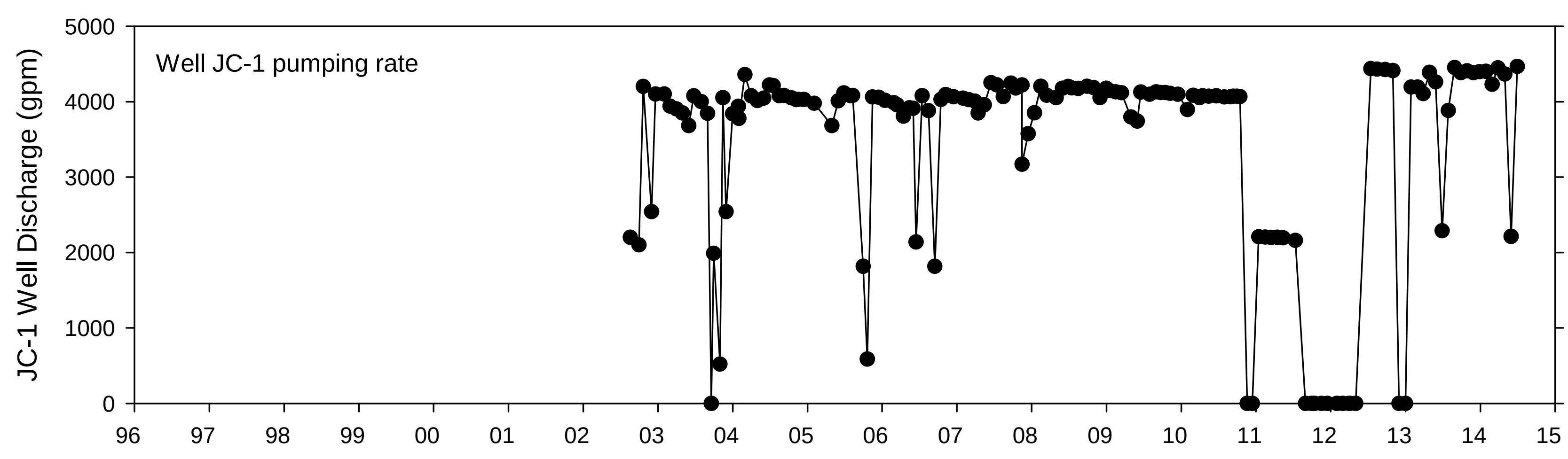
W20-4-2



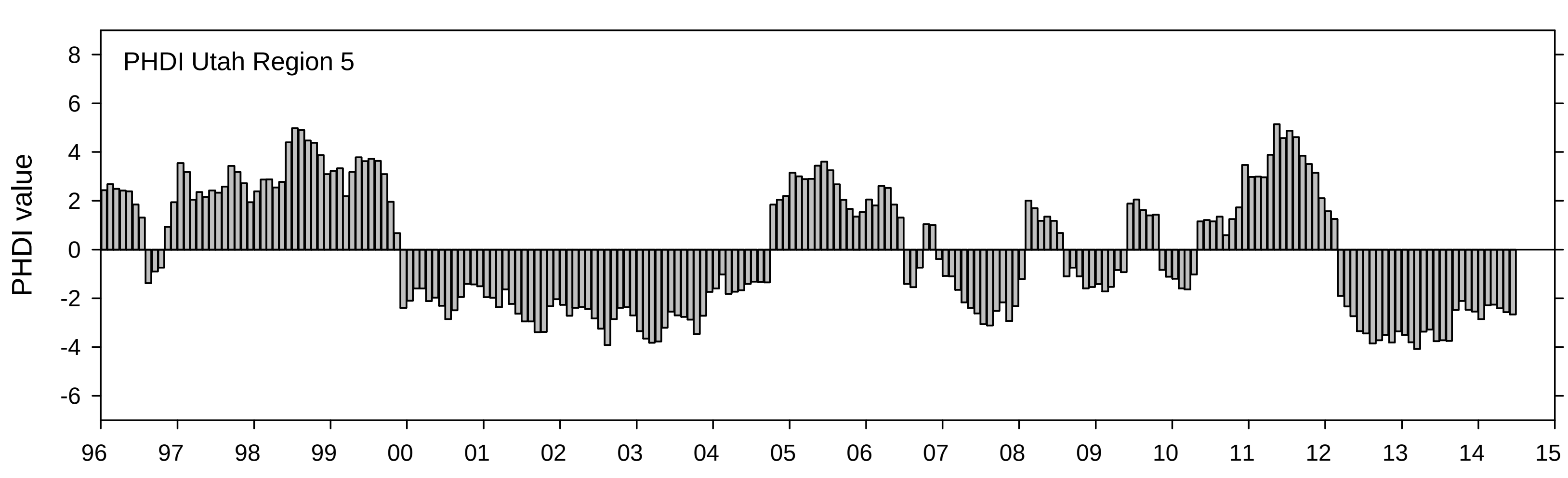
Water elevation (feet)
8540
8520
8500
8480
8460
8440
8420
8400
8380
8360
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15



CS-14 Mine Discharge
(west area)
Discharge (gpm)
10000
8000
6000
4000
2000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

