Canyon Fuel Company, LLC
A Subsidiary of Wolverine Fuels, LLC

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

June 5, 2020

Received
6-9-20

Steve Christensen
Coal Program Supervisor
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84114-5801

RE: Midterm Review Response, Task #6138, CLEAN COPIES, Canyon Fuel Company, LLC, Skyline Mine, C/007/005

Dear Mr. Christensen:

Attached are two (2) sets of clean copies of information cited in "Completion of Midterm Review, Task #6138". Note that most of the requested modifications required only minor revisions, with the exception of a complete review of all sections of the bond and the addtion of Appendix 4.17-1 to Section 4.17 – Subsidence Control Plan of Chaper 4, which addresses the subsidence monitoring related to Boulger Reservoir. Please note that Appendix 4.17-1 addresses only subsidence as it relates to Boulger Reservoir, and an additional amendment will be submitted at a future date to address other aspects of the modified mine plan as it affects the overall permit.

Attached to this cover letter are completed C1 and C2 forms, and two (2) clean copies of the information to be incorporated into the M&RP.

If you have any questions, please call me at (435) 448-2636.

Sincerely,

Gregg A. Galecki

Gregg A. Galecki
Sr. Environmental Engineer, Skyline Mine
Canyon Fuel Company, LLC

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: Midterm Review Response Task# 6138 CLEAN COPIES

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

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Chaper 1, Table of Contents
☒ Add	☐ Replace	☐ Remove	Chapter 1 Appendicies; Missing Exhibit pages
☐ Add	☒ Replace	☐ Remove	Chapter 2, Section 2.11, Pages 2-120(l), 2-120(m)
☐ Add	☒ Replace	☐ Remove	~~Chapter 2, Plate 2.7.1-2REV2~~ is superseded by Revision 3
☐ Add	☒ Replace	☐ Remove	Chapter 2, Plate 2.8.1-1REV5 12.20.19 in NOV Shaft Removal
☐ Add	☒ Replace	☐ Remove	Chapter 3, Section 3.2. page 3-72c application
☐ Add	☒ Replace	☐ Remove	Chapter 3, Plate 3.2.1-2B Rev. 3
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.2, Bond Total Sheet
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.2, Demolition Section
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.2, Earthwork Section
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.2, Revegetation Sectoin
☐ Add	☐ Replace	☐ Remove	Chapter 4, Section 4.6 pages 4-34(b), 4-35, 4-38(a) through 4-38(d), 4-39(a)1
☒ Add	☐ Replace	☐ Remove	Chapter 4, Section 4.17 page 4-94
☒ Add	☐ Replace	☐ Remove	Chapter 4, Section 4.17, Appendix 4.17-1 Boulger Subsidence Monitoring *
☐ Add	☒ Replace	☐ Remove	Chapter 4, Plate 4.17.3-1A rev.10 12-20-19
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	
☐ Add	☐ Replace	☐ Remove	* contains confidential information (SHPO)
☐ Add	☐ Replace	☐ Remove	that has been moved to confidential binder.
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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**
Two (2) sets of CLEAN COPIES are provided.	

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: Skyline Mine Midterm Review
Description, Include reason for application and timing required to implement:
Midterm review information Task #6138 CLEAN COPIES

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

☐ Yes ☒ No 1. Change in the size of the Permit Area? Acres: _____ Disturbed Area: _____ ☐ increase ☐ decrease.
☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO# _____
☐ Yes ☒ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☒ Yes ☐ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes ☒ No 6. Does the application require or include public notice publication?
☐ Yes ☒ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☐ Yes ☒ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV # _____
☒ Yes ☐ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain: Response to Division personnel midterm review of the permit
☐ 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?

Please attach four (4) review copies of the application. If the mine is on or adjacent to Forest Service land please submit five (5) copies, thank you. (These numbers include 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.

DEWLY L TANNER.
Print Name

[signature] GM 6/4/20
Sign Name, Position, Date

Subscribed and sworn to before me this 4 day of June, 2020

[signature]
Notary Public

My commission Expires: 03-19, 2023 }
Attest: State of Utah } ss:
County of Carbon

MELISSA S. WILLDEN
NOTARY PUBLIC · STATE OF UTAH
COMMISSION# 705119
COMM. EXP. 03-19-2023

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

Form DOGM- C1 (Revised March 12, 2002)

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July 2002
(Volume 1)

Addendum to the Probable Hydrologic Consequence July 2002

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Baseline Monitoring of the Benthos in Winter Quarters Creek & Woods Canyon Creek - October 2003 & June 2004

An Electrofishing Survey of Woods & Winter Quarters Canyons, October 2002

Biological Studies in Winter Quarters Canyon Creek & Woods Canyon Creek, May 9, 2005

Intermountain Labs Soil Sample Analysis North lease portion Mine #3 Oct 2007

Intermountain Labs Soil Sample Analysis North lease portion Mine #3 Jan 2008

Tetra Tech Winter Quarters Canyon wildlife studies summary Mar 2009

Western Land Services Winter Quarters Canyon Subsidence and Pad Disturbance Areas report addendum Mar 2010

Mt Nebo Scientific Estimates of the Fall 2010 Cutthroat Trout population densities in Winter Quarters Canyon creek and Woods Canyon creek, tributaries to Scofield Reservoir Nov 2010

Gregg Galecki Basis for Macroinvertebrate and fish monitoring program Mar 2015

Appendix A- Skyline Mine Macroinvertebrate review for Eccles, Winter Quarters, and Woods Canyon Creeks Mar 2015

Western Land Services Southwest Reserves NEPA analysis Area 2011 Northern Goshawk, other Raptors, and General wildlife surveys Aug 2011

Western Land Services Southwest Reserves NEPA analysis Area 2012 Northern Goshawk, other Raptors, and General wildlife surveys Aug 2012

Standard Labs Soil samples Apr 2010

Commercial Testing and Engineering Geology samples analysis Jan 1996

Commercial Testing and Engineering Geology samples analysis Feb 1996

Commercial Testing and Engineering Geology samples analysis Apr 1999

SGS Labs 15-21-2 Geology samples analysis Nov 2015

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A-3, Volume 2 (continued)

SGS Labs 15-21-2 Geology samples analysis Nov 2015

SGS Labs 15-21-2 Geology samples analysis Nov 2015

Skyline Mine Drill logs for hole 15-21-2

Western Land Services 2017 Wildlife survey report, Areas of potential Subsidence July 2017

A-4 Volume 1

Confidential Drill Hole Geology

A-4 Volume 2

Confidential Cultural

Confidential Sensitive wildlife agreements

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A-5 Volume 1

1 Slope Stability Evaluations and Access Road Embankments - Sedimentation Ponds, Miscellaneous Fills, Facilities and Designs

2 Estimate of Peak Flow Discharge

3 Mine Site CSP Design

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14 Drainage Control Waste Rock Disposal Site

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16 Waste Rock Disposal Area Capacity and Schedule

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20 Designs For ASCA Treatments

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21a Demonstrations for Exempt Areas (14 sites)

22 Undisturbed Drainage Ditch and Culvert to Route Runoff Around James Canyon Water Wells

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23a Environmental Assessment UTU-67939 Winter Quarters Tract

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25 NOG Pad & Hydrology

26 Swens Canyon pad

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Eccles/ Mud Creek Work Plan

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Swens Canyon Ventilation Facility (SCVF)

A detailed description of the soils associated with the Swens Canyon Ventilation Facility (SCVF) and associated power line is available in Appendix A-2, Volume 2, titled, "Order 2 Soil Survey of the Powerline Corridor Swens Pad Ventilation and Escape Shafts Coal Pile Expansion at the Skyline Mine" (December 2014). The survey conducted by Long

Resources Consultants, Inc. provides a comprehensive assessment of the various soils that are within the power line corridor and the pad site. No soils are anticipated to be disturbed along the power line with the exception of soils moved for the placement of the single, wooden poles, and the area where the buried section of cable daylights, which are both exempt due to the limited disturbance. The buried section of power line will be bored from the Swens pad using a directional drilling method. Where the buried cable connects to the above-ground section, any potentially disturbed topsoil will be salvaged and a sample collected to test nitrogen, phosphorus, and potassium analyzing for future treatment when reclaiming. The power line corridor is approximately 2.6 miles in length and will be approximately 15-feet wide with no disturbance of the topsoil anticipated. Installation will be conducted using rubber-tired vehicles or tracked vehicles keeping the number of access trips necessary for construction to a minimum.

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The SCVF pad site encompasses approximately 9.7 acres with two (2) soil types present. The majority of the site is represented by the Hailman soil family, with a sandy loam on 5-15% slopes. The soil pit identified an estimated topsoil depth is approximately 16-inches (S1 from Figure 2 of soil survey). The remainder of the site consisting of the access road is represented by the Kamack soil family with a sandy loam on 10-35% slopes (S2), with an estimated topsoil depth of approximately 10-1nches. Prior to construction, soil samples were collected from the A and B horizon at sample locations 14SKY14 and 14SKY15 and analyzed for available nutrients nitrogen, phosphorus, and potassium per DOGM 2008 guidelines. Lab Soil Analysis of these samples are located in both Appendix D of "Order 2 Soil Survey of the Powerline Corridor Swens Pad Ventilation and Escape Shafts Coal Pile Expansion at the Skyline Mine" Appendix Volume A-2, Volume 2 of the M&RP and the 2016 Annual Report. Approximately 1-foot of topsoil was salvaged and stored. Plate 3.2.4-4F illustrates the removal areas, and estimated depths of combined topsoil and subsoil to be stockpiled totaling approximately 15,100 cu-yds. Topsoil (~8750 cu-yd) and subsoil (~6350 cu-yd) will be segregated on the pile using orange fencing/construction fabric. Once stored, the topsoil will be analyzed for available nitrogen, phosphorus, and potassium for future soil treatment. Efforts will be made to minimize the steepness of the slopes of the topsoil by configuring the pile with the steeper slopes being subsoil. A berm and silt trap will be used to retain the material until vegetation is established. The surface of the pile will also be deep-gouged, seeded, and top-dressed with mulch or straw.

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Area 39. This 1.01 acre area addresses both the undisturbed area between the upper undisturbed ditch (UDW-4 from Earth Fax report) and the primary portion of the WQVF access road (DW-5 from Earth Fax report). Sediment from the area is controlled by a catch basin that incorporates a wattle to trap sediment prior entering a culvert taking water under the road (Plate 3.2.4-3A). The ditch has been widened in the vicinity of catch basin to accommodate the installation of the wattles. The outfall of the culvert, although not having a erosive velocity, is armored with riprap to further reduce any sediment loading.

Area 40: The Swens Canyon Ventilation Facility pad is an area that addresses both a small undisturbed area (UW3) and the pad (DW3) totaling 1.5 acres (Plate 3.2.4-4D). Storm water runoff and sediment from the area flows to the east-southeast area of the pad. Water and sediment reaching the east side of the pad will either be treated by a silt fence or directed to the south portion of the pad using a berm. Water and sediment reaching the south end of the pad is controlled by a swale and small catch basin located at the southern portion of the pad. At that location, the small amount of water will collect to a maximum depth of 1.28-inches and eventually evaporate. The maximum design velocity is 1.02 ft/sec which is not considered erosive. See Attachement A of Earthfax Swens Canyon Design Report in Appendix Volume 5, Engineering Calculations, Section 24 for details.

Area 41: The Swens Canyon Ventilation Facility Topsoil Pile is designed to safely retain runoff from a 100-year, 24-hour storm event (176 cu-yds.) and one year of predicted sediment yield (195 cu-yds.) Topsoil will be collected/contained in the sediment basin and will either be retained in-place or re-deposited on the pile. Once vegetation is established on the Topsoil Pile, the sediment yield will be significantly reduced. Plate 3.2.4-4D illustrates the area.

Area 42: Attachment 4.17-1 of Section 4.17 Subsidence Control Plan, Chapter 4 of this M&RP contains the Boulger Dam Subsidence Monitoring Plan. The plan includes six (6) Seismic sites (A-F) shown of Figure 1-1 of Attachment 4.17-1. The sites are approximately 0.01-acres in size. Sediment is controlled by existing vegetation as the sites were located on level ground with minimal disturbance during installation.

On all areas not reporting to a sediment pond, and classified as Alternate Sediment Control Areas, the alternate sediment control measure such as straw bales, silt fences, catch basins, excelsior mats, etc. will be maintained until there is adequate vegetative cover to properly filter any surface runoff (see Sec. 20, Vol. 5 for design). When this can be demonstrated, the alternate control measures will be removed and the area reclassified as an "Exempt area". (See Sec. 21, Vol. 5 for Demonstrations) On all areas classified as Exempt Areas, if they should become redisturbed they will be reclassified as ASCA areas and will have the runoff treated with a designed treatment.