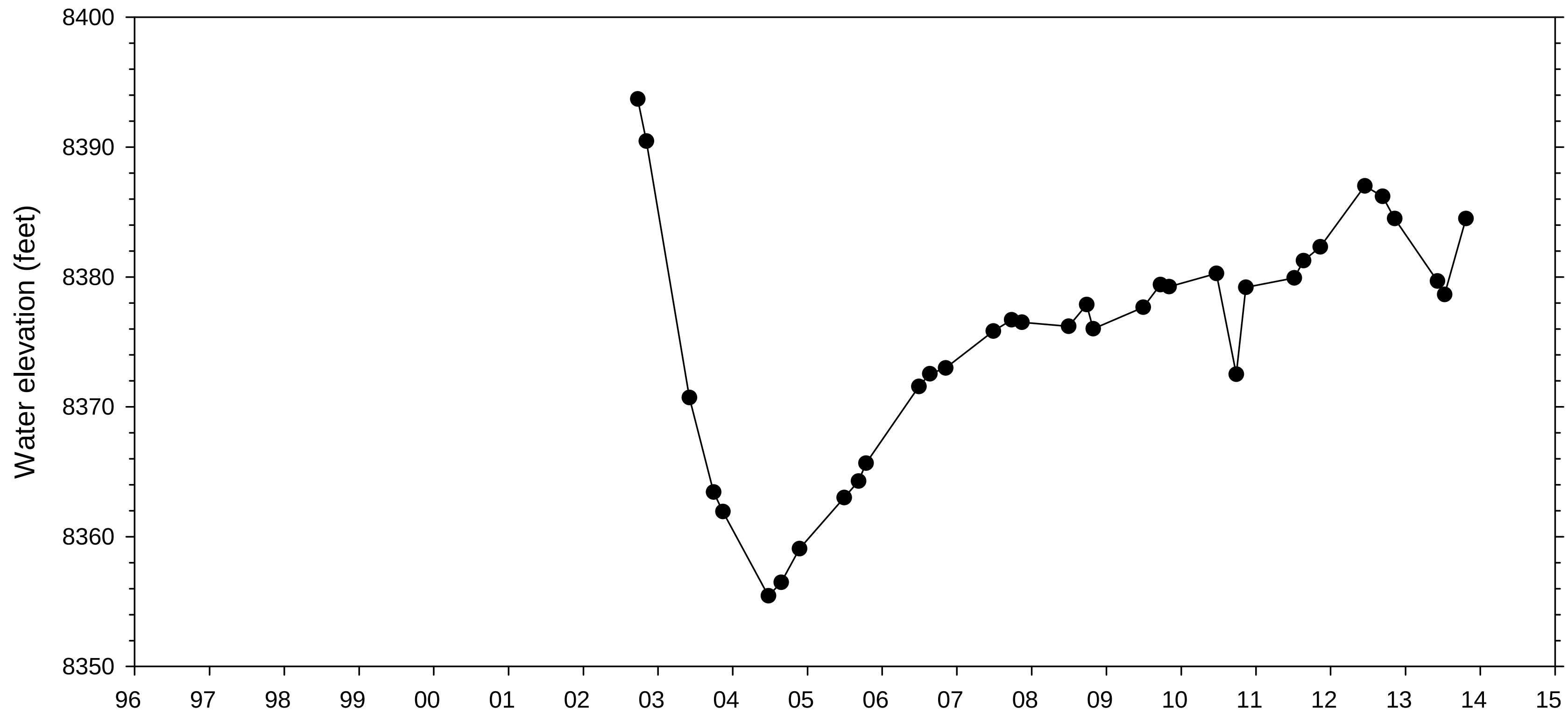


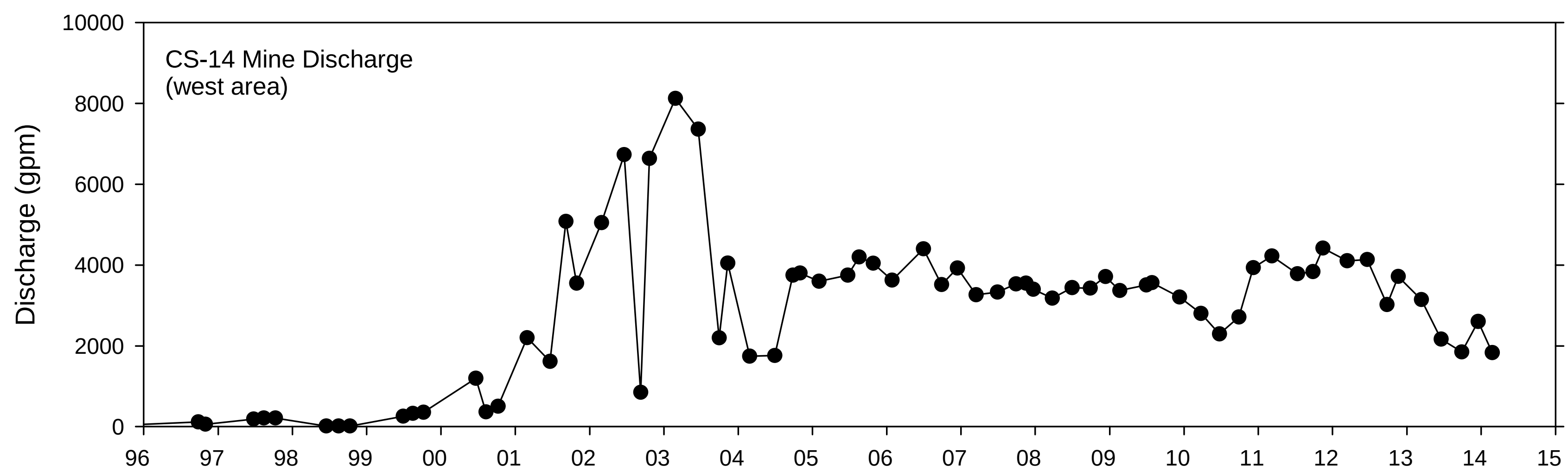
Well JC-1 pumping rate
JC-1 Well Discharge (gpm)
5000
4000
3000
2000
1000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

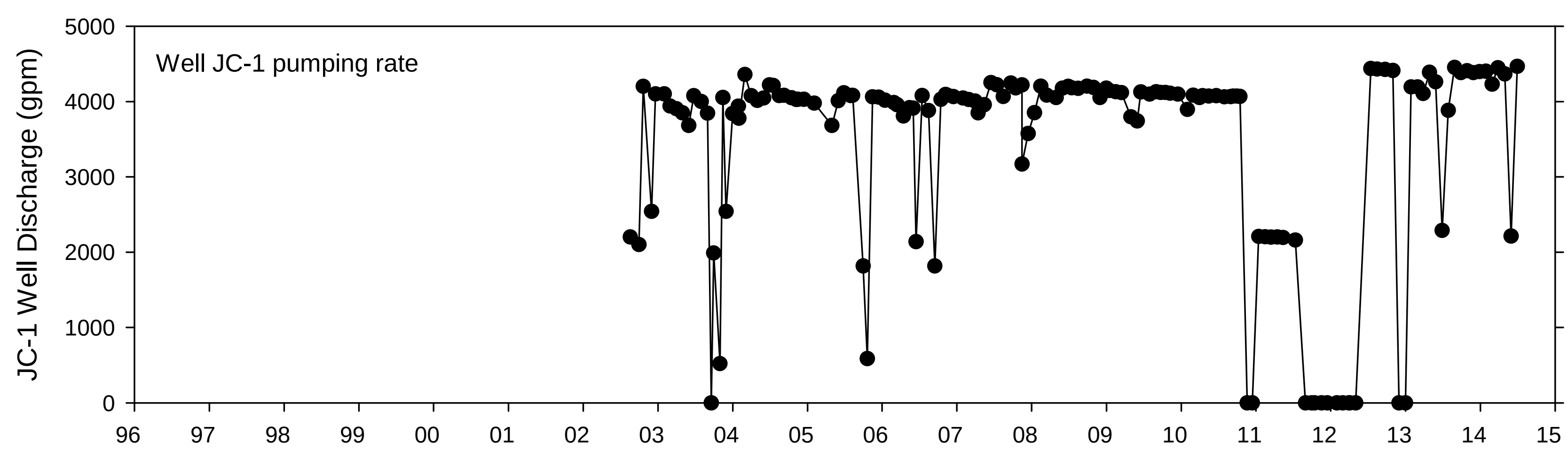


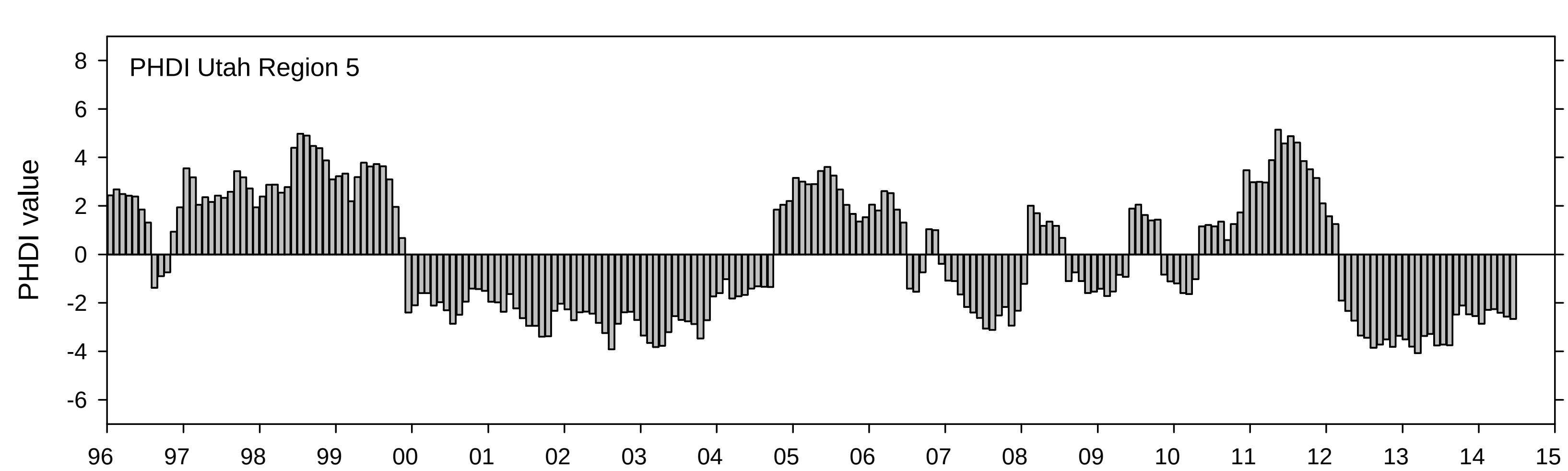
PHDI Utah Region 5
PHDI value
8
6
4
2
0
-2
-4
-6
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

W20-28-1


Water elevation (feet)
8400
8390
8380
8370
8360
8350
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15


CS-14 Mine Discharge
(west area)
Discharge (gpm)
10000
8000
6000
4000
2000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15


Well JC-1 pumping rate
JC-1 Well Discharge (gpm)
5000
4000
3000
2000
1000
0
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15


PHDI Utah Region 5
PHDI value
8
6
4
2
0
-2
-4
-6
96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

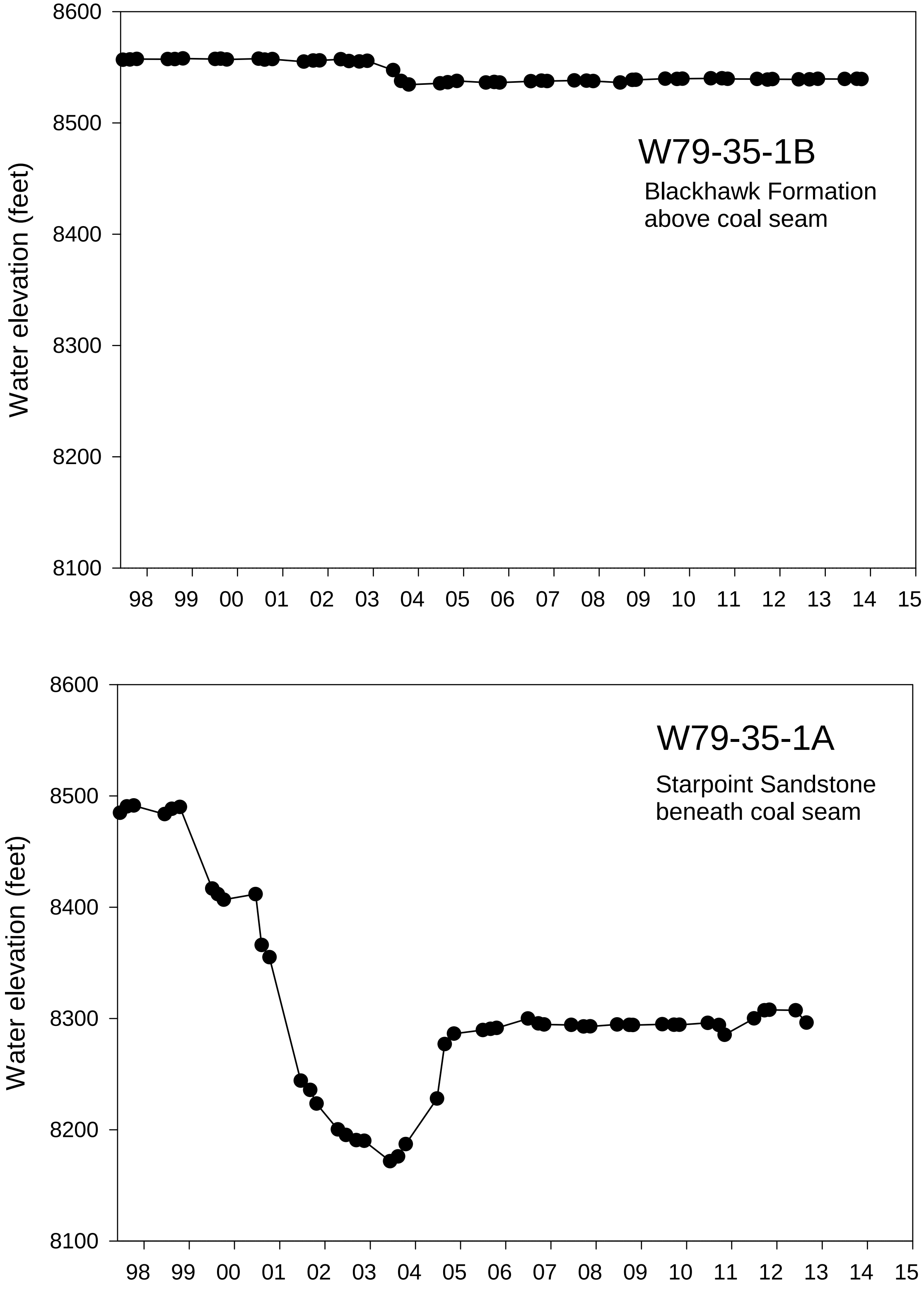


Figure 5 Comparison of water level declines at the nested piezometers at W79-35-1.

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

	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

	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

	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

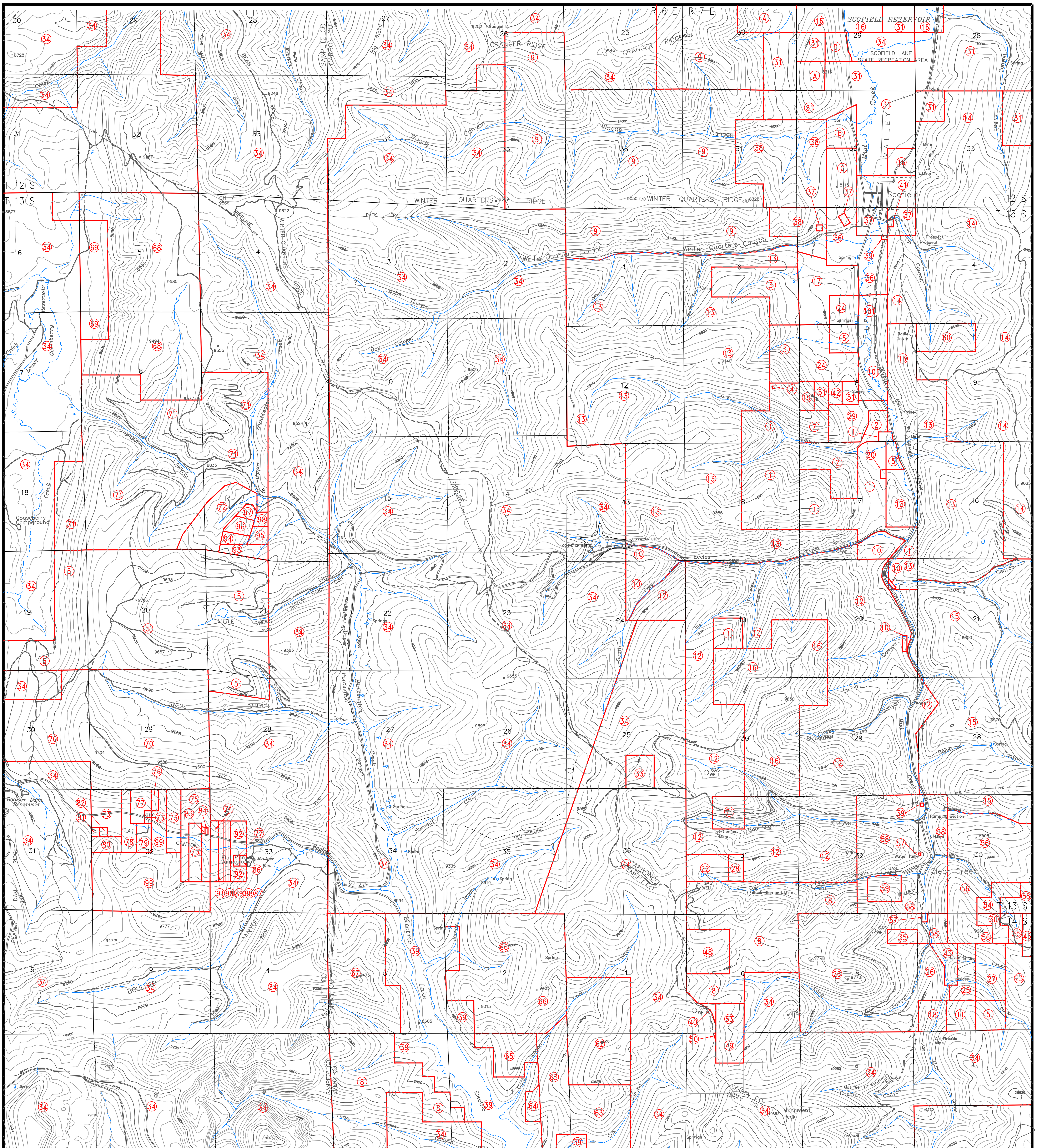
	Date	(feet)	(feet above sea level)
W98-2-1	6/28/2004	910.66	8360.34
W98-2-1	8/25/2004	893.44	8377.56
W98-2-1	11/23/2004	887.13	8383.87
W98-2-1	6/26/2005	866.15	8404.85
W98-2-1	8/31/2005	863.77	8407.23
W98-2-1	10/30/2005	859.69	8411.31
W98-2-1	6/29/2006	827.85	8443.15
W98-2-1	9/25/2006	853.5	8417.5
W98-2-1	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

	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

	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

	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

	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



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

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.