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Ch. 4 Sec. 4.3
Total

Bonding Calculations

Direct Costs

Subtotal Demolition and Removal	$1,922,577	
Subtotal Backfilling and Grading	$1,492,730	
Subtotal Revegetation	$473,092	
Direct Costs Subtotal	$3,888,399	

Indirect Costs

Mob/Demob	$388,840	10.0%
Contingency	$194,420	5.0%
Engineering Redesign	$97,210	2.5%
Main Office Expense	$264,411	6.8%
Project Management Fee	$97,210	2.5%
Subtotal Indirect Costs	$1,042,091	26.8%
Total Cost 2019	**$4,930,490**	
Escalation factor		*5*
Number of years		*0.0232*
Escalation	*$571,937*	
Reclamation Cost Escalated	$5,502,427	
Reclamation Bond Amount (rounded to nearest $1,000) 2019 Dollars	**$5,502,000**	
Posted Bond March 18, 2015	$5,799,000	
Difference Between Cost Estimate and Bond	$297,000	
Percent Difference	5.12%	

Errors in permittee's total sheet: indirect should be updated, escalation should be held constant at $479,715, TOTAL rec bond amount in 2019 $5,455,000

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Demo

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Ref	Description	Materials	Rooms Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Shop Warehouse 01																			76154
	Administration Bld 02																			31834
	Mine No 1 Transfer Tower 03																			44692.5
	BC 2 Drive House 04																			10621
	BC 3 Drive House 05																			40854
	Crusher Raw Coal 06																			21819
	Truck Loadout 07																			2405
	Railcar Loadout 08																			24078
	Conveyors 8 total 09																			181777
	Water Tanks Two 10																			9550
	Pump House 11																			1825
	Well House Three 12																			4898
	Water Treatment Bld 13																			18365
	Misc Storage Bld 14																			7729
	Overland Conveyor 15																			97946
	Guard Rail 16																			25874
	Rock Dust Bld 17																			8712.5
	Overland Dust Collector 18																			1165
	Substation 19																			3067
	Power Line 20																			528
	Cap Magazine 21																			53
	Fuel Storage 22																			1546
	Propane Tanks 23																			2419
	Stacking Tube 24																			8427
	Reclaim Tunnel 25																			69705
	Slope Proctection Apron 26																			26782
	Concrete Lined Ditch 27																			2096
	Raw Coal Silo 28																			24183
	Parking Area Middle 29																			3743
	Truck Loadout Foundation 30																			356
	Road Pad Lower 31																			5799
	Silo Rail Loadout 32																			214374
	Loadout Foundation RR 33																			8813
	Pavement Rail Loadout 34																			49982
	Steel 35																			2690
	James Canyon 36																			139776
	Culvert Backfilling 37																			11777
	Channel Construction 38																			569631
	Equipment 39																			9637
	Portal Face Door 40																			9281
	Concrete Building 41																			2916
	Winter's Quarters Ventilation 42																			74882
	North of Graben Bleeder Shaft 43	REMOVED FROM BOND - NEVER CONSTRUCTED																		0
	Swens Canyon Ventilation Facility 44																			49228
	Well Abandonment 45																			20588
	Total																			1,922,577

Demolition Cost					O&P
Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	/CF	0.36
Structure's Demolition Cost	Concrete Bld. Large	02 41 16 13 0060	0.39	/CF	0.50
Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0020	0.27	/CF	0.30
Structure's Demolition Cost	Guideail remove	02 41 13 33 0800	12.13	LF	17.20
Structure's Demolition Cost	Electrical Demolition	26 05 05 0300	1.06	cf	1.78
Disposal Cost Non Steel	City Services	City Service Price	4.33	/CY	4.33
Ashpshit Demolition	Pavement Removal 4"	02 41 13 17 5050	7.01	/SY	9.40
Concrete Demolition	Pavement Removal 3"	02 41 13 17 5010	4.27	/SY	5.75
Demolition Cost	**Nielson Concrete <15"**	**Nielson Quote**	**13.75**	**CY**	**13.75**
Demolition Cost	**Nielson Concrete >15"**	**Nielson Quote**	**36**	**CY**	**36**
Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	/CY	2.05
Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. md. trip	31 23 23 20 1014	2.95	/CY	3.63
Disposal Costs	On site disposal	02 41 16 17 4200	8.65	/CY	10.80
Transportation Cost Steel Truck	Truck dump 16 ton payload	01 54 33 20 5300	168.14	/hr	168.14
Cut and Fill	Excavator 3 1/2 CY	01 54 33 20 0820	594.4	/day	594.4
Cut and Fill	Eq. Op., Medium Equipment (Eqmd)	Eqmd	48.9	HR	48.9
Support Personal	Foreman Average, Outside	Foreman	40.3	HR	83.2
Support Personal	Pickup Rental	01 54 33 40 7200	168.4	/day	168.4
	Plate & Bar Stock for Reinforced Beams	05120 440 1250	1.42	/LB	
Remove pumps from all JC wells	Pull Pumps	Skyline 001	81,180.00	LS	
Plug JC-1	Concrete Ready Mix 8000 psi	03 31 13 35 0412	119.00	/CY	130
Plug JC-2	Concrete Ready Mix 8000 psi	03 31 13 35 0412	119.00	/CY	130
Plug JC-3	Concrete Ready Mix 8000 psi	03 31 13 35 0412	119.00	/CY	130
Culvert CU-1 48 inch	Excavation Bulk Bank 2 CY (322BL)	31 23 16 42 0260	1.42	/CY	1.78
	6'-10'	02 41 13 60 1700	2.98	/LF	4.22
	Fence top and bottom rail	02 41 13 62 1400	0.66	LF	0.84
	Footings 2' thick and 3' wide Gate posts	02 41 16 17 1140	21.1	LF	0.29
	Footings 2' thick and 3' wide Line post	02 41 16 17 1140	21.1	LF	0.29
	75-ton Crane with crew (A3L)	01 54 33 60 1100	1492	day	1492
	Equipment Operator Truck	equiptruck	11	ton	
	Flatbed Trailer 40-tone Capacity	01 54 3340 6600	2	day	152
	Steel Worker Crew (E4)	E4	1793.2	day	3070.6
	18-inch CMP culvert removal	02 41 13.4 0100	1.66	LF	2.47
	10' Wide heavy duty gate	02 41 13.62 0200	83	EA	117
	Pavement Removal - 5" entire length	02 41 13 1705050	9.4	SY	9.40
	Backfill Trench Minimal Haul 2 1/4 CY	31 23 16.13 3080	1.77	/CY	2.33
	D6R Series II (9-54) (1st14)	(9-54) rt 14	100.4	HR	235.56
Filter Material	Pea stone	03 05 13.25 1100	24	CY	28
RipRap Material	Machine placed rip-rap slope protection	31 37 13 10 0100	52.35	CY	62.5
Structure's Demolition Cost	Equipment Removal	Skyline 002	174.26	/TON	
Structure's Demolition Cost	Mechanical equipment heavy	15055 300 3800	174.26	/ton	
Disposal at approved Facility	City Service Price	40	TON		40
mechanical heavy equipment	removal of heavy equipment	23 05 05.10 3000	780	ton	1150
fencing	**Size tanks**	**02 65 10.30 0110**	**566**	**EA**	**815**
	Fencing barbed wire 3 strand	02 41 13.60 1600	1.38	LF	2.1
	chain link remove 6'-10'	02 41 13 60 1700	2.98	LF	4.22

DO NOT ADD CELLS BELOW THIS

Earthwork				
ITEM	Equipment Cost	Hourly Operating Cost	Equipment Overhead	Operator's Hourly Wage Rate
97-15Z 15CY (21-10) (1st14)	191.4	118.25	19.14	55.4
CIAB			0	
988G EROPS (9-37) (1st14)	210	119.32	21	52.25
700D (20-11) (1st14)	210	119.32	21	48.15
Pickup Truck Crew 4x4 1 ton (20-17) (1st14)	11.05	15.55	1.105	41.95
Foreman Average, Outside			0	
D6R Series II (9-54) (1st14)	190	352.27	19	55.4
410G EROPS 4WD EXTEN. (9-26)(1st14)	36.2	27.05	3.62	55.4
631G (9-51) (1st14)	165	93.75	16.5	55.4
14H EROPS (9-11)(9-2014	145	82.39	14.5	55.4
CAT 345BL II (10-23)X1st14)	171	113.1	17.1	55.4
6X4 70,000lbs 12-18 CY (20-11) (1st14)	44.1	63.45	4.41	55.4
D6R Series II (9-54) (1st14)	108	61.36	10.8	55.4
980G Series II EROPS (9-37) (1st14)	130	73.86	13	55.4
D10	310	352.27	31	55.4

Eq. Op. Medium Equipment (Eqmd) — Eqmd
General fill by dozer — 31 23 23.17 0320

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[illegible] Cost	[illegible]
384.19	1
36.65	0.5
402.57	
300.47	
69.655	
51.9	
616.67	
122.27	
330.65	
297.29	
356.6	
187.36	
235.56	
272.29	
748.67	
48.9	
1.87	

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell factor	Quantity	Unit	Cost
	Shop Warehouse 01																				
	Deduct 50% no interior walls																				
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF													196900	CF	35442
	Structure's Vol. Demolished				0													0.3	2188	CY	
	Structure's Demolition Cost				0																
	Truck's Capacity				0																
	Structure's Demolition Cost	Steel Bld. Large - Covered Yard Storage	02 41 16 13 0020	0.27	0.39	/CF	50	23	15										8625	CF	4373
	Transportation Cost Non Steel Truck				0																0
	Transportation Cost Non Steel Drive				0																0
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY													2188	CY	12316
	Steel's Weight				0																0
	Structure's Demolition Cost	Steel Bld. Large - Generator Building	02 41 16 13 0020	0.27	0.39	/CF	60	40	16										19200	CF	9734
	Disposal Cost Steel	City Services	City Service Price	4.33	4.33	/CY												0.3	213	CY	1199
	Transportation Cost Steel Truck				0																0
	Transportation Cost Steel Truck Drive				0																0
	Disposal Cost Steel				0																0
	Subtotal				0																63065
					0																0
	Equipment 's Disposal Cost				0																0
	Dismantling Cost				0																0
	Equipment 's Vol. Demolished				0																0
	Loading Costs				0																0
	Transport Costs				0																0
	Disposal Costs				0																0
	Subtotal				0																0
					0																0
	Concrete Demolition				0																0
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY													311	CY	4276
	Concrete's Vol. Demolished				0													1.3	404	CY	0
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY													404	CY	1077
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. tri	31 23 23 20 1014	2.95	3.63	/CY													404	CY	1906
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY													404	CY	5830
	Subtotal																				13089
	Total																				76154

Note: Volume is in CY

10-18-2016: Added 56 cu-yd concrete and All-Steel demolition for Covered Warehouse storage
5-17-17: Added 65 cu-yd concrete and All-Steel demolition for Generator Building

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Use	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Administration Bld 02																				
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF						78000					CF		78000	CF	28080
	Structure's Vol. Demolished				0													0.3	867	CY	
	Rubble's Weight (exclude steel)				0																
	Truck's Capacity				0																
	Haulage				0																
	Transportation Cost Non Steel Truck				0																
	Transportation Cost Non Steel Drive				0																
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY													867	CY	3754
	Steel's Weight																				
	Truck's Capacity																				
	Haulage																				
	Transportation Cost Steel Truck																				
	Transportation Cost Steel Truck Drive																				
	Disposal Cost Steel	Mixed Materials Bld. Large																			
	Subtotal																				
																					31834
	Equipment 's Disposal Cost																				
	Dismantling Cost																				
	Equipment 's Vol. Demolished																				
	Loading Costs																				
	Transport Costs	City Services																			
	Disposal Costs																				
	Subtotal																				
	Total																				**31834**

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Mine No 1 Transfer Tower 03																				
	Deduct 50% no interior walls																				
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF															
	Structure's Vol. Demolished				0														186040	CF	33487
	Rubble's Weight (exclude steel)				0													0.3	2067	CY	
	Truck's Capacity				0																
	Haulage				0																
	Transportation Cost Non Steel Truck				0																
	Transportation Cost Non Steel Drive				0																
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY													2067	CY	8950
	Steel's Weight				0																
	Truck's Capacity				0																
	Haulage				0																
	Transportation Cost Steel Truck				0																
	Transportation Cost Steel Truck Drive				0																
	Disposal Cost Steel				0																
	Subtotal				0																42437
					0																
	Equipment 's Disposal Cost				0																
	Dismantling Cost				0																
	Equipment 's Vol. Demolished				0																
	Loading Costs				0																
	Transport Costs				0																
	Disposal Costs				0																
	Subtotal				0																
					0																
	Concrete Demolition				0																
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY													66	CY	907.5
	Concrete's Vol. Demolished				0													1.3	86	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY													86	CY	143
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. trip	31 23 23 20 1014	2.95	3.63	/CY													86	CY	253
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY													86	CY	952
	Subtotal																				2255.5
	Total																				44692.5

Note: Volume is in CY

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	BC 2 **Drive House 04**																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Concrete Bld. Large	02 41 16 13 0050	0.39	0.5	/CF												38750	CF	9688
	Structure's Vol. Demolished				0												0.3	431	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												431	CY	933
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			10621
	Total																			10621

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit
	BC 3 Drive House 05																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Mixed Materials Bld, Large	02 41 16 13 0100	0.3	0.36	/CF														
	Structure's Vol. Demolished				0														184000	CF
	Rubble's Weight (exclude steel)				0													0.3	2044	CY
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY														
	Steel's Weight				0														2044	CY
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Steel Truck				0															
	Transportation Cost Steel Truck Drive				0															
	Disposal Cost Steel				0															
	Subtotal				0															
					0															
	Equipment 's Disposal Cost				0															
	Dismantling Cost				0															
	Equipment 's Vol. Demolished				0															
	Loading Costs				0															
	Transport Costs				0															
	Disposal Costs				0															
	Subtotal				0															
					0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY														
	Concrete's Vol. Demolished				0														186	CY
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												1.3	242	CY
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. m	31 23 23 20 1014	2.95	3.63	/CY													242	CY
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY													242	CY
	Subtotal																		242	CY
	Total																			