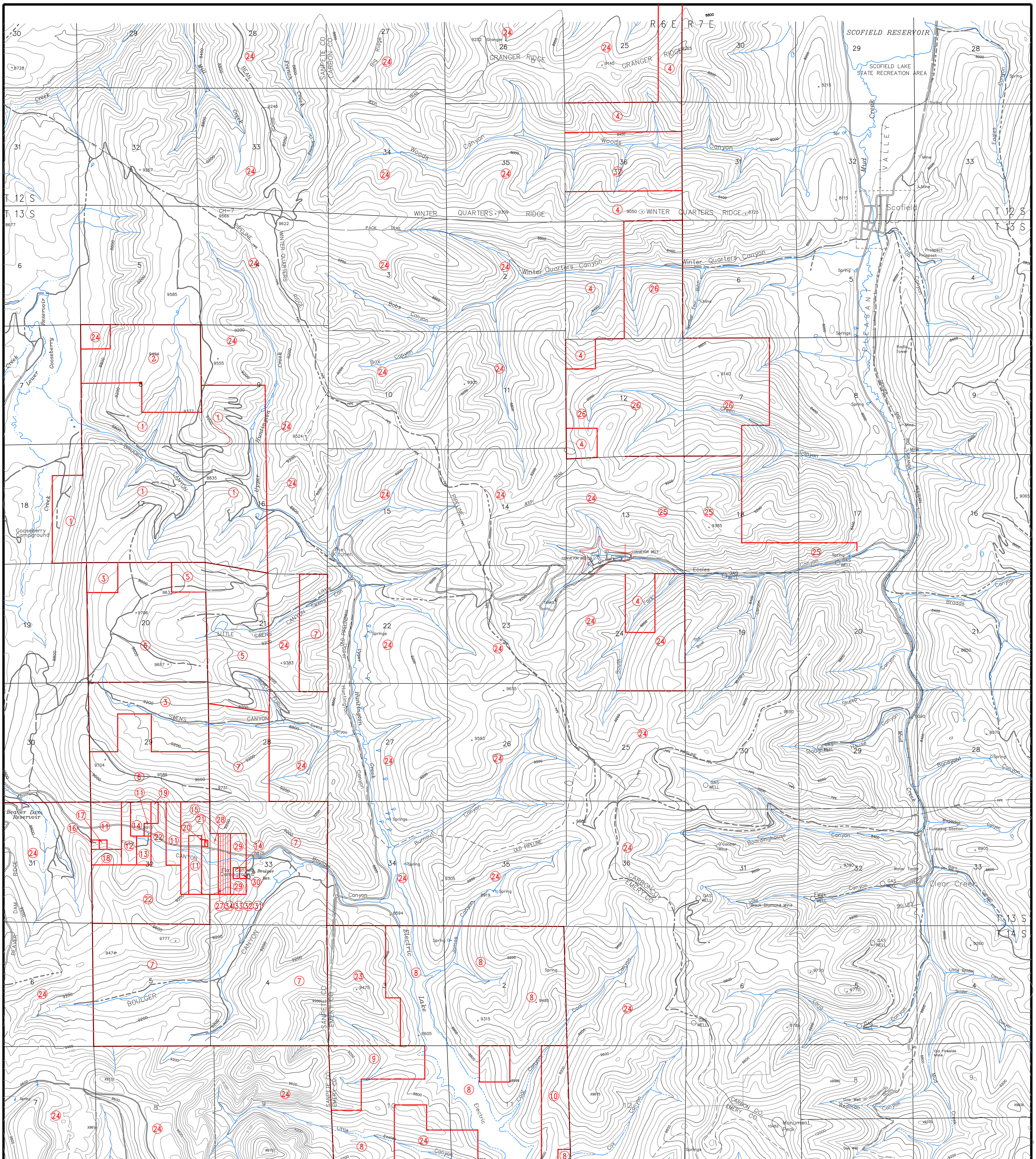
BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

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
FEB 15	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
DWG. NO.: 1.6-1 | DR.BY: CDH
CAD FILE: 1.6-1REV6
REVISION: 6
2/20/2015



SEE PLATE 1.6–3 FOR PERMIT AND ADJACENT AREAS

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'

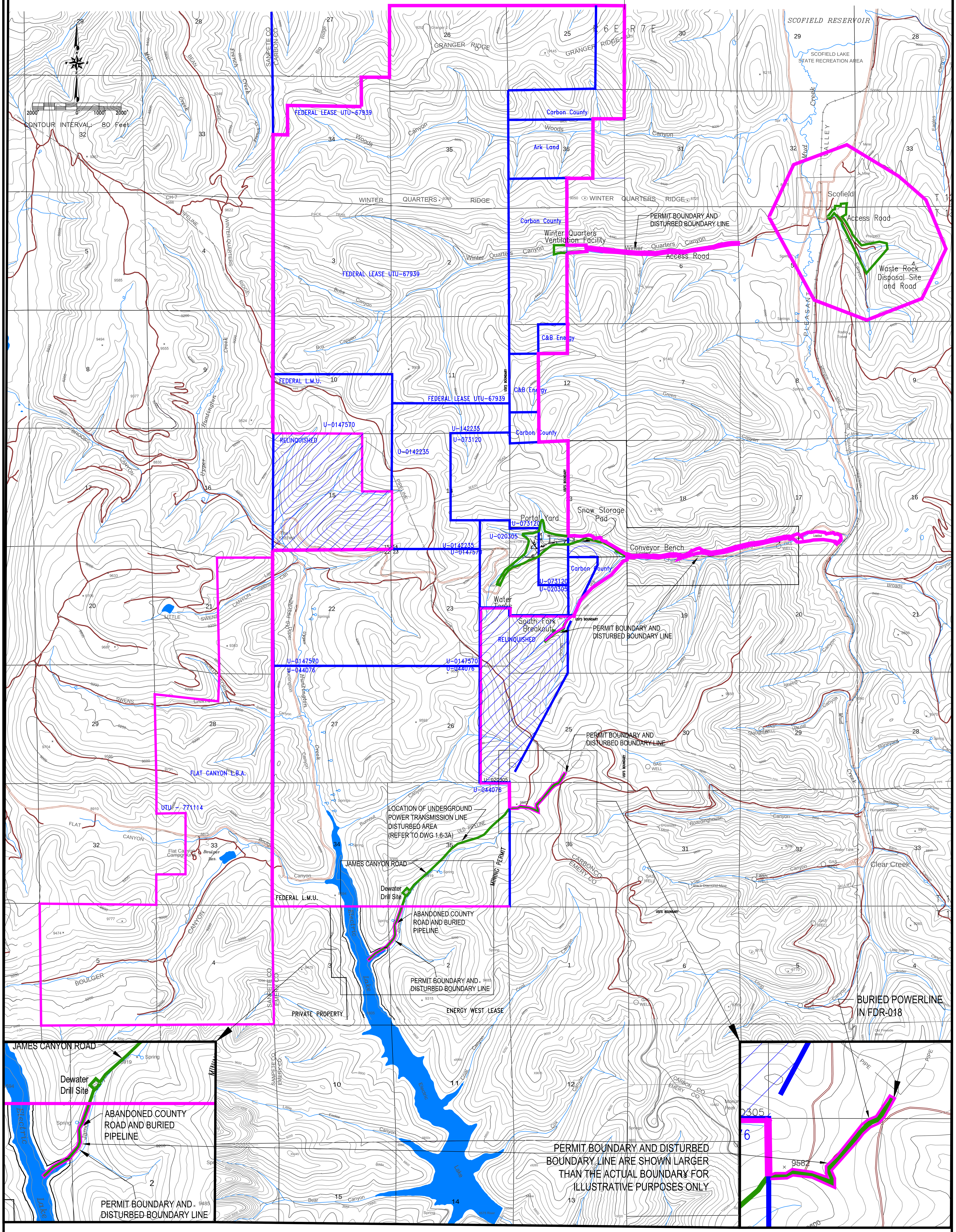
CONTOUR INTERVAL: 80 Feet

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
Feb 15	8	Modified ownership adjacent to Flat Canyon lease; #'s 22, 29, 30	/
			/
			/

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 2/20/2015
DWG. NO.: 1.6–2		DR.BY: JLP	
CAD FILE: 1.6–2REV8			



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
122.31	

LEASE ACREAGE WITHIN ADJACENT AREA

FEDERAL COAL	ACREAGE
U-0147570	1532.70
U-0142235	520.0
U-073120	557.22
U-044076	2489.32
U-020305	279.40
UTU-67939	4061.52
UTU-771114	2692.16
TOTAL	12,132.32

NON-FEDERAL COAL	ACREAGE
C&B COAL	120.00
CARBON COUNTY	811.25
ARK LAND COMPANY	240.00
TOTAL	1,171.25

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.

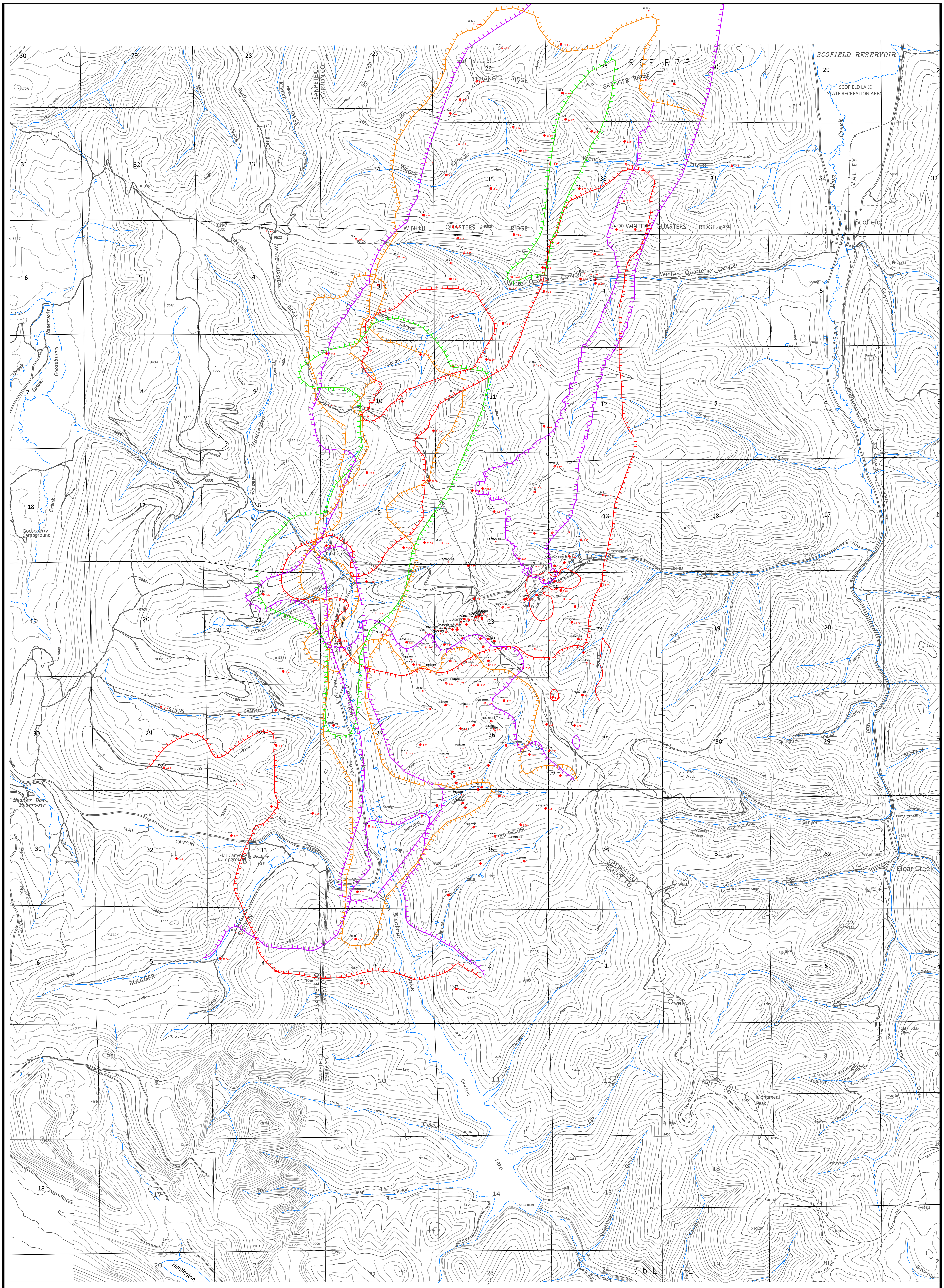
BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

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
AUG 2014	9	ADDED FLAT CANYON L.B.A.	JA/GG

SKYLINE MINE PERMIT AREA

Canyon Fuel Company, LLC
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463
Skyline Mines

SCALE: 1" = 2000' | DATE: 9/24/01 | CK.BY: G. Galecki
DWG. NO.: 1.6–3 | DR.BY: JCA
CAD FILE: 1.6–3REV9
REVISION: 9
8/25/2014



LOA SEAM PLYS

LOA7
LOA5
LOA3
LOA1
FC5
FC3
FC1

PARTINGS

FC SEAM PLYS

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'

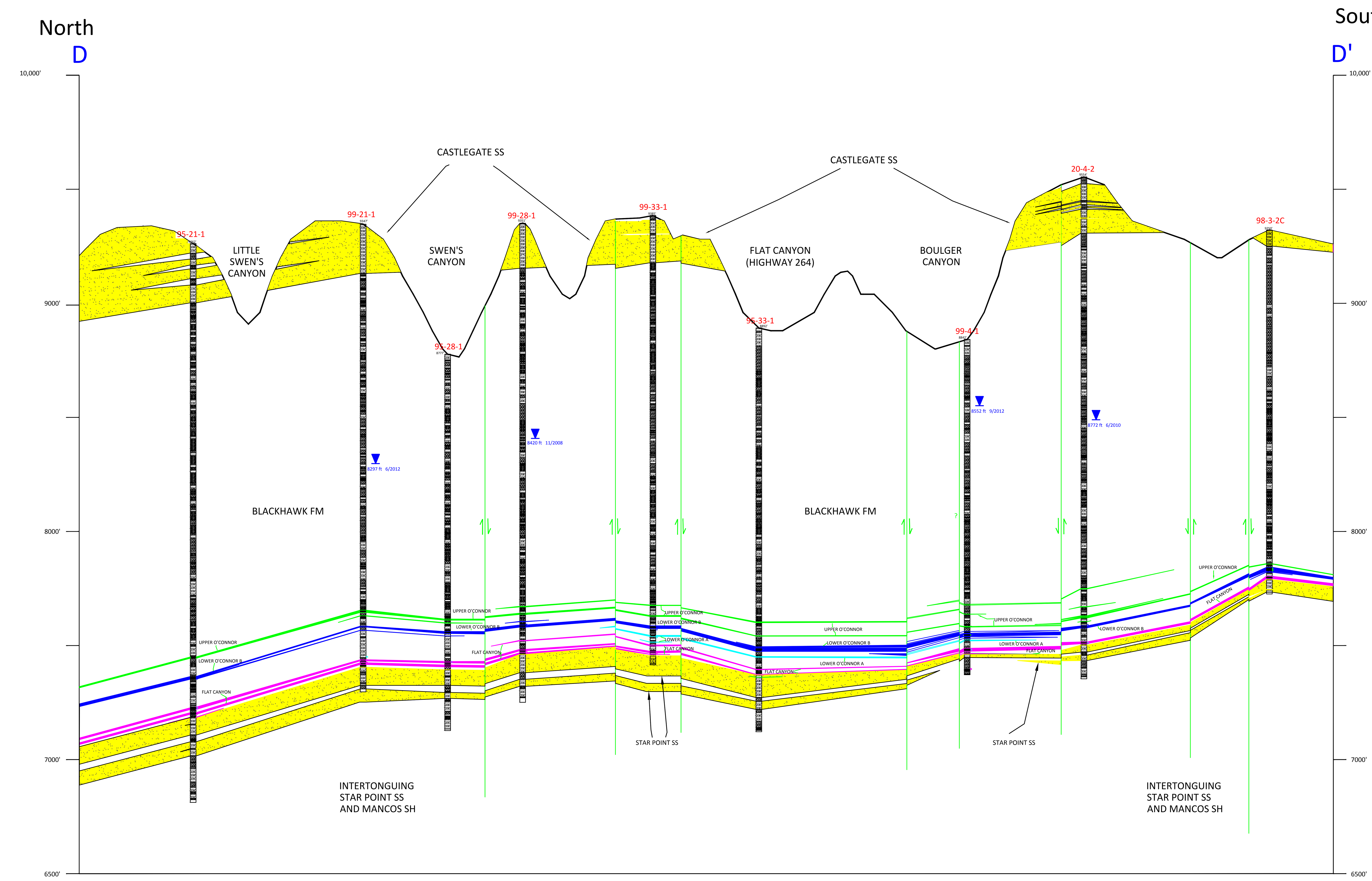
N

DATE	No.	REVISIONS	DR./CHKD
DEC 09	1	MODIFIED PERMIT BOUNDARY	AB/GG
JULY 10	2	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JH/GG
AUG 14	3	UPDATED SEAM ISOPACH	PJ/GG