Note: Volume is in CY

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Cost
33120
4425
37545
1279
248
439
1343
3309
40854

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Crusher Raw Coal 06																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF						88000				CF		88000	CF	15840
	Structure's Vol. Demolished				0												0.3	978	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												978	CY	2117
	Steel's Weight				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Steel Truck				0															
	Transportation Cost Steel Truck Drive				0															
	Disposal Cost Steel				0															
	Subtotal				0															17957
					0															
	Equipment 's Disposal Cost				0															
	Dismantling Cost				0															
	Equipment 's Vol. Demolished				0															
	Loading Costs				0															
	Transport Costs				0															
	Disposal Costs				0															
	Subtotal				0															
					0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	49.75	CY												108	CY	2687
	Concrete's Vol. Demolished				0												1.3	140	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												140	CY	144
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. md. tri	31 23 23 20 1014	2.95	3.63	/CY												140	CY	254
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												140	CY	777
	Subtotal																			3862
	Total																			21819

Note:

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Ref.	Description	Materials	Nirmin Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Truck Loadout 07																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF						30000				CF		30000	CF	1620
	Structure's Vol. Demolished				0												0.3	333	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												333	CY	216
	Steel's Weight				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Steel Truck				0															
	Transportation Cost Steel Truck Drive				0															
	Disposal Cost Steel				0															
	Subtotal				0															1836
					0															
	Concrete Demolition	Pavement Removal 4"	02 41 13 17 5050	7.01	9.4	/SY						250				SY		250	SY	353
	Demolition Cost				0															
	Concrete's Vol. Demolished				0															
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												35	CY	11
	Transportation Cost				0															
	Disposal Costs	Disposat at approved Facility	City Service Price	4.33	4.33	/CY							35	1.35		Ton		47.25	Ton	204.59
	Subtotal																			$68.59
	Total																			2404.6

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Railcar Loadout 08																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF														
	Structure's Vol. Demolished				0													118000	CF	21240
	Rubble's Weight (exclude steel)				0												0.3	1311	CY	
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY														
	Steel's Weight																	1311	CY	2838
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			24078
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Total																			24078

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Conveyors 8 total 09																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF												357960	CF	64433
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																0.3	3977	CY	
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY														
	Steel's Weight																	3977	CY	17220
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Steel Truck				0															
	Transportation Cost Steel Truck Drive				0															
	Disposal Cost Steel				0															
	Subtotal																			
																				81653
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Upper Terrace Area																			
	Concrete Demolition																			
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	49.75	CY												47	CY	2338
	Concrete's Vol. Demolished																1.3	61	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												61	CY	125
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. tri	31 23 23 20 1014	2.95	3.63	/CY												61	CY	221
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												61	CY	677
	Subtotal				0															3361
					0															
	Middle Terrace Area				0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	49.75	CY												62	CY	3085
	Concrete's Vol. Demolished				0												1.3	81	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												81	CY	166
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. tri	31 23 23 20 1014	2.95	3.63	/CY												81	CY	294
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												81	CY	899
	Subtotal				0															4444
					0															
	Lower Terrace Area				0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	49.75	CY												90	CY	4478
	Concrete's Vol. Demolished				0												1.3	117	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												117	CY	240
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. tri	31 23 23 20 1014	2.95	3.63	/CY												117	CY	425
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												117	CY	1299
	Subtotal				0															6442
					0															
	Acces Raod Area				0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	49.75	CY												1200	CY	59700
	Concrete's Vol. Demolished				0												1.3	1560	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												1560	CY	3198
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. tri	31 23 23 20 1014	2.95	3.63	/CY												1560	CY	5663
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												1560	CY	17316
	Subtotal																			85877
	Total																			181777

Note: Volume is in CY

9/2016 - Added 8 CY concrete for BC-4 Take-up Slab

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Ref.	Description	Material	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Water Tanks Two 10																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0020	0.27	0.36	/CF									2	ea		46800	CF	8424
	Structure's Vol. Demolished				0												0.3	520	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												520	CY	1126
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			9550
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Total																			9550

Size haul of tanks

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Ref	Description	Materials	Means Refrence Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Pump House 11																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF						860				CF		860	CF	155
	Structure's Vol. Demolished				0												0.3	10	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												10	CY	22
	Steel's Weight				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Steel Truck				0															
	Transportation Cost Steel Truck Drive				0															
	Disposal Cost Steel				0															
	Subtotal				0															177
					0															
	Equipment 's Disposal Cost				0															
	Dismantling Cost				0															
	Equipment 's Vol. Demolished				0															
	Loading Costs				0															
	Transport Costs				0															
	Disposal Costs				0															
	Subtotal				0															
					0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	49.75	CY												46	CY	1144
	Concrete's Vol. Demolished				0												1.3	60	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												60	CY	62
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. tri	31 23 23 20 1014	2.95	3.63	/CY												60	CY	109
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												60	CY	333
	Subtotal																			1648
	Concrete Demolition																			
	Demolition Cost																			
	Concrete's Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Total																			1825

Note: Volume is in CY

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Well House Three 12																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF														
	Structure's Vol. Demolished				0													24000	CF	4320
	Rubble's Weight (exclude steel)				0												0.3	267	CY	
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY														
	Steel's Weight																	267	CY	578
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			4898
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Total																			4898

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Water Treatment Bld 13																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF												90000	CF	16200
	Structure's Vol. Demolished				0												0.3	1000	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												1000	CY	2165
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			18365
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Total																			18365

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Misc Storage Bld 14																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF														
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0020	0.27	0.39	/CF	40	20	20									6265	CF	1128
	Structure's Vol. Demolished				0													16000	CF	3120
	Rubble's Weight (exclude steel)				0												0.3	70	CY	
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												70	CY	152
	Steel's Weight				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Steel Truck				0															
	Transportation Cost Steel Truck Drive				0															
	Disposal Cost Steel				0															
	Subtotal				0															
					0															4400
	Equipment 's Disposal Cost				0															
	Dismantling Cost				0															
	Equipment 's Vol. Demolished				0															
	Loading Costs				0															
	Transport Costs				0															
	Disposal Costs				0															
	Subtotal				0															
					0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY												114	CY	784
	Concrete's Vol. Demolished				0												1.3	148	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												148	CY	152
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. trip	31 23 23 20 1014	2.95	3.63	/CY												148	CY	269
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												148	CY	821
	Subtotal				0															2026
					0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY					800						SF	29.6	CY	204
	Concrete's Vol. Demolished				0												1.3	38		
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY						29.6						38	CY	39
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. trip	31 23 23 20 1014	2.95	3.63	/CY						29.6						38	CY	69
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY						29.6						38	CY	211
	Subtotal				0															523
	Sweeper Garage	added two walls			0															
	Dismantling Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF														
	Equipment 's Vol. Demolished	Steel Bld. Large	02 41 16 13 0020	0.27	0.39	/CF	20	20	20									8000	CF	1560
	Disposal Costs	50% decuction for no interior walls																	CF	780
	Subtotal																			
	Total																			7729

Note: see drawing 3.2.1-1

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Overland Conveyor 15																			
	Deduct 50% no interior walls																			
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	0.36	/CF												480000	CF	86400
	Structure's Vol. Demolished				0												0.3	5333	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												5333	CY	11546
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			97946
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Total																			97946

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Guard Rail 16																			
	Structure's Demolition Cost	Guiderail remove	02 41 13 33 0800	12.13	17.2	LF	1500									LF		1500	LF	25800
	Structure's Vol. Demolished				0												0.3	17	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												17	CY	74
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			25874
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Total																			25874

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Rock Dust Bld 17																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0020	0.27	0.39	/CF												15504	CF	3023.5
	Structure's Vol. Demolished				0												0.3	172	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												172	CY	745
	Steel's Weight				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Steel Truck				0															
	Transportation Cost Steel Truck Drive				0															
	Disposal Cost Steel				0															
	Subtotal				0															3768.5
					0															
	Equipment 's Disposal Cost				0															
	Dismantling Cost				0															
	Equipment 's Vol. Demolished				0															
	Loading Costs				0															
	Transport Costs				0															
	Disposal Costs				0															
	Subtotal				0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	49.75	CY												69	CY	3433
	Concrete's Vol. Demolished				0												1.3	90	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												90	CY	185
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. md. tri	31 23 23 20 1014	2.95	3.63	/CY												90	CY	327
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												90	CY	999
	Subtotal																			4944
	Total																			8712.5

Note: Boreholes reclaimed prior to 2014

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Overland Dust Collector 18																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0020	0.27	0.39	/CF												4800	CF	936
	Structure's Vol. Demolished				0												0.3	53	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												53	CY	229
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			1165
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Total																			1165

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Substation 19																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0020	0.27	0.39	/CF												1000	CF	390
	Structure's Vol. Demolished				0												0.3	11	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												11	CY	48
	Steel's Weight				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Steel Truck				0															
	Transportation Cost Steel Truck Drive				0															
	Disposal Cost Steel				0															
	Subtotal				0															438
					0															
	Equipment 's Disposal Cost				0															
	Dismantling Cost				0															
	Equipment 's Vol. Demolished				0															
	Loading Costs				0															
	Transport Costs				0															
	Disposal Costs				0															
	Subtotal				0															
					0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY												74	CY	1018
	Concrete's Vol. Demolished				0												1.3	96	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												96	CY	197
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. trip	31 23 23 20 1014	2.95	3.63	/CY												96	CY	348
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												96	CY	1066
	Subtotal																			2629
	Total																			3067

Note: Volume is 74 CY

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Power Line 20																			
	Structure's Demolition Cost	Electrical Demolition	26 05 05 0300	1.06	1.76	cif												300	LF	528
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			528
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Total																			528

Note: Demo volume for line is insignificant and accounted for within concrete of facility

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Cap Magazine 21																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0020	0.27	0.39	/CF												125	CF	49
	Structure's Vol. Demolished				0												0.3	1	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												1	CY	4
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			53
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Total																			53

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Fuel Storage 22																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0020	0.27	0.39	/CF												265	CF	103
	Structure's Vol. Demolished	Steel Walkway	05 05 05 0250	120	120	ea												1	ea	120
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												2	CY	9
	Steel's Weight				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Steel Truck				0															
	Transportation Cost Steel Truck Drive				0															
	Disposal Cost Steel				0															
	Subtotal				0															232
					0															
	Equipment 's Disposal Cost				0															
	Dismantling Cost				0															
	Equipment 's Vol. Demolished				0															
	Loading Costs				0															
	Transport Costs				0															
	Disposal Costs				0															
	Subtotal				0															
					0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY														
	Concrete's Vol. Demolished				0													37	CY	509
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY											1.3	48	CY	
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. trip	31 23 23 20 1014	2.95	3.63	/CY												48	CY	98
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												48	CY	174
	Subtotal																	48	CY	533
																				1314
	Total																			1546

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Propane Tanks 23																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0020	0.27	0.39	/CF									2	ea		38	CF	1630
	Structure's Vol. Demolished	Size tanks	02 65 10.30 0110	566	815	EA											0.3	0	CY	
	Rubble's Weight (exclude steel)				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Non Steel Truck				0															
	Transportation Cost Non Steel Drive				0															
	Disposal Cost Non Steel	City Services	City Service Price	4.33	4.33	/CY												0	CY	0
	Steel's Weight				0															
	Truck's Capacity				0															
	Haulage				0															
	Transportation Cost Steel Truck				0															
	Transportation Cost Steel Truck Drive				0															
	Disposal Cost Steel				0															
	Subtotal				0															1630
					0															
	Equipment 's Disposal Cost				0															
	Dismantling Cost				0															
	Equipment 's Vol. Demolished				0															
	Loading Costs				0															
	Transport Costs				0															
	Disposal Costs				0															
	Subtotal				0															
					0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY												22	CY	303
	Concrete's Vol. Demolished				0												1.3	29	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												29	CY	59
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. md. tri	31 23 23 20 1014	2.95	3.63	/CY												29	CY	105
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												29	CY	322
	Subtotal																			789
	Total																			2419

Needs to size the tank based on 02 65 10.30 0011 through 0130

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Stacking Tube 24																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY														
	Concrete's Vol. Demolished				0													237	CY	3259
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY											1.3	308	CY	
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. tri	31 23 23 20 1014	2.95	3.63	/CY												308	CY	631
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												308	CY	1118
	Subtotal																	308	CY	3419
																				8427
	Total																			8427

Note: Volume is in CY

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Reclaim Tunnel 25																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY												1960	CY	26950
	Concrete's Vol. Demolished				0												1.3	2548	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												2548	CY	5223
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. md. tri	31 23 23 20 1014	2.95	3.63	/CY												2548	CY	9249
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												2548	CY	28283
	Subtotal																			69705
	Total																			69705

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Slope Proctection Apron 26																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY												753	CY	10354
	Concrete's Vol. Demolished				0															
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY											1.3	979	CY	
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. md. tri	31 23 23 20 1014	2.95	3.63	/CY												979	CY	2007
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												979	CY	3554
	Subtotal																	979	CY	10867
																				26782
	Total																			26782

Note:

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Concrete Lined Ditch 27																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Silt trap at rail loadout																			
	Equipment 's Disposal Cost																			
	Dismantling Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY	17	17	5			17						17	CY	234
	Equipment 's Vol. Demolished				0												1.3	22.1	CY	
	Loading Costs	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												22.1	CY	45
	Transport Costs	12 CY (16 Ton) Dump Truck 1/2 mi. md. trip	31 23 23 20 1014	2.95	3.63	/CY												22.1	CY	80
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	10.8	/CY												22.1	CY	239
	Subtotal				0															598
					0															
	Concrete Demolition				0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	49.75	CY												21	CY	1045
	Concrete's Vol. Demolished				0												1.3	27	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												27	CY	55
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. md. trip	31 23 23 20 1014	2.95	3.63	/CY												27	CY	98
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												27	CY	300
	Subtotal																			1498
	Total																			2096