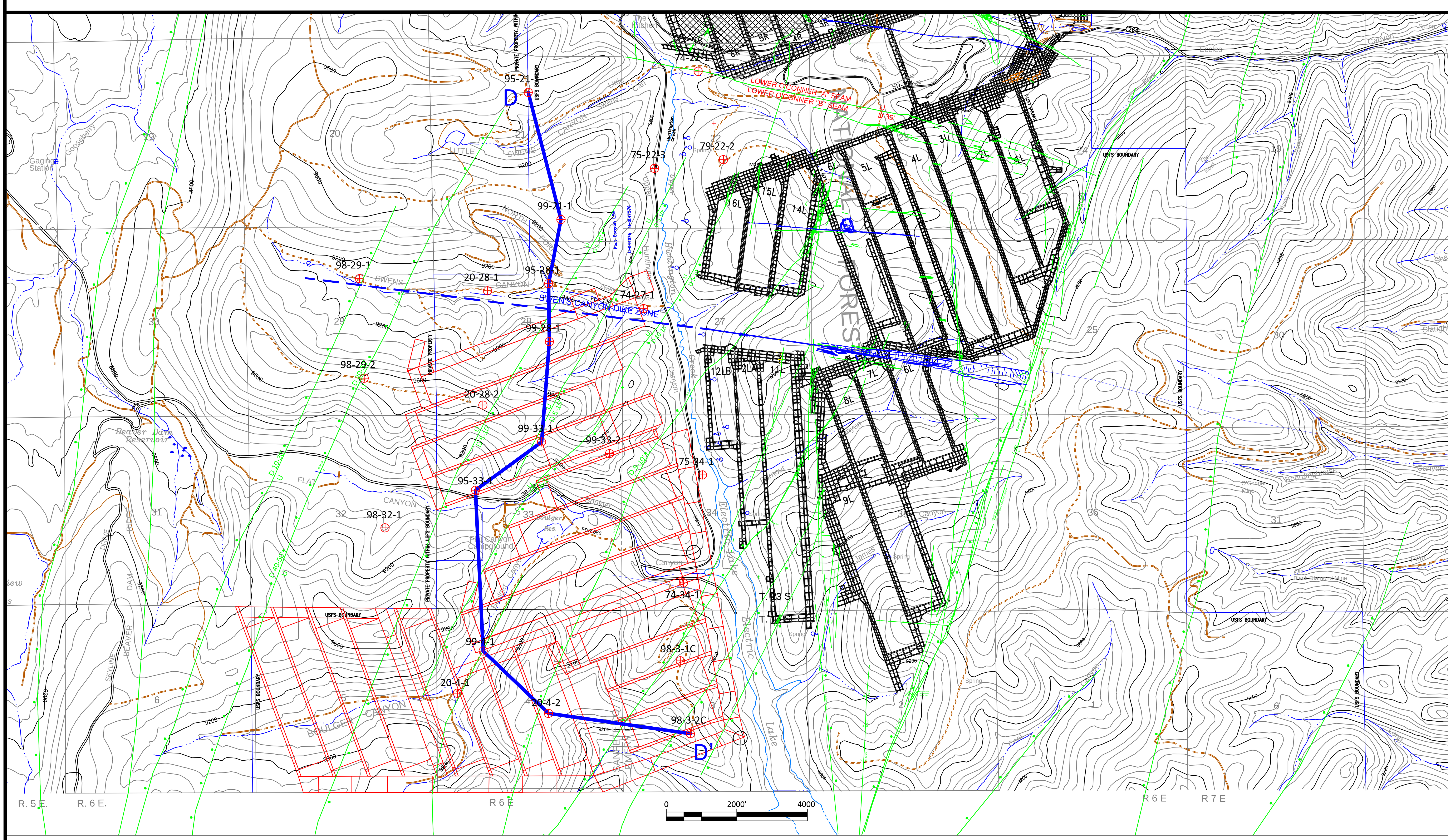
SKYLINE MINE
LOWER O'CONNER "A" / FLAT CANYON
SEAM ISOPACH

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 | 8/25/2014
CAD FILE: 2.2.7-1REV3



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

DATE	No.	REVISIONS	DR. / CKD.
			/
			/
			/
			/
			/
			/
			/
			/
			/
			/

Skyline Mine Cross Section
Structure Profile
Flat Canyon LBA

Canyon Fuel Company, LLC
Skyline Mines
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463

SCALE: Varied	DATE: 6/1/2014	CK.BY: G. GALECKI	REVISION: 0
DWG. NO.: 2.2.4-1D		DR.BY: P. JENSEN	6/1/2014
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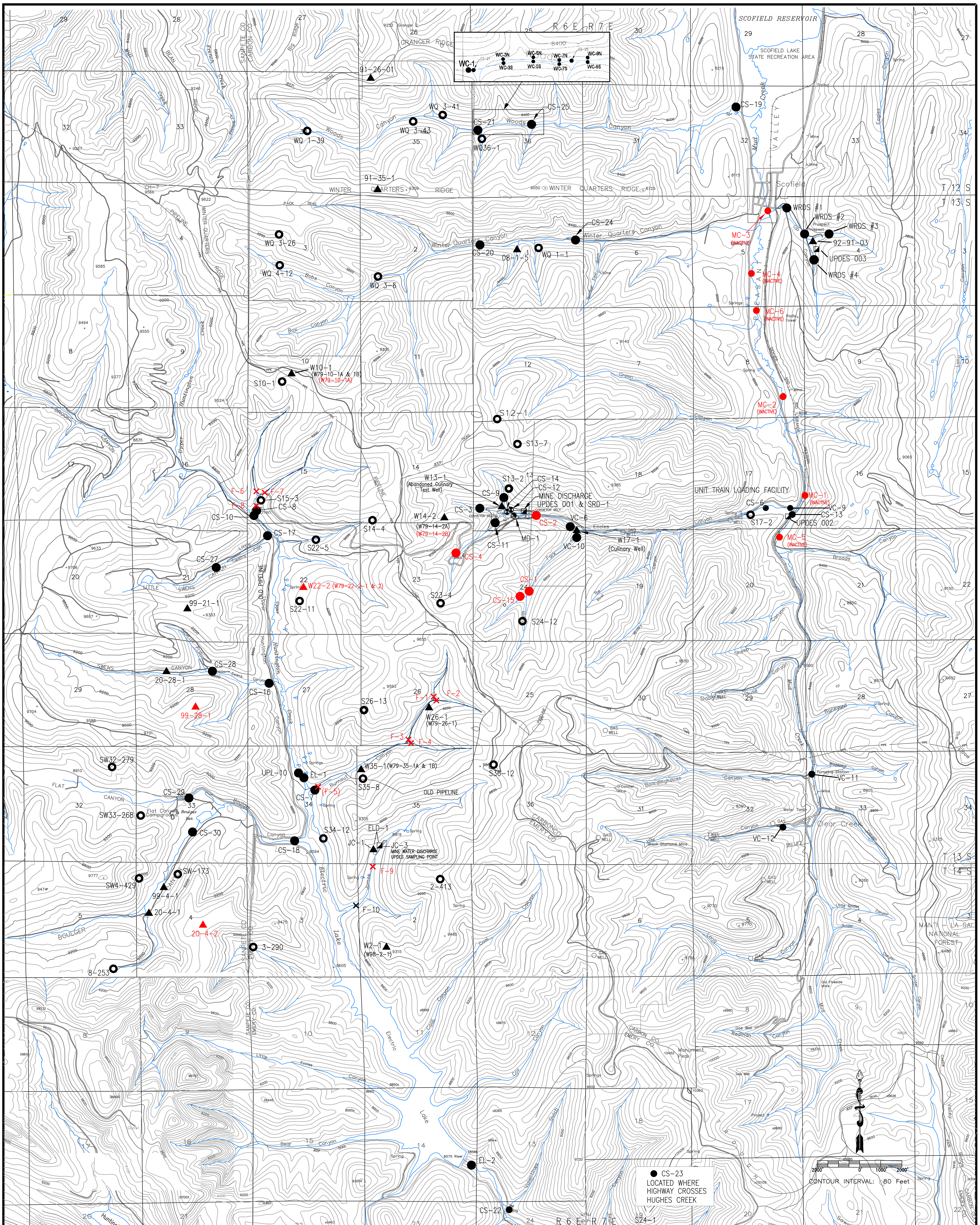


NOTES: 1. COORDINATE BASE ON MINE GRID DATA.
2. MAP DIGITIZED FROM 1:24000 USGS QUADRANGLE MAPS, SCOFIELD, UTAH AND FAIRVIEW LAKES, UTAH.
3. MINE FACILITY, CONVEYOR, AND NEW ECCLES CANYON ROAD LOCATIONS FROM EXISTING RECORD DATA AND INCORPORATED TO MAP IN BEST FIT LOCATIONS.
4. UTM GRID TICK VALUES SHOWN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

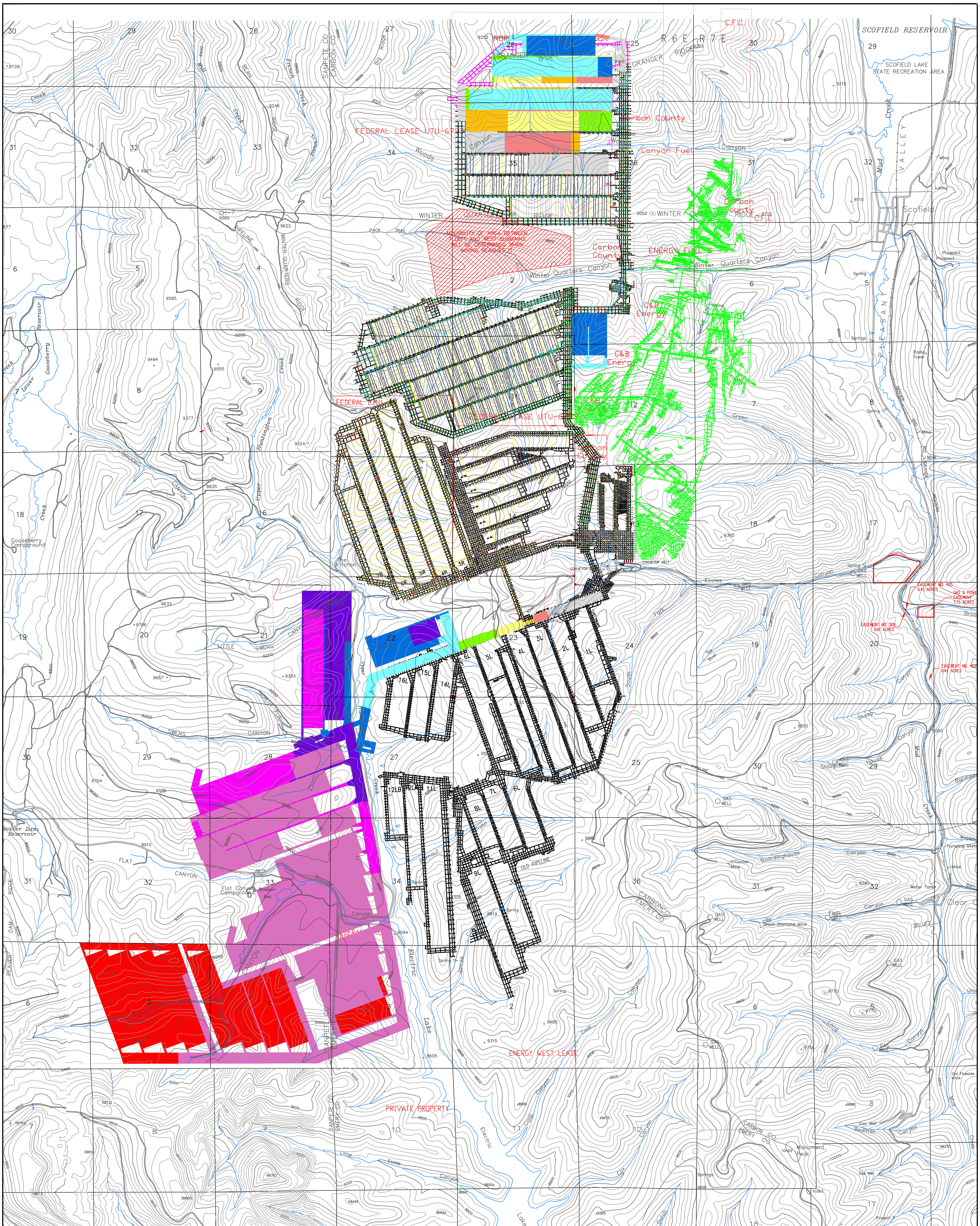
DATE	No.	REVISIONS	DR/CHKD.	DATE	No.	REVISIONS	DR/CHKD.
09/04/02	1		/GAG	AUG 09	10	Updated Current Water Monitoring Sites, Discontinued W99-28-1, CS-4, F-9 and Removed the Permit Boundary	ARB/GAG
10/07/02	2		/GAG				
04/03/03	3		/GAG	DEC 09	11	MODIFIED PERMIT BOUNDARY and Discontinued F-1 – F-8	ARB/GAG
06/04/03	4		/GAG	JULY 10	12	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JLH/GAG
03/19/04	5		/GAG	SEPT	13	RELOCATED CS-24, ADDED CS-25 AND WQ36-1	ARB/GAG
06/18/04	6		/GAG	JULY 11	14	Added WC-1 thru WC-9S, Discontinued W20-4-2	ARB/GAG
11/19/04	7		/CDH	OCT 12	15	Added NOG Sites S25-32. S26-1 and CS-26	ARB/GAG
05/05/05	8		/CDH	AUG 14	16	Added CS-27,-28,-29,-30; SW32-279, SW4-429,-173, SW33-268	JCA/GAG
JUNE 07	9	MODIFIED PERMIT BOUNDARY (IBC & WASTE ROCK) ADDED WQ1-1; INACTIVATED MC SITES	BR/GG				

Location of
Hydrologic Monitoring Stations

Canyon Fuel Company, LLC
HC35 BOX 380, HELPER, UTAH 84526
435-448-6463
Skyline Mines

SCALE: 1" = 2000'	DATE: 04-04-01	CK.BY: CDH
DWG. NO.: 2.3.6-1		DR.BY: JLP
CAD FILE: 2.3.6-1REV16		

REVISION: 16
8/25/2014



LEGEND

Legend
Remaining 2014
1st Quarter 2015
2nd Quarter 2015
3rd Quarter 2015
4th Quarter 2015
2016
2017
2018
2019
2020–2024
2025– 2030
AS MINED
WINTER QUARTERS MINE

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.

N E S W

2000' 0' 1000' 2000'

CONTOUR INTERVAL: 80 Feet

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

DATE	No.	REVISIONS	DR./CHKD.
09/04/02	1		/CDH
10/07/02	2		/CDH
05/05/05	3		/CDH
08/29/05	4		/CDH
JUNE 07	5	MODIFIED PERMIT BOUNDARY (IBC & WASTE ROCK) UPDATED MINE 3	BR/GG
DEC 09	6	Modified Permit Boundary and Mine Timing	AB/GG
JULY 10	7	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JH/GG
SEPT 10	8	MODIFIED PANEL ORIENTATION AND MINING TIMING	AB/GG
Aug 2014	9	MODIFIED MINING TIMING AND ADDED SOUTH WEST RESERVE	JA/GG
			/