See drawing on page 3-44a for concrete silt trap detail and See Plate 3.2.1-3

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Raw Coal Silo 28																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY												680	SF	9350
	Concrete's Vol. Demolished				0												1.3	884	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												884	CY	1812
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. md. tri	31 23 23 20 1014	2.95	3.63	/CY												884	CY	3209
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												884	CY	9812
	Subtotal																			24183
	Total																			24183

Note

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Parking Area Middle 29																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition	Pavement Removal 3"	02 41 13 17 5010	4.27	5.75	/SY														
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY					1260					SY		105	CY	1444
	Concrete's Vol. Demolished				0				0.0833							YD	1.3	137	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												137	CY	281
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. tri	31 23 23 20 1014	2.95	3.63	/CY												137	CY	497
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												137	CY	1521
	Subtotal																			3743
	Total																			**3743**

Note

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Truck Loadout Foundation 30																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY												10	CY	138
	Concrete's Vol. Demolished				0												1.3	13	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												13	CY	27
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. md. tri	31 23 23 20 1014	2.96	3.63	/CY												13	CY	47
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												13	CY	144
	Subtotal																			356
	Total																			356

Note

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Road Pad Lower 31																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition	Pavement Removal 3"	02 41 13 17 5010	4.27	5.75	/SY														
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY					1630					SY		163	CY	2241
	Concrete's Vol. Demolished				0				0.1							YD	1.3	212	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												212	CY	435
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. trip	31 23 23 20 1014	2.95	3.63	/CY												212	CY	770
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												212	CY	2353
	Subtotal																			5799
	Total																			5799

Note

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit
	Silo Rail Loadout 32																		
	Structure's Demolition Cost																		
	Structure's Vol. Demolished																		
	Rubble's Weight (exclude steel)																		
	Truck's Capacity																		
	Haulage																		
	Transportation Cost Non Steel Truck																		
	Transportation Cost Non Steel Drive																		
	Disposal Cost Non Steel																		
	Steel's Weight																		
	Truck's Capacity																		
	Haulage																		
	Transportation Cost Steel Truck																		
	Transportation Cost Steel Truck Drive																		
	Disposal Cost Steel																		
	Subtotal																		
	Equipment 's Disposal Cost																		
	Dismantling Cost																		
	Equipment 's Vol. Demolished																		
	Loading Costs																		
	Transport Costs																		
	Disposal Costs																		
	Subtotal																		
	Concrete Demolition																		
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY													
	Concrete's Vol. Demolished				0													6028	SF
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY											1.3	7836	CY
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. trip	31 23 23 20 1014	2.95	3.63	/CY												7836	CY
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												7836	CY
	Subtotal																	7836	CY
	Total																		

Note

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Cost
82885
16064
28445
86980
214374
214374

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Loadout Foundation RR 33																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	Equipment 's Disposal Cost																			
	Dismantling Cost																			
	Equipment 's Vol. Demolished																			
	Loading Costs																			
	Transport Costs																			
	Disposal Costs																			
	Subtotal																			
	Concrete Demolition																			
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY												248	CY	3410
	Concrete's Vol. Demolished				0												1.3	322	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												322	CY	660
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. trip	31 23 23 20 1014	2.95	3.63	/CY												322	CY	1169
	Disposal Costs	On site disposal	02 41 16 17 4200	8.65	11.1	/CY												322	CY	3574
	Subtotal																			8813
	Total																			**8813**

Note

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Pavement Rail Loadout 34																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Steel Truck																			
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
	West of Silos																			
	Equipment 's Disposal Cost	Concrete west of silos																		
	Dismantling Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY	1.5	33.5	0.55		123					CY		123	CY	1691
	Equipment 's Vol. Demolished				0												1.3	160	CY	
	Loading Costs	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY					160					CY		160	CY	328
	Transport Costs	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. tri	31 23 23 20 1014	2.95	3.63	/CY					160					CY		160	CY	581
	Disposal Costs	City Services	City Service Price	4.33	4.33	/CY					160					CY		160	CY	693
	Subtotal				0															3293
					0															
	Concrete Demolition	Pavement Removal 3"			0															
	Demolition Cost	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY					5					CY		5	CY	69
	Concrete's Vol. Demolished				0				0.66							YD	1.3	7	CY	
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												7	CY	14
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. rnd. tri	31 23 23 20 1014	2.95	3.63	/CY												7	CY	25
	Disposal Costs	City Services	City Service Price	4.33	4.33	/CY												7	CY	30
	Subtotal				0															138
					0															
	Concrete Demolition				0															
	Demolition Cost				0															
	Concrete's Vol. Demolished				0															
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY												142	CY	291
	Transportation Cost				0															
	Disposal Costs	City Services	City Service Price	4.33	4.33	/CY						15371		0.61		Ton		142	CY	615
	Subtotal																			906
	Paving From W entracne to Silos	Pavement Removal - 5" entire length	02 41 13 1705050	9.4	9.6	SY						4592				SY		4592	SY	44083
	Asphalt Demolition																			
	Concrete's Vol. Demolished																			
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.15	/CY												241	CY	518
	Transportation Cost																			
	Disposal Costs	City Services	City Service Price	4.33	4.33	/CY							579	1.35		ton		241	CY	1044
	Subtotal																			45645
	Total																			**49982**

See Plate 3.2.1-3 Error was found in spreadsheet. Multiple subtotals were hard coded in, instead of a sum.

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Unit	Swell Factor	Quantity	Unit	Cost
	Steel 35																			
	Structure's Demolition Cost																			
	Structure's Vol. Demolished																			
	Rubble's Weight (exclude steel)																			
	Truck's Capacity																			
	Haulage																			
	Transportation Cost Non Steel Truck																			
	Transportation Cost Non Steel Drive																			
	Disposal Cost Non Steel																			
	Steel's Weight																			
	Truck's Capacity												2000			TON		2000	TON	
	Haulage																			
	Transportation Cost Steel Truck	Truck dump 16 ton payload	01 54 33 20 5300	168.14	168.14	/hr									16	DY		16	DY	2690
	Transportation Cost Steel Truck Drive																			
	Disposal Cost Steel																			
	Subtotal																			
																				2690
	Total																			2690

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Ref.	Description	Material	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Time	Number	Unit	Swell Factor	Quantity	Unit
	James Canyon 36																		
	Reclaim Area																		
	Cut and Fill	Excavator 3 1/2 CY	01 54 33 20 0325		594.4	Day								13		HR		1.6	Day
	Cut and Fill	Eq. Op., Medium Equipment (Eqmd)	Eqmd	48.9	82.7	HR								13		HR		13	HR
	Support Personal	Foreman Average, Outside	Foreman	49.3	84.25	HR								13		HR		13	HR
	Support Personal	Pickup Rental	01 54 33 40 7200	168.4	168.4	/day								13		HR		13	HR
					0														
					0														
					0														
					0														
					0														
					0														
					0														
					0														
	Subtotal				0														
					0														
	Well Plugging				0														
	Remove pumps from all JC wells	Pull Pumps	Skyline 001	81180	0	LS									1	EA		1	EA
	Plug JC-1	Concrete Ready Mix 8000 psi	03 31 13.35 0412	119	166	/CY						40				CY		40	CY
	Plug JC-2	Concrete Ready Mix 8000 psi	03 31 13.35 0412	119	166	/CY						81				CY		81	CY
	Plug JC-3	Concrete Ready Mix 8000 psi	03 31 13.35 0412	119	166	/CY						200				CY		200	CY
	Subtotal																		
	Concrete Demolition																		
	Demolition Cost																		
	Concrete's Vol. Demolished																		
	Loading Cost																		
	Transportation Cost																		
	Disposal Costs																		
	Subtotal																		
	Total																		

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Cost
951
1075
1095
2189
5310
81180
6640
13446
33200
134466
139776

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Ref	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Culvert Backfilling 37																			
	Culvert CU-1 48 inch	Excavation Bulk Bank 2 CY (322BL)	31 23 16 42 0260	1.42	1.78	/CY	560	4	8							FT		664	CY	1182
		Backfill Trench Mininal Haul 2 1/4 CY	31 23 16 13 3080	1.77	2.33	/CY	560	4	8							FT		664	CY	1547
	Culvert CU-2	Excavation Bulk Bank 2 CY (322BL)	31 23 16 42 0260	1.42	1.78	/CY	588	4	8							FT		697	CY	1241
		Backfill Trench Mininal Haul 2 1/4 CY	31 23 16 13 3080	1.77	2.33	/CY	588	4	8							FT		697	CY	1624
	Culvert CU-3	Excavation Bulk Bank 2 CY (322BL)	31 23 16 42 0260	1.42	1.78	/CY	410	4	8							FT		486	CY	865
		Backfill Trench Mininal Haul 2 1/4 CY	31 23 16 13 3080	1.77	2.33	/CY	410	4	8							FT		486	CY	1132
	Culvert CU-2a	Excavation Bulk Bank 2 CY (322BL)	31 23 16 42 0260	1.42	1.78	/CY	410	4	8							FT		870	CY	1549
		Backfill Trench Mininal Haul 2 1/4 CY	31 23 16 13 3080	1.77	2.33	/CY	410	4	8							FT		870	CY	2027
	Culvert Waste Rock Site (UC-1) 24in	Excavation Bulk Bank 2 CY (322BL)	31 23 16 42 0260	1.42	1.78	/CY	180	3	5							FT		100	CY	178
		Backfill Trench Mininal Haul 2 1/4 CY	31 23 16 13 3080	1.77	2.33	/CY	180	3	5							FT		100	CY	233
		Nielson Concrete <15"	Nielson Quote	13.75	49.75	CY						4				CY		4	CY	199
	Subtotal																			11777
	Total																			11777

See drawings 3.2.8-1, 3.2.8-1a, and 3.2.8-2

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Channel Construction 38																				
	Stream A																				
	Filter Material	Pea stone	03 05 13.25 1100	24	17.35	CY						1097					CY		1097	CY	19033
	RipRap Material	Machine placed rip-rap slope protection	31 37 13 10 0100	52.35	70	CY						1241					CY		1241	CY	86870
	Subtotal				0																105903
					0																
	Stream B				0																
	Filter Material	Pea stone	03 05 13.25 1100	24	17.35	CY						1251					CY		1251	CY	21705
	RipRap Material	Machine placed rip-rap slope protection	31 37 13 10 0100	52.35	70	CY						1416					CY		1416	CY	99120
	Subtotal				0																120825
					0																
	Stream C				0																
	Filter Material	Pea stone	03 05 13.25 1100	24	17.35	CY						929					CY		929	CY	16118
	RipRap Material	Machine placed rip-rap slope protection	31 37 13 10 0100	52.35	70	CY						1051					CY		1051	CY	73570
	Subtotal				0																89688
					0																
	Stream D				0																
	Filter Material	Pea stone	03 05 13.25 1100	24	17.35	CY						2333					CY		2333	CY	40478
	RipRap Material	Machine placed rip-rap slope protection	31 37 13 10 0100	52.35	70	CY						1004					CY		1004	CY	70280
	Subtotal				0																110758
					0																
	Stream E				0																
	Filter Material	Pea stone	03 05 13.25 1100	24	17.35	CY						2190					CY		2190	CY	37997
	RipRap Material	Machine placed rip-rap slope protection	31 37 13 10 0100	52.35	70	CY						971					CY		971	CY	67970
	Subtotal				0																105967
					0																
	Stream B to D Transition				0																
	Filter Material	Pea stone	03 05 13.25 1100	24	17.35	CY						316					CY		316	CY	5483
	RipRap Material	Machine placed rip-rap slope protection	31 37 13 10 0100	52.35	70	CY						154					CY		154	CY	10780
	Subtotal				0																16263
					0																
	Stream C to D Transition				0																
	Filter Material	Pea stone	03 05 13.25 1100	24	17.35	CY						75					CY		75	CY	1301
	RipRap Material	Machine placed rip-rap slope protection	31 37 13 10 0100	52.35	70	CY						30					CY		30	CY	2100
	Subtotal				0																3401
					0																
	Arch Culvert				0																
	Filter Material	Pea stone	03 05 13.25 1100	24	17.35	CY						238					CY		238	CY	5712
	RipRap Material	Machine placed rip-rap slope protection	31 37 13 10 0100	52.35	70	CY						48					CY		48	CY	2513
	Concrete	Concrete Ready Mix 8000 psi	03 31 13.35 0412	119	166	/CY						15					CY		15	CY	1785
	Steel Plate	Plate & Bar Stock for Reinforced Beams	05120 440 1250	1.42	1.6	/LB							4800				lb		4800	lb	6816
	Subtotal																				16826
	Total																				569631

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(#)	Description	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Equipment 39																				
	Structure's Demolition Cost	80-ton Crane with crew (A3L)	01 54 1950 0500		1492	Day											tons		2	DAY	2984
	Structure's Vol. Demolished	Equipment Operator Truck	equptruck	11	13	HR											tons		16	hr	208
	Rubble's Weight (exclude steel)				0																
	Truck's Capacity	Flatbed Trailer 40-tone Capacity	01 54 3340 6600	2	152	day											tons		2	Day	304
	Haulage				0																
	Transportation Cost Non Steel Truck				0																
	Transportation Cost Non Steel Drive				0																
	Disposal Cost Non Steel				0																
	Steel's Weight				0																
	Truck's Capacity				0																
	Haulage				0																
	Transportation Cost Steel Truck				0																
	Transportation Cost Steel Truck Drive				0																
	Disposal Cost Steel				0																
	Subtotal				0																
					0																3496
	Equipment 's Disposal Cost				0																
	Dismantling Cost	Steel Worker Crew (E4)	E4	1793.2	3070.6	day							1925				tons		2	Day	6141
	Equipment 's Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
																					6141
	Concrete Demolition																				
	Demolition Cost																				
	Concrete's Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete's Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete's Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Total																				9637

Need to track this down

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Ref	Description	Notes/ds	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Portal Face Door 40																				
	Structure's Demolition Cost	removal of heavy equipment	23 05 05.10 3600	780	1150	ton								8.07			Ton		8.07	Ton	9281
	Structure's Vol. Demolished																				
	Rubble's Weight (exclude steel)																				
	Truck's Capacity																				
	Haulage																				
	Transportation Cost Non Steel Truck																				
	Transportation Cost Non Steel Drive																				
	Disposal Cost Non Steel																				
	Steel's Weight																				
	Truck's Capacity																				
	Haulage																				
	Transportation Cost Steel Truck																				
	Transportation Cost Steel Truck Drive																				
	Disposal Cost Steel																				
	Subtotal																				9281
	Equipment 's Disposal Cost																				
	Dismantling Cost																				
	Equipment 's Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete's Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete's Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete's Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Total																				**9281**

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Ref.	Description	Materials	Means Reference Number	Unit Cost	O&P	Use	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Cost	Swell Factor	Quantity	Unit	Cost
	Concrete Building 41																				
	Structure's Demolition Cost	Concrete Bld. Large	02 41 16 13 0060	0.39	0.5	/CF	18	18	18										5832	CF	2916
	Structure's Vol. Demolished																	0.3	65	CY	
	Rubble's Weight (exclude steel)																				
	Truck's Capacity																				
	Haulage																				
	Transportation Cost Non Steel Truck																				
	Transportation Cost Non Steel Drive																				
	Disposal Cost Non Steel																				
	Steel's Weight																				
	Truck's Capacity																				
	Haulage																				
	Transportation Cost Steel Truck																				
	Transportation Cost Steel Truck Drive																				
	Disposal Cost Steel																				
	Subtotal																				2916
	Equipment 's Disposal Cost																				
	Dismantling Cost																				
	Equipment 's Vol. Demolished																				
	Loading Costs																				
	Transport Costs																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete's Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete's Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Concrete Demolition																				
	Demolition Cost																				
	Concrete's Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Total																				2916

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Ref.	Description Winter Quarters Ventilation Facility 42	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Steel																				
	Substation/Transformers 42																				
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0020	0.27	0.39	/CF															
					0														1000	CF	390
	Escape Shaft				0																
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0020	0.27	0.39	/CF															
					0														88	CF	34.32
	Fencing	Fencing barbed wire 3 strand	02 41 13 60 1600	1.36	2.1	LF													1000	LF	2100
	Topsoil Pile	chain link remove 8'-10'	02 41 13 60 1700	2.98	4.22	LF													2900	LF	12238
	Ventilation Pad	chain link remove 8'-10'	02 41 13 60 1700	2.98	4.22	LF													9000	LF	37980
	Reinforced Earth Retaining Wall				0																
					0																
	Ventilation Fan	Steel Bld. Large	02 41 16 13 0020	0.27	0.36	/CF															
	Structure's Demolition Cost				0														150	CF	54
					0																
	Mobile Field Office				0																
	Structure's Demo cost	mixed materials	02 41 16 13 0100	0.3	0.36	/CF															
	Structure's Demolition Cost generator	Steel Bld. Large	02 41 16 13 0020	0.27	0.36	/CF													1000	CF	360
	Subtotal				0														1000	CF	360
					0																53516.32
	Concrete				0																
	Substation				0																
	Escape Shaft Pad	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY													60	CY	825
	Shaft Collar and Fan Pad, temp	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY													35	CY	481.25
	Mobile Field Office Pad	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY													463	CY	6366.25
	Slope Collar	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY													15	CY	206.25
	Misc	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY													30	CY	412.5
	Concrete's Vol. Demolished	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY													25	CY	343.75
	Loading Cost				0													1.3	816	CY	
	Disposal Costs	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY													816	CY	1672.8
	Loading Cost	On site deposal	02 41 16 17 4200	8.65	11.1	/CY													816	CY	9057.6
	Subtotal																				19365.4
	Concrete Demolition	Remove RipRap Pond Discharge Apron																			2000
	Demolition Cost																				
	Concrete's Vol. Demolished																				
	Loading Cost																				
	Transportation Cost																				
	Disposal Costs																				
	Subtotal																				
	Total																				**74881.72**

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Ref.	Description North of Graben Bleeder Shaft 43	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Steel																			
	Ventilation Shaft																			
	Three (3) sheds - Fan, Fuel, Generator	Steel Bld. Large	02 41 16 13 0020	0.27	/CF						6500					CF		6500	CF	1755
	CHAIN LINKFENCE																			
	Chainlink Removal (2 pads)	8'-10'	02 41 13.60 1700	2.98	/LF	480												480	LF	1430.4
	Chainlink Rails	Fence top and bottom rail	02 41 13.62 1400	0.66	LF	480												480	LF	316.8
	Concrete demolition	Footings 2' thick and 3' wide Gate posts	02 41 16.17 1140	21.1	LF	3									4			3	LF	63.3
	Concrete demolition	Footings 2' thick and 3' wide Line post	02 41 16.17 1140	21.1	LF	2									29			2	LF	42.2
	Loading Cost	Front end loader 3 CY	31 23 16 42 1300	1.67	/CY						2.1							2.1	CY	3.507
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. md. tri	31 23 23 20 1014	2.95	/CY															
	Disposal Costs	City Sanitation - Price, UT	City Service Price	4.33	/CY						2.1							2.1	CY	9.093
	Culvert Removal	18-inch CMP culvert removal	02 41 13.4 0100	1.66	LF	40												40	LF	66.4
	GATES																			
	Chain link Gates	10' Wide heavy duty gate	02 41 13.62 0200	83	EA										2			2	EA	166
	Loading Cost	Front end Loader 3 CY	31 23 16 42 1300	1.67	/CY						1.8							1.8	CY	3.006
	Transportation Cost	12 CY (16 Ton) Dump Truck 1/2 mi. md. tri	31 23 23 20 1014	2.95	/CY						1.8							1.8	CY	5.31
	Disposal Costs	City Sanitation - Price, UT	City Service Price	4.33	/CY						1.8							1.8	CY	7.794
	Ventilation Fan Removal (not demolition)	removal of heavy equipment	23 05 05.10 3600	780	ton													4	Ton	3120
	Subtotal																			6989
	Concrete																			
	Bleeder Shaft Pad	Nielson Concrete <15"	Nielson Quote	13.75	CY													150	CY	2062.5
	Generator pad	Nielson Concrete <15"	Nielson Quote	13.75	CY													150	CY	2062.5
	Fuel pad	Nielson Concrete <15"	Nielson Quote	13.75	CY													45	CY	618.75
		Nielson Concrete <15"	Nielson Quote	13.75	CY													30	CY	412.5
	Loading Cost	Nielson Concrete <15"	Nielson Quote	13.75	CY															
	Disposal Costs	Front end Loader 3 CY	31 23 16 42 1300	1.67	/CY												1.3	488	CY	
	Loading Cost	On site disposal	02 41 16 17 4200	8.65	/CY													488	CY	814.96
	Subtotal																	488	CY	4221.2
																				10192
	Subtotal																			
	Total																			17181

SITE REMOVED FROM BOND - NEVER BUILT

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Ref.	Description Swens Canyon Vent Facility 44	Materials	Means Reference Number	Unit Cost	O&P	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	Steel																				
	Substation Transformers																				
	Structure's demo	Steel Bld. Large	02 41 16 13 0020	0.27	0.36	/CF						1000					CF		1000	CF	360
					0																
	Fuel Containment cover				0																
	Structure's demo	Steel Bld. Large	02 41 16 13 0020	0.27	0.36	/CF						12600					CF		12600	CF\	4536
					0																
	Fencing				0																
	Topsoil pile	Fencing barbed wire 3 strand	02 41 13 60 1600	2.1	2.1	LF	1050												1050	LF	2205
	ventilation pad	chain link remove 8'-10'	02 41 13 60 1700	4.22	4.22	LF	1000												1000	LF	4220
	Cuttings Pond	Fencing barbed wire 3 strand	02 41 13 60 1600	2.1	2.1	LF	1100												1100	LF	2310
	Subtotal				0																
					0																13631
	substation pad	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY						36							36	CY	495
	Hoist pad	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY						45							45	CY	619
	Fuel Bay	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY						54							54	CY	743
	Shaft collar and pad	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY						100							100	CY	1375
	misc (gravel bin)	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY						30							30	CY	413
	Concrete's vol	Nielson Concrete <15"	Nielson Quote	13.75	13.75	CY						25							25	CY	344
	Loading Cost				0													1.3	260	CY	
	Disposal Costs	Front end Loader 3 CY	31 23 16 42 1300	1.67	2.05	/CY													260	CY	533
	Loading Cost	On site disposal	02 41 16 17 4200	8.65	10.8	/CY													260	CY	2808
	Subtotal				0																7330
	Transmission line removal				0																
	demo cost	D6R Series II (9-54) (1st14)	(9-54) st 14	190.4	235.56	HR									120		HR		120	HR	28267
	Subtotal																				
																					28267
	Subtotal																				
	Total																				**49228**

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Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost
	(17) 2-inch Monitoring Wells Abandonment	Super Plug; 2-bags		11.16	50lb bag	400-ft					100-gallons							2		22.32
	W79-10-1B (Blocked @400')					400												2		22.32
	W79-26-1 (200)					200												1		11.16
	W2-1(98-2-1) (1519')					1549												8		89.28
	W99-4-1 (1470')					1470												7		78.12
	W20-28-1 (1690')					1690												8		89.28
	92-91-03 (132')					132												2		22.32
	08-1-5 (327')					327												2		22.32
	15-21-2 (2142')					2142												11		122.76
	16-24-1 (600')					600												3		33.48
	17-21-1 (1200')					1200												6		66.96
	17-34-1B (350')					350												2		22.32
	17-34-1S (910')					910												5		55.8
	18-28-1 (1160')					1160												6		66.96
	18-32-1B (1140')					1140												6		66.96
	Subtotal																			
	18-32-1S (1680')					1680												9		100.44
	18-5-1S (2525')					2525												13		145.08
	19-5-1B (1755')					1750												9		100.44
	Subtotal																			
	Drill Crew	2-man		125	hr									90						11250
	Water truck w/crew			100										72						7200
	Boulger Dam Piezometer abandonment	2-man		125	hr									8						1000
	Subtotal																			
	Subtotal																			
	Subtotal																			
	Total																			**20588**

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Ch. 4 Sec. 4.3

Earthwork

	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Portal 01															70928
Water Tank 02															12835
Lower Terrace 03															487.3
Middle Bench 04															258768
Upper Bench West Fork 05															137340
Southwest Fork 06															7750
Loadout Faclities 07															187522
South Fork Portal Area 08															71822
Waste Rock Disposal 09															399159
Pond Enlargement Interim 10															17
Pond Diversion DU2 Interim 11															449
Interim Sediment Control 12															5192
Overland Conveyor 13															1812
James Canyon 14															0
Winter Quarters 15															159928
North of Groben Bleeder Shaft 16	REMOVED FROM PERMIT														
Swens Canyon Ventilation Facility 17															178721
Total															**1492730**

Notes: Revised operator wages 6/21/16

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Earthwork

ITEM			Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.
ST-15Z 15CY	(21-10)	(1st14)	19140	118.25	0.1	55.4	305.1	1
CLAB							62.1	0.5
988G EROPS	(9-37)	(1st14)	21000	119.32	0.1	52.25	314.75	
769D	(20-11)	(1st14)	21000	119.32	0.1	49.15	311.65	
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	
Foreman Average, Outside							84.25	
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	561.65	
410G EROPS 4WD EXTEN.	(9-28)	(1st14)	3620	27.05	0.1	55.4	107.78	
631G	(9-51)	(1st14)	16500	93.75	0.1	55.4	261.65	
14H EROPS	(9-11)	(2H2014)	14500	82.39	0.1	55.4	236.65	
CAT 345BL II	(10-23)	(1st14)	17095	113.1	0.1	55.4	286.65	
6X4 70,000lbs 12-18 CY	(20-11)	(1st14)	4410	63.45	0.1	55.4	152.76	
D6R Series II	(9-54)	(1st14)	10800	61.36	0.1	55.4	190.4	
980G Series II EROPS	(9-37)	(1st14)	13000	73.86	0.1	55.4	217.9	
D10	(9-54)	(1st14)	31000	352.27	0.1	55.4	636.65	
Eq. Op., Medium Equipment (Eqmd)	Eqmd						82.7	
General fill by dozer	31 23 23.17 0320						1.87	