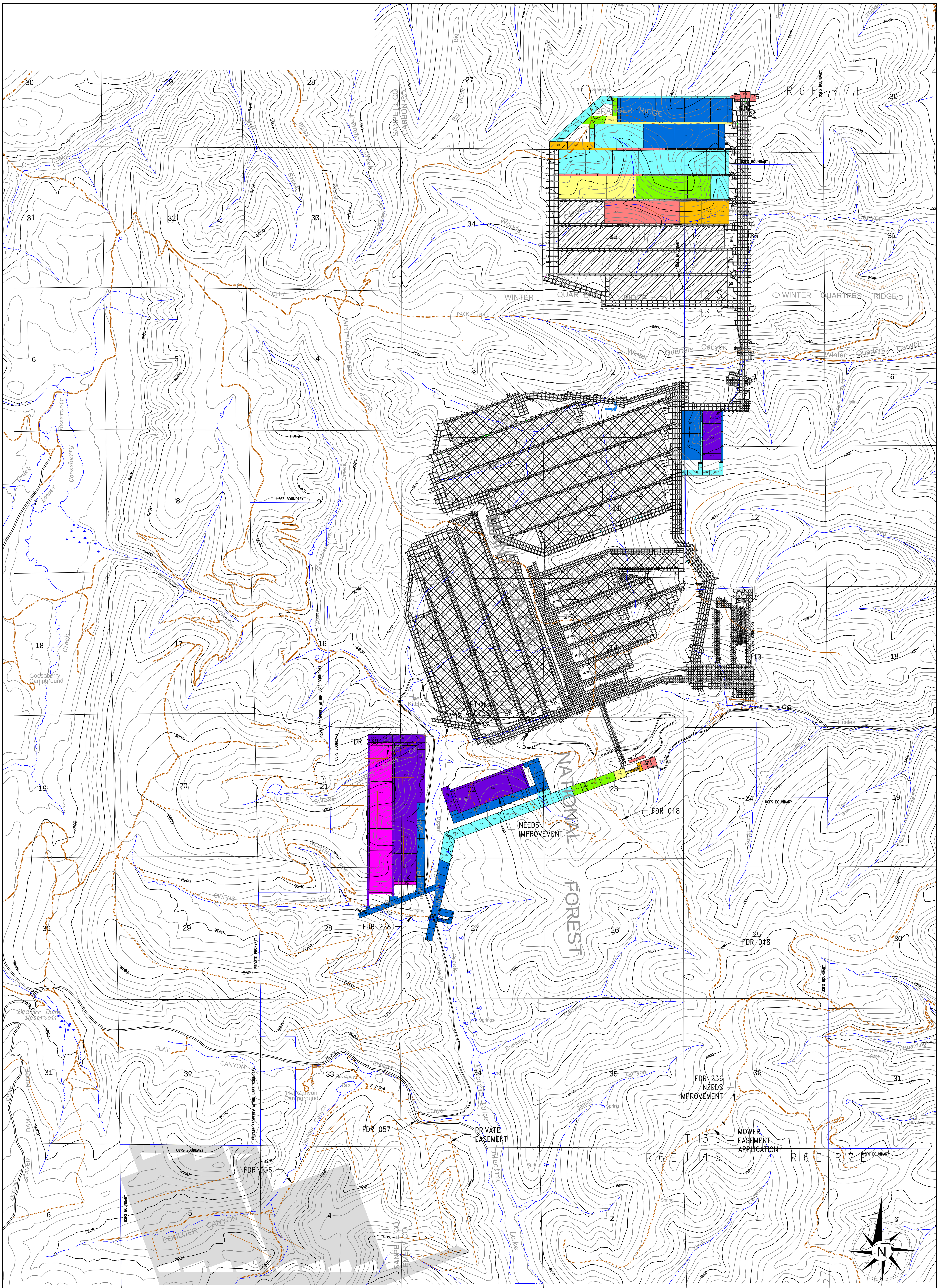
MINE 3 LEVELS 2 & 3
MINE PLAN

Canyon Fuel Company, LLC
Skyline Mines

P.O. BOX 719 HELPER, UTAH 84526
435-448-6463

CAD FILE: P\...\3.1.8-2Northlease8/05

DATE: 09/04/02
SCALE: 1"=2000'
CK.BY: C. Hansen
DR.BY:
REVISION: 9
8-25-14
DWG. NO.: 3.1.8-2



LEGEND

Color	Period
	1st QUARTER 2015
	2nd QUARTER 2015
	3rd QUARTER 2015
	4th QUARTER 2015
	2016
	2017
	2018
	2019
	2020–2029

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147   CONTOUR INTERVAL: 80 Feet

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.

2000' 0' 1000' 2000'

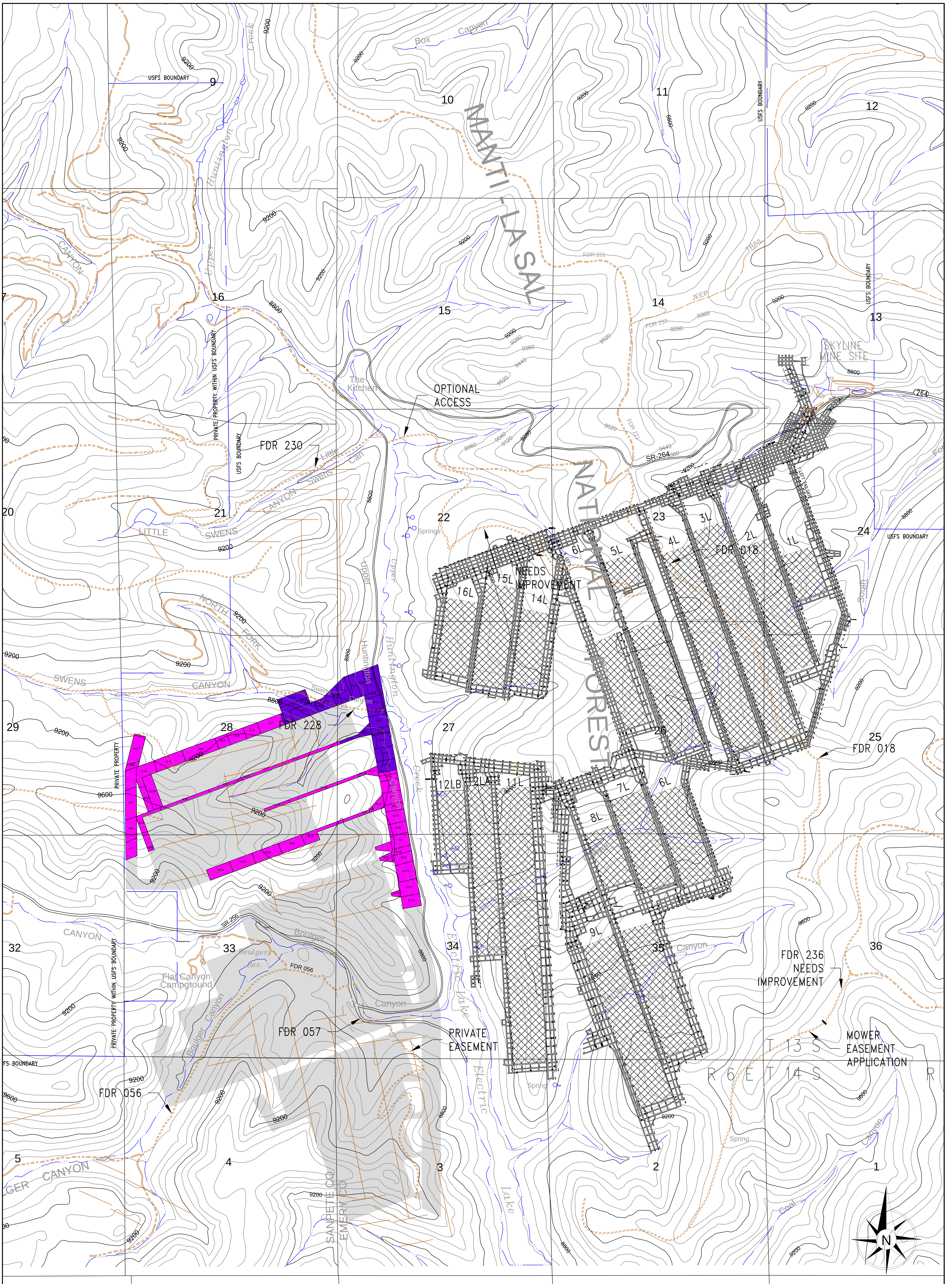
DATE	No.	REVISIONS	DR./CHKD.
09/04/02	1	CREATED MAP	/CDH
10/07/02	2		/CDH
05/05/05	3		/CDH
06/30/05	4		/CDH
06/19/07	5	MODIFIED PERMIT BOUNDARY (IBC & WASTE ROCK) UPDATED FIVE YEAR PROJECTED MINE PLAN	BR/GG
OCT 09	6	Modified Permit Boundary and Mine Timing	AB/GG
JULY 10	7	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JH/GG
SEPT 10	8	MODIFIED PANEL ORIENTATION AND MINING TIMING	AB/GG
APR. 12	9	Modified timing, added 13 Left through 15 Left	GG/GG
Feb. 20	10	Modified timing, added Flat Canyon Lease	TE/GG
			/

Skyline Mine
Lower O'Connor A, Flat Canyon Seams
Mine Plan

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526
435–448–2632

HCR 35 BOX380, HELPER, UT, 84526 435–448–2632	DATE: 2/20/15	CK.BY: GGalecki	REVISION: 10
CAD FILE:	SCALE: 1"=1500'	DR.BY: TEarl	2/20/2015
DWG. NO.: 3.3-2			



LEGEND

2018	
2019	
2020–2029	

CONTOUR INTERVAL: 80 Feet

BASE PREPARED BY INTERMOUNTAIN AERIAL SURVEYS, SALT LAKE CITY, UTAH – M96147

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.

2000' 0' 1000' 2000'

DATE	No.	REVISIONS	DR./CHKD.
2/20/15	0	CREATED MAP	TE/GG

Skyline Mine
Lower O'Conner B Seam
Mine Plan

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526
435–448–2632

DATE: 2/20/15 | CK.BY: GGalecki
CAD FILE: | SCALE: 1"=1000' | DR.BY: TEarl

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