Swens Material 2014 Rates **Supplied by Nelco Contractors**

Material	Quan.	UM	Freight	Per ton Material	Material Price	FOB Material Price
6" Rock Screened	226	CY	$ 15.81	$ 5.00	$ 7.50	$ 23.31
2-4" Rock Crushed	76	CY	$ 15.81	$ 9.00	$ 13.50	$ 29.31
Gravel Crushed	491	CY	$ 15.81	$ 9.00	$ 13.50	$ 29.31
Sand	38	CY	$ 15.81	$ 15.00	$ 22.50	$ 38.31
Bentonite	102	CY	$ 15.81	$ 20.00	$ 22.00	$ 37.81
Crushed Concrete	91	CY	$ 15.81	$ 25.00	$ 41.25	$ 57.06

Christensen Ready Mix 2014 Rates

6-bag concrete per yard $117
Delivery per 10-yard load $50

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	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Skyline Mine Backfilling and Grading Portal 01																	
ST-15Z 15CY	(21-10)	(1st14)	19140	118.25	0.1	55.4	305.1	1	305.1	$/HR	16740	CY	79.15	CY/HR	211	HR	64376
CLAB							62.1	0.5	31.05	$/HR					211	HR	6552
																	70928

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	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Cost	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Skyline Mine **Water Tank 02** 0.26 arces																	
Backfilling and Grading																	
988G EROPS	(9-37)	(1st14)	21000	119.32	0.1	52.25	314.75	1	314.75	$/HR	1683	CY	276.16	CY/HR	6	HR	1889
769D	(20-11)	(1st14)	21000	119.32	0.1	49.15	311.65	3	934.95	$/HR					6	HR	5610
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					6	HR	396
CLAB							62.1	1	62.1	$/HR					6	HR	373
Foreman Average, Outside							84.25	1	84.25	$/HR					6	HR	506
Place Topsoil																	
769D	(20-11)	(1st14)	21000	119.32	0.1	49.15	311.65	1	311.65	$/HR	420	CY	92	CY/HR	4.6	HR	1434
988G EROPS	(9-37)	(1st14)	21000	119.32	0.1	52.25	314.75	1	314.75	$/HR					4.6	HR	1448
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	561.65	0	0	$/HR					4.6	HR	0
CLAB							62.1	1.5	93.15	$/HR					4.6	HR	428
410G EROPS 4WD EXTEN.	(9-28)	(1st14)	3620	27.05	0.1	55.4	107.78	1	107.78	$/HR	0.3	AC	1	AC/HR	0.3	HR	32
CLAB							62.1	1.5	93.15	$/HR					0.3	HR	28
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					4.6	HR	303
Foreman Average, Outside							84.25	1	84.25	$/HR					4.6	HR	388
																	12835

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	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Skyline Mine Mine Facilities Area **Lower Terrace 03**																	
Backfilling and Grading																	
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	561.65	0	0	$/HR					79.5	HR	0
631G	(9-51)	(1st14)	16500	93.75	0.1	55.4	261.65	3	784.95	$/HR					79.5	HR	62404
CLAB							62.1	1	62.1	$/HR					79.5	HR	4937
Foreman Average, Outside							84.25	1	84.25	$/HR					40	HR	3370
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					40	HR	2639
Place Topsoil																	
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	561.65	0	0	$/HR					21.1	HR	0
631G	(9-51)	(1st14)	16500	93.75	0.1	55.4	261.65	1	261.65	$/HR					21.1	HR	5521
CLAB							62.1	1	62.1	$/HR					21.1	HR	1310
14H EROPS	(9-11)	(2H2014)	14500	82.39	0.1	55.4	236.65	1	236.65	$/HR					21.1	HR	4993
410G EROPS 4WD EXTEN.	(9-28)	(1st14)	3620	27.05	0.1	55.4	107.78	1	107.78	$/HR					21.1	HR	2274
CLAB							62.1	1	62.1	$/HR					21.1	HR	1310
Foreman Average, Outside							84.25	1	84.25	$/HR					21.1	HR	1778
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					21.1	HR	1392
Subtotal																	**487**

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	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Skyline Mine Mine Facilities Area **Middle Bench 04**																	
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	561.65	1	561.65	$/HR					122.46	HR	68780
631G	(9-51)	(1st14)	16500	93.75	0.1	55.4	261.65	3	784.95	$/HR					122.46	HR	96125
CLAB							62.1	1	62.1	$/HR					122.46	HR	7605
Foreman Average, Outside							84.25	1	84.25	$/HR					61	HR	5139
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					61	HR	4024
Place Topsoil																	
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	561.65	5	2808.25	$/HR					20.9	HR	58692
631G	(9-51)	(1st14)	16500	93.75	0.1	55.4	261.65	1	261.65	$/HR					20.9	HR	5468
CLAB							62.1	1	62.1	$/HR					20.9	HR	1298
14H EROPS	(9-11)	(2H2014)	14500	82.39	0.1	55.4	236.65	1	236.65	$/HR					20.9	HR	4946
410G EROPS 4WD EXTEN.	(9-28)	(1st14)	3620	27.05	0.1	55.4	107.78	1	107.78	$/HR					20.9	HR	2253
CLAB							62.1	1	62.1	$/HR					20.9	HR	1298
Foreman Average, Outside							84.25	1	84.25	$/HR					20.9	HR	1761
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					20.9	HR	1379
																	258768

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	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Skyline Mine Mine Facilities Area **Upper Bench West Fork 05**																	
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	561.65	1	561.65	$/HR					37.5	HR	21062
631G	(9-51)	(1st14)	16500	93.75	0.1	55.4	261.65	3	784.95	$/HR					37.5	HR	29436
CLAB							62.1	1	62.1	$/HR					37.5	HR	2329
Foreman Average, Outside							84.25	1	84.25	$/HR					19	HR	1601
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					19	HR	1253
Place Topsoil																	
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	561.65	5	2808.25	$/HR					23.7	HR	66556
631G	(9-51)	(1st14)	16500	93.75	0.1	55.4	261.65	1	261.65	$/HR					23.7	HR	6201
CLAB							62.1	1	62.1	$/HR					23.7	HR	1472
14H EROPS	(9-11)	(2H2014)	14500	82.39	0.1	55.4	236.65	1	236.65	$/HR					9.52	HR	2253
410G EROPS 4WD EXTEN.	(9-28)	(1st14)	3620	27.05	0.1	55.4	107.78	1	107.78	$/HR					9.52	HR	1026
CLAB							62.1	1	62.1	$/HR					9.52	HR	591
Foreman Average, Outside							84.25	1	84.25	$/HR					23.7	HR	1997
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					23.7	HR	1563
																	137340

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	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Skyline Mine Mine Facilities Area **Southwest Fork 06**															
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	5.54	$/HR					66	HR	**366**
631G	(9-51)	(1st14)	16500	93.75	0.1	55.4	5.54	$/HR					66	HR	**366**
CLAB							62.1	$/HR					66	HR	**4099**
Foreman Average, Outside							84.25	$/HR					33	HR	**2780**
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	4.2	$/HR					33	HR	**139**
															7750

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	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Skyline Mine **Loadout Faclities 07**																	
Backfilling and Grading																	
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	561.65	1	561.65	$/HR					88.8	HR	49875
631G	(9-51)	(1st14)	16500	93.75	0.1	55.4	261.65	3	784.95	$/HR					88.8	HR	69704
CLAB							62.1	1	62.1	$/HR					88.8	HR	5514
Foreman Average, Outside							84.25	1	84.25	$/HR					44	HR	3707
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					44	HR	2902
Topsoil																	
631G	(9-51)	(1st14)	16500	93.75	0.1	55.4	261.65	3	784.95	$/HR					28.4	HR	22293
D8R Series II	(9-54)	(1st14)	19000	352.27	0.1	55.4	561.65	1	561.65	$/HR					28.4	HR	15951
CLAB							62.1	1	62.1	$/HR					28.4	HR	1764
14H EROPS	(9-11)	(2H2014)	14500	82.39	0.1	55.4	236.65	1	236.65	$/HR					28.4	HR	6721
410G EROPS 4WD EXTEN.	(9-28)	(1st14)	3620	27.05	0.1	55.4	107.78	1	107.78	$/HR					28.4	HR	3061
CLAB							62.1	1	62.1	$/HR					28.4	HR	1764
Foreman Average, Outside							84.25	1	84.25	$/HR					28.4	HR	2393
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					28.4	HR	1873
Subtotal																	**187522**

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	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Skyline Mine **South Fork Portal Area 08**																	
Backfilling and Grading																	
CAT 345BL II	(10-23)	(1st14)	17095	113.1	0.1	55.4	286.65	1	286.65	$/HR					25.2	HR	**7224**
6X4 70,000lbs 12-18 CY	(20-11)	(1st14)	4410	63.45	0.1	55.4	152.76	2	305.52	$/HR					25.2	HR	**7699**
988G EROPS	(9-37)	(1st14)	21000	119.32	0.1	52.25	314.75	1	314.75	$/HR					25.2	HR	**7932**
D6R Series II	(9-54)	(1st14)	10800	61.36	0.1	55.4	190.4	1	190.4	$/HR					25.2	HR	**4798**
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					25.2	HR	**1662**
CLAB							62.1	1.5	93.15	$/HR					25.2	HR	**2347**
Foreman Average, Outside							84.25	1	84.25	$/HR					25.2	HR	**2123**
Topsoil																	
988G EROPS	(9-37)	(1st14)	21000	119.32	0.1	52.25	314.75	1	314.75	$/HR					35.82	HR	**11274**
D6R Series II	(9-54)	(1st14)	10800	61.36	0.1	55.4	190.4	1	190.4	$/HR					35.82	HR	**6820**
14H EROPS	(9-11)	(2H2014)	14500	82.39	0.1	55.4	236.65	1	236.65	$/HR					35.82	HR	**8477**
410G EROPS 4WD EXTEN.	(9-28)	(1st14)	3620	27.05	0.1	55.4	107.78	1	107.78	$/HR					35.82	HR	**3861**
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					35.82	HR	**2363**
CLAB							62.1	1	62.1	$/HR					35.82	HR	**2224**
Foreman Average, Outside							84.25	1	84.25	$/HR					35.82	HR	**3018**
																	71822

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Skyline Mine
Waste Rock Disposal 09

	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Backfilling and Grading																	
CAT 345BL II	(10-23)	(1st14)	17095	113.1	0.1	55.4	286.65	1	286.65	$/HR					4.5	HR	1290
6X4 70,000lbs 12-18 CY	(20-11)	(1st14)	4410	63.45	0.1	55.4	152.76	2	305.52	$/HR					4.5	HR	1375
980G Series II EROPS	(9-37)	(1st14)	13000	73.86	0.1	55.4	217.9	1	217.9	$/HR					4.5	HR	981
D6R Series II	(9-54)	(1st14)	10800	61.36	0.1	55.4	190.4	1	190.4	$/HR					4.5	HR	857
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					4.5	HR	297
In Situ Topspoil																	
CAT 345BL II	(10-23)	(1st14)	17095	113.1	0.1	55.4	286.65	1	286.65	$/HR					20.9	HR	5991
6X4 70,000lbs 12-18 CY	(20-11)	(1st14)	4410	63.45	0.1	55.4	152.76	2	305.52	$/HR					20.9	HR	6385
980G Series II EROPS	(9-37)	(1st14)	13000	73.86	0.1	55.4	217.9	1	217.9	$/HR					20.9	HR	4554
D6R Series II	(9-54)	(1st14)	10800	61.36	0.1	55.4	190.4	1	190.4	$/HR					20.9	HR	3979
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					20.9	HR	1379
Topsoil Placement																	
6X4 70,000lbs 12-18 CY	(20-11)	(1st14)	4410	63.45	0.1	55.4	152.76	3	458.28	$/HR					279.8	HR	128227
988G EROPS	(9-37)	(1st14)	21000	119.32	0.1	52.25	314.75	1	314.75	$/HR					279.8	HR	88067
CLAB							62.1	1	62.1	$/HR					279.8	HR	17376
14H EROPS	(9-11)	(2H2014)	14500	82.39	0.1	55.4	236.65	1	236.65	$/HR					279.8	HR	66215
410G EROPS 4WD EXTEN.	(9-28)	(1st14)	3620	27.05	0.1	55.4	107.78	1	107.78	$/HR					279.8	HR	30157
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					279.8	HR	18456
Foreman Average, Outside							84.25	1	84.25	$/HR					279.8	HR	23573
Subtotal																	399159

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Skyline Mine
Interim Sediment Control

Loadout Facilities Sediment

Pond Enlargement Interim 10

	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. or Labor Time/Dis.	Units	Cost
980G Series II EROPS	(9-37)	(1st14)	13000	73.86	0.1	55.4	217.9	1	217.9	$/HR					4.3	HR	937
CLAB							62.1	1	62.1	$/HR					4.3	HR	267
Foreman Average, Outside							84.25	1	84.25	$/HR					4.3	HR	362
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					4.3	HR	284
Subtotal																	17

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Skyline Mine
Interim Sediment Control

Loadout Diversion to Sediment

Pond Diversion DU2 Interim 11

	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
14H EROPS	(9-11)	(2H2014)	14500	82.39	0.1	55.4	236.65	1	236.65	$/HR					1	HR	237
CLAB							62.1	1	62.1	$/HR					1	HR	62
Foreman Average, Outside							84.25	1	84.25	$/HR					1	HR	84
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					1	HR	66
																	449

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	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Skyline Mine **Interim Sediment Control 12**																	
Backfill Pond With																	
Embankment Material																	
988G EROPS	(9-37)	(1st14)	21000	119.32	0.1	52.25	314.75	1	314.75	$/HR					6.8	HR	**2140**
CLAB							62.1	1	62.1	$/HR					6.8	HR	**422**
Foreman Average, Outside							84.25	1	84.25	$/HR					6.8	HR	**573**
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					6.8	HR	**449**
Topsoil Placement																	
1Ft. Depth																	
988G EROPS	(9-37)	(1st14)	21000	119.32	0.1	52.25	314.75	1	314.75	$/HR					2.2	HR	**692**
CLAB							62.1	1	62.1	$/HR					2.2	HR	**137**
Foreman Average, Outside							84.25	1	84.25	$/HR					2.2	HR	**185**
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					2.2	HR	**145**
Diversion Removal DU2																	
14H EROPS	(9-11)	(2H2014)	14500	82.39	0.1	55.4	236.65	1	236.65	$/HR					1	HR	**237**
CLAB							62.1	1	62.1	$/HR					1	HR	**62**
Foreman Average, Outside							84.25	1	84.25	$/HR					1	HR	**84**
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					1	HR	**66**
																	5192

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	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Skyline Mine **Overland Conveyor 13**																	
6X4 70,000lbs 12-18 CY	(20-11)	(1st14)	4410	63.45	0.1	55.4	152.76	1	152.76	$/HR					2.3	HR	351
988G EROPS	(9-37)	(1st14)	21000	119.32	0.1	52.25	314.75	1	314.75	$/HR					2.3	HR	724
CLAB							62.1	1	62.1	$/HR					2.3	HR	143
Foreman Average, Outside							84.25	1	84.25	$/HR					2.3	HR	194
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	$/HR					2.3	HR	152
410G EROPS 4WD EXTEN.	(9-28)	(1st14)	3620	27.05	0.1	55.4	107.78	1	107.78	$/HR					2.3	HR	248
Subtotal																	**1812**

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	Reference		Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
	Page	Year															
James Canyon 14																	
See Demo worksheet																	
	(21-10)	1st14															
Subtotal																	

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	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Winter Quarters Ventilation Facility 15																	
Sealing Shaft																	
(+) 6 inch rock			20.38				20.38	1	20.38	CY	283				283	CY	5768
2 inch - 4inch Rock			29.29				29.29	1	29.29	CY	95				95	CY	2783
Gravel			29.29				29.29	1	29.29	CY	614				614	CY	17984
Sand			23.08				23.08	1	23.08	CY	47				47	CY	1085
Bentonite	(21-10)	1st14	35.35				35.35	1	35.35	CY	127				127	CY	4489
Concrete			120				120	1	120	CY	114				114	CY	13680
Fill Material			7				7	1	7	CY	2839				2839	CY	19873
D6R Series II	(9-54)	(1st14)	10800	61.36	0.1	55.4	190.4	1	190.4	HR	80	HR	1		80	HR	15232
Eq Op Medium Equiment						82.7	82.7	1	82.7	HR	80	HR	1		80	HR	6616
Subtotal																	87510
Sealing Escape Shaft																	
(+) 6 inch rock			20.38				20.38	1	20.38	CY	32				32	CY	652
2 inch - 4inch Rock			29.2				29.2	1	29.2	CY	10.5				10.5	CY	307
Gravel			29.29				29.29	1	29.29	CY	213				213	CY	6239
Sand			23.08				23.08	1	23.08	CY	5				5	CY	115
Bentonite			35.35				35.35	1	35.35	CY	22				22	CY	778
Concrete			120				120	1	120	CY	30				30	CY	3600
Fill Material			7				7	1	7	CY	323				323	CY	2261
Subtotal																	13952
Cementateous Grout			125				125	1	125	CY	89				89	HR	11125
Bentonite			35.35				35.35	1	35.35	CY	45				45	HR	1591
Concrete			120				120	1	120	CY	11.5				11.5	HR	1380
Fill Material			7				7	1	7	CY	445				445	HR	3115
D6R Series II	(9-54)	(1st14)	10800	61.36	0.1	55.4	190.4	1	190.4	HR	80	HR			80	HR	15232
Eq Op medium equipment						82.7	82.7	1	82.7	HR	80	HR			80	HR	6616
Subtotal																	39059
Backfilling and grading																	
CAT 345BL II	(10-23)	(1st14)	17095	113.1	0.1	55.4	286.65	1	286.65	HR					12	HR	3440
D6R Series II	(9-54)	(1st14)	10800	61.36	0.1	55.4	190.4	1	190.4	HR					16	HR	3046
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	HR					20	HR	1319
CLAB							62.1	1.5	93.15	HR					20	HR	1863
Foreman Average, Outside							84.25	1	84.25	HR					20	HR	1685
Subtotal																	11353
Topsoil																	
D6R Series II	(9-54)	(1st14)	10800	61.36	0.1	55.4	190.4	1	190.4	HR					20	HR	3808
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14)	1105	15.55	0.1	41.95	65.96	1	65.96	HR					20	HR	1319
CLAB							62.1	1	62.1	HR					20	HR	1242
Foreman Average, Outside							84.25	1	84.25	HR					20	HR	1685
Subtotal																	9054
TOTAL																	**159928**

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North of Groben Bleeder Shaft 16	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Sealing Shaft																	
(+) 6 inch rock			20.38				20.38	1	20.38	CY	27				27	CY	550
2 inch - 4inch Rock			29.29				29.29	1	29.29	CY	9				9	CY	264
Gravel			29.29				29.29	1	29.29	CY	179				179	CY	5243
Sand			23.08				23.08	1	23.08	CY	4				4	CY	92
Bentonite			35.35				35.35	1	35.35	CY	19				19	CY	672
Concrete			120				120	1	120	CY	25				25	CY	3000
Fill Material			7				7	1	7	CY	1656				1656	CY	11592
General fill by dozer	31 23 23.17 0320								1.87	CY	6739	CY			6739	HR	12602
Subtotal																	34015
Subtotal																	
Subtotal																	
Backfilling and grading																	
CAT 345BL II	(10-23)	(1st14	17095	113.1	0.1	55.4	292.97	1	292.97	HR					12	HR	3516
D8R Series II	(9-54)	(1st14	19000	352.27	0.1	55.4	642.97	1	642.97	HR					16	HR	10288
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14	1105	15.55	0.1	41.95	83.28	1	83.28	HR					20	HR	1666
CLAB							62.1	1.5	54.98	HR					20	HR	1100
Foreman Average, Outside							84.25	1	76.35	HR					20	HR	1527
Subtotal																	18097
Topsoil																	
D8R Series II	(9-54)	(1st14	19000	352.27	0.1	55.4	642.97	1	642.97	HR					20	HR	12859
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14	1105	15.55	0.1	41.95	83.28	1	83.28	HR					20	HR	1666
CLAB							62.1	1	36.65	HR					20	HR	733
Foreman Average, Outside							84.25	1	76.35	HR					20	HR	1527
Subtotal																	16785
TOTAL																	0

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Swens Canyon Ventilation Facility 17	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Sealing Shaft 16ft D																	
(+) 6 inch rock			$ 7.50				$ 15.81	1	$ 23.31	CY	226	CY			226	CY	5269
2 inch - 4inch Rock			$ 13.50				$ 15.81	1	$ 29.31	CY	76	CY			76	CY	2228
Gravel			$ 13.50				$ 15.81	1	$ 29.31	CY	38	CY			38	CY	1114
Sand			$ 22.50				$ 15.81	1	$ 38.31	CY	38	CY			38	CY	1456
Bentonite			$ 22.00				$ 15.81	1	$ 37.81	CY	74	CY			74	CY	2798
Concrete			$ 117.00				$ 5.00	1	$ 122.00	CY	37	CY			37	CY	4514
Pit Run or Reject fill							$ 15.81		$ 15.81		7100	CY			7100		112269
General fill by dozer	31 23 23.17 0320								1.87	CY	7589	CY			7589	HR	14191
Subtotal																	143839
Subtotal																	
Subtotal																	
Backfilling and grading																	
CAT 345BL II	(10-23)	(1st14	17095	113.1	0.1	55.4	292.97	1	292.97	HR					12	HR	3516
D8R Series II	(9-54)	(1st14	19000	352.27	0.1	55.4	642.97	1	642.97	HR					16	HR	10288
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14	1105	15.55	0.1	41.95	83.28	1	83.28	HR					20	HR	1666
CLAB							62.1	1.5	54.98	HR					20	HR	1100
Foreman Average, Outside							84.25	1	76.35	HR					20	HR	1527
Subtotal																	18097
Topsoil																	
D8R Series II	(9-54)	(1st14	19000	352.27	0.1	55.4	642.97	1	642.97	HR					20	HR	12859
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14	1105	15.55	0.1	41.95	83.28	1	83.28	HR					20	HR	1666
CLAB							62.1	1	36.65	HR					20	HR	733
Foreman Average, Outside							84.25	1	76.35	HR					20	HR	1527
Subtotal																	16785
TOTAL																	178721

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Swens Canyon Ventilation Facility 17	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Sealing Shaft 16ft D																	
(+) 6 inch rock			$ 7.50				$ 15.81	1	$ 23.31	CY	226	CY			226	CY	5269
2 inch - 4inch Rock			$ 13.50				$ 15.81	1	$ 29.31	CY	76	CY			76	CY	2228
Gravel			$ 13.50				$ 15.81	1	$ 29.31	CY	38	CY			38	CY	1114
Sand			$ 22.50				$ 15.81	1	$ 38.31	CY	38	CY			38	CY	1456
Bentonite			$ 22.00				$ 15.81	1	$ 37.81	CY	74	CY			74	CY	2798
Concrete			$ 117.00				$ 5.00	1	$ 122.00	CY	37	CY			37	CY	4514
Pit Run or Reject fill							$ 15.81		$ 15.81		7100	CY			7100		112269
General fill by dozer	31 23 23.17 0320								1.87	CY	7589	CY			7589	HR	14191
Subtotal																	143839
Subtotal																	
Subtotal																	
Backfilling and grading																	
CAT 345BL II	(10-23)	(1st14	17095	113.1	0.1	55.4	292.97	1	292.97	HR					12	HR	3516
D8R Series II	(9-54)	(1st14	19000	352.27	0.1	55.4	642.97	1	642.97	HR					16	HR	10288
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14	1105	15.55	0.1	41.95	83.28	1	83.28	HR					20	HR	1666
CLAB							62.1	1.5	54.98	HR					20	HR	1100
Foreman Average, Outside							84.25	1	76.35	HR					20	HR	1527
Subtotal																	18097
Topsoil																	
D8R Series II	(9-54)	(1st14	19000	352.27	0.1	55.4	642.97	1	642.97	HR					20	HR	12859
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14	1105	15.55	0.1	41.95	83.28	1	83.28	HR					20	HR	1666
CLAB							62.1	1	36.65	HR					20	HR	733
Foreman Average, Outside							84.25	1	76.35	HR					20	HR	1527
Subtotal																	16785
TOTAL																	178721

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Swens Canyon Ventilation Facility 17	Reference Page	Reference Year	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Unit	Units	Cost
Sealing Shaft 16ft D																	
(+) 6 inch rock			$ 7.50				$ 15.81	1	$ 23.31	CY	226	CY			226	CY	5269
2 inch - 4inch Rock			$ 13.50				$ 15.81	1	$ 29.31	CY	76	CY			76	CY	2228
Gravel			$ 13.50				$ 15.81	1	$ 29.31	CY	38	CY			38	CY	1114
Sand			$ 22.50				$ 15.81	1	$ 38.31	CY	38	CY			38	CY	1456
Bentonite			$ 22.00				$ 15.81	1	$ 37.81	CY	74	CY			74	CY	2798
Concrete			$ 117.00				$ 5.00	1	$ 122.00	CY	37	CY			37	CY	4514
Pit Run or Reject fill							$ 15.81		$ 15.81		7100	CY			7100		112269
General fill by dozer	31 23 23.17 0320								1.87	CY	7589	CY			7589	HR	14191
Subtotal																	143839
Subtotal																	
Subtotal																	
Backfilling and grading																	
CAT 345BL II	(10-23)	(1st14	17095	113.1	0.1	55.4	292.97	1	292.97	HR					12	HR	3516
D8R Series II	(9-54)	(1st14	19000	352.27	0.1	55.4	642.97	1	642.97	HR					16	HR	10288
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14	1105	15.55	0.1	41.95	83.28	1	83.28	HR					20	HR	1666
CLAB							62.1	1.5	54.98	HR					20	HR	1100
Foreman Average, Outside							84.25	1	76.35	HR					20	HR	1527
Subtotal																	18097
Topsoil																	
D8R Series II	(9-54)	(1st14	19000	352.27	0.1	55.4	642.97	1	642.97	HR					20	HR	12859
Pickup Truck Crew 4x4 1 ton	(20-17)	(1st14	1105	15.55	0.1	41.95	83.28	1	83.28	HR					20	HR	1666
CLAB							62.1	1	36.65	HR					20	HR	733
Foreman Average, Outside							84.25	1	76.35	HR					20	HR	1527
Subtotal																	16785
TOTAL																	**178721**

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Review

Ref.	Description	Materials	Means Reference Number	Unit Cost	OR?	Unit	Length	Width	Height	Diame	Area	Volum	Weight	Dens	Time	Numb	Unit	Quantity Factor	Unit	Cost*
1	**South Facing Slopes 1H:3H or Greater**																			
	Seeding	South Facing Slope Seed 1H : 3H or gentler	Table 4.7-1	300.15		/AC					39.81						AC	39.81	AC	11,949
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					39.81						AC	1734	MSF	71,966
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					39.81						AC	39.81	AC	11,505
	Subtotal																			95,420
2	**North Facing Slopes**																			
	Seeding	North Facing Slopes Seed	Table 4.7-2	267.02		/AC					20.33						AC	20.33	AC	5,429
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					20.33						AC	886	MSF	36,751
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					20.33						AC	20.33	AC	5,875
	Subtotal																			48,055
3	**Riparian Habitat**																			
	Seeding	Riparian Habitat Seed	Table 4.7-3	68.26		/AC					0.04						AC	0.04	AC	3
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					0.04						AC	2	MSF	72
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					0.04						AC	0.04	AC	12
	Subtotal																			87
4	**Soth to West Facing Slopes**																			
	Seeding	South to West Facing Riparian Habitat Seed	Table 4.7-4	450.73		/AC					39.81						AC	39.81	AC	17,943
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					39.81						AC	1734	MSF	71,966
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					39.81						AC	39.81	AC	11,505
	Subtotal																			101,415
5	**North to East Facing Slopes**																			
	Seeding	North to East Facing Riparian Habitat Seed	Table 4.7-5	343.31		/AC					20.33						AC	20.33	AC	6,980
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					20.33						AC	886	MSF	36,751
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					20.33						AC	20.33	AC	5,875
	Subtotal																			49,605
6	**Waste Rock**																			
	Seeding	Waste Rock Slopes Seed	Table 4.7-6A	136.52		/AC					12.81						AC	12.81	AC	1,749
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					12.81						AC	558.004	MSF	23,157
		Fertilizer Hydro Spread		289.00		/AC					12.81							12.81	AC	3,702
	Subtotal																			28,608
7	**James Canyon**																			
	Seeding	Waste Rock Slopes Seed	Table 4.7-6A	136.52		/AC					4.85						AC	4.85	AC	662
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					4.85						AC	211	MSF	8,768
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					4.85						AC	4.85	AC	1,402
	Subtotal																			10,831
8	**Riparian Stem Supplement**																			
	Stems	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		Ea										9800	Ea	18718	EA	35,751
	Subtotal																			35,751
9	**Silt Fence Interim Vegetation**																			
	Stems	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		Ea	20000										ea	20000	EA	38,200
	Subtotal																			38,200
10	**Reveg Loadout Sediment Pond**																			
	Seeding	Riparian Habitat Seed	Table 4.7-3	68.26		/AC					0.3						AC	0.3	/AC	20
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					0.3						AC	13	MSF	542
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					0.3						AC	0.3	/AC	87
	Subtotal																			650
11	**Winter Quarters Ventilation Facility Bond**																			
	South facing slopes																			
	Seeding	Final Reveg Seed Mix Rip Commun Win Qu Ven Fac	Table 4.7-9B	######		/AC					2.36						AC	2.36	/AC	2,379
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					2.36						AC	103	/MSF	4,266
		Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					2.36						AC	2.36	/AC	682
	Quaking Aspen	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					2.36			400			ea	400	ea	764
	Blue Elderberry	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					2.36			400			ea	400	ea	764
	Subtotal																			8,855
12	**North of Graben Bleeder Shaft** THIS SITE WAS NEVER BUILT																			
	REVEGETATION																			
	NOG																			
	South facing slopes																			
	Seeding	South facing slope seed mix	Table 4.7-10B	209.80		/AC					1.7						AC	1.7	/AC	
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					1.7						AC	74	/MSF	
	Tublings	Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					1.7						AC	1.7	/AC	
	Quaking Aspen	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					1.7			200			ea	200	ea	
	red Elderberry	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					1.7			20			ea	20	ea	
	Mountain Snowberry	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		EA					1.7			100			ea	100	ea	
	Subtotal																			
13	**Swens Canyon Ventilation Facility**																			
	South facing slopes																			
	Seeding	Final Reveg Sage/Grass Swens Can Ven Fac south facing slope seed mix	Table 4.7-11B	287.10		/AC					9.7						AC	9.7	/AC	2,785
	Equipment	Hydro Spreader (equip. & labor) B-81/mulch & fertilizer	32 92 19.14 5800	41.50		/MSF					9.7						AC	423	/MSF	17,535
	Tublings	Fertilizer Hydro Spread	32 92 19.14 7025	289.00		/AC					9.7						AC	9.7	/AC	2,803
	Sagebrush	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					9.7			400			ea	400	ea	764
	rabbitbrush	Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91		ea					9.7			400			ea	400	ea	764
	Subtotal																			24,651
	Revegetation																			
	25% of Initial Seeding																			30,962
	Subtotal																			30,962
	Total										150.3									[illegible]

* Hay material only: assume 2 tons/ac (1 to 2 tons recommended in The Practical Guide to Reclamation in Utah pp.112-113)
*2014 R.S. Means and 2014 Nevada SRCE use $0.15/lb ($300/ton)

Note: MRP Hay costs vary from line item. Varies other errors in cell calcs

Tree Plat 13.8

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Materials	Means Reference Number	2019 Unit Cost*	Unit	O&P Incl.
Bare root seedlings, 11" to 16" med. soil	32 93 43.10 0562	1.91	ea	1.74
Fertilizer Hydro Spread	32 92 19.14 7025	289.00	/AC	265
Final Reveg Sage/Grass Swens Can Ven Fac south facing slope s	Table 4.7-11B	287.10	/AC	
Final Reveg Seed Mix North of Graben Bleeder Shaft	Table 4.7-10B	209.80	/AC	
Final Reveg Seed Mix Rip Commun Win Qu Ven Fac	Table 4.7-9B	1007.86	/AC	
Final Reveg Seed Mix Sage/Grass Win Qu Ven Fac	Table 4.7-9C	2070.93	/AC	
Hay 1" material only (029105000250)	SRCE	0.00	/AC	
Hydro Spreader (equip. & labor) B-81	32 92 19.14 5800	41.50	/MSF	39.5
Interim Reveg Seed Mix North of Graben Bleeder Shaft	Table 4.7-10A	149.57	/AC	
Interim Reveg Seed Mix Sage/Grass Swens Canyon Ven Fac	Table 4.7-11A	210.81	/AC	
Interim Reveg Seed Mix Win Qu Ven Fac	Table 4.7-9A	828.17	/AC	
North Facing Slopes Seed	Table 4.7-2	267.02	/AC	
North Facing Slopes Riparian Habitat Seed	Table 4.7-5	343.31	/AC	
Riparian Habitat Seed	Table 4.7-3	68.26	/AC	
South Facing Slope Seed 1H : 3H or gentler	Table 4.7-1	300.15	/AC	
south facing slope seed mix	Table 4.7-10B	209.80	/AC	
Riparian Habitat Seed	Table 4.7-4	450.73	/AC	
Waste Rock Slopes Seed	Table 4.7-6A	136.52	/AC	

*With the exception 2019 Means Reference Numbers Local 2014 Unit costs were increased by 1.023.

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Escalation I	1.012	1.007	Cost 2016	1.019	1.0232	5	Cost	
	2014	2015	2016		2019 (5-yr esc.)			
	0.00	0.00					287.16	213.85
	0.00	0.00					293.82	218.81
	280.64	284.01	286		287.10		300.63	223.89
	205.09	207.55	209		209.80		307.61	229.08
	985.20	997.02	1004		1007.86		314.74	234.40
	2024.37	2048.66	2063		2070.93			
	0.00	0.00			0.00		209.844	
	0.00	0.00			0.00			
	146.21	147.96	149		149.57			
	206.07	208.54	210		210.81			
	809.55	819.27	825		828.17			
	261.02	264.15	266		267.02			
	335.60	339.62	342		343.31			
	66.73	67.53	68		68.26			
	293.40	296.92	299		300.15			
	205.09	207.55	209		209.80			
	440.59	445.88	449		450.73			
	133.45	135.05	136		136.52			

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The topsoil and subsoil from the Swens Canyon Ventilation Facility (SCVF) area was collected from the disturbed area as construction advanced. Prior to construction, soil samples were collected from the A and B horizon at sample locations 14SKY14 and 14SKY15 and analyzed for available nutrients nitrogen, phosphorus, and potassium per DOGM 2008 guidelines. The associated soil survey (see Appendix A-2, Volume 2, titled, "Order 2 Soil Survey of the Powerline Corridor Swens Pad Ventilation and Escape Shafts Coal Pile Expansion at the Skyline Mine"; Appendix D and 2016 Annual Report) the depth of topsoil ranges from approximately 0.83 to 1.3 feet. An as-built survey estimates approximately 8,750 cu-yds of topsoil and 6,350 cu-yds of subsoil were collected and stored. The total topsoil and subsoil areas store approximately 15,100

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4.6.2 Topsoil Stockpile

Topsoil is stored within areas of the permit boundary which will not be routinely disturbed (See Maps 3.2.1-1, 3.2.1-3, 3.2.4-3A, 3.2.4-4A,3.2.8-1 3.2.8-2, 3.2.11-1,3.4-1, and Volume 5 Section 24). Six topsoil stockpile areas are utilized: 1) portal area, 2)the loadout facility, 3) the Scofield Waste Disposal site area, 4) the Winter Quarters Ventilation Facility; 5)Swens Canyon Ventilation Facility; and 6)James Canyon Well site.

Long-Term Topsoil Storage Areas

During construction at the mine site, a stockpile area of approximately 0.6 surface acre was established in the draw on the north side of the site. The long-term stockpile is composed of topsoil collected at the mine site and portions of the conveyor bench. It will later be used for post-mining reclamation of the benches and conveyor routes.

A second long-term topsoil stockpile, covering approximately 0.3 surface acre, was established at the load-out site for later reclamation use in that area. All six of the topsoil piles mentioned above are considered long-term, with the exception of three(3) locations at the Scofield Waste Disposal site. The Scofield site is reclaimed contemporaneously.

4.6.3 Topsoil Protection

Long-term topsoil stockpile protection is achieved by the performance of the following operational steps:

CHANGES TO		TEXT		
Section 4.6	Page 4-35	Section 4.6.2	Page 4-35	Date 5-20-20

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4.6.4.1 Coal Mine Waste Disposal Site

Canyon Fuel Company, LLC proposes to perform the revegetation of the waste disposal area in successive stages with a stage representing the portions of the site that have been filled to design capacity. When a stage is completely full, that area will be graded subsoil and topsoil will be placed over the waste material. Topsoil derived from the 1992 AML project and aspen or sagebrush vegetative type areas will be placed on the fill area. Cover soil brought to the site in 2016 is stored at the location shown on Plate 3.2.8-1. Additional soil will be brought into the disposal site from the mine site stockpile (which contain soil from non-National Forest areas), since previous mining activity has rendered insufficient topsoil available at the site. Imported topsoil will be analyzed for N-P-K, pH, EC and texture to assess suitability as a topsoil medium.

The road cut and fill slopes will be reclaimed when construction is completed. The cut slopes will be hydro-seeded where the soils and sub-soils will support growth. Cut slopes without sufficient soils and sub-soils will be topsoil-ed and hydro-seeded. Fill slopes not covered by waste rock will be topsoil-ed and hydro-seeded.

There is not enough subsoil cover material available on site to cover the entire 7.68 area disturbed with 16 inches of material. As has been the practice in the past, subsoil cover material will be purchased from a commercial source to make up the difference between what is on site and what is needed to meet the requirements of the plan. The subsoil material will be tested using the Division's Guideline #6 requirements. The entire disturbed reclaimed site will have 12 inches of topsoil added over the subsoil cover material. To meet the requirements of R645-301-553.252, the site will have a minimum of 20 inches of non-potentially toxic or acid forming materials placed immediately under the 16" of subsoil. Waste rock is routinely sampled for potentially toxic or acid forming materials. If any unsatisfactory waste rock is found it will be placed where it will have a minimum of 48" of total non-toxic or acid forming materials over it. Analysis of the Scofield topsoil and subsoil are shown on pages 4-38e and 4-38f.

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All non-toxic, non-combustible material, as well as the top soil and subsoil will be tested for toxicity, acid/base accounting, selenium, boron and complete soil analysis, as outlined on Table 1 of the Division's guideline for topsoil management. Topsoil will be applied to the final layer of moderately-compacted rock waste material and subsoil cover. Typically, the coal mine waste which will be disposed of consists of 36.00 percent less than 1/4 x 0 inch material and 28.6 percent between 1 x 1/2 and 1/2 x 1/2 inch (Exhibit 3). Therefore, the loss of topsoil into the pore space of the fill should not be a problem. The

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TABLE 4.6-4
TOPSOIL REDISTRIBUTION

	Acreage	Planned Depth Inches	Needed (cu-yds)	Current Storage (cu-yds)
Loadout Area				
South Slopes	10.52	18	25,458 (Private)	
North Slopes	3.30	12	5,324 (Private)	
Riparian	.04	18	97 (Private)	
Sub-Total	13.86		30,879	27,787
Portal Yard Area				
South Slopes	20.03	18	48,473 (USFS)	
North Slopes	16.37	12	26,410 (USFS)	
Sub-Total	36.40		74,883[1]	94,576[1]
Water Tank and Well Pads	.19	12	306 (USFS)	306
	.07	12	113 (Private)	113
Sub-Total	.26		419	
Waste Rock Disposal Site		12[2]	7,340[2] (Private)	
			(Private)	4,904[2]
Winter Quarters Ventilation Facility				
North Slope	1.69[3]	18	4,090 (Private)	5,200[4]
Overland Conveyor Route	.39	12	629 (Private)	15,295[1]
Swens Canyon Ventilation Facility				
North Slope	3.1	12	5001[5] (USFS)	6,240[5]
			43,051 (Private)	53,304
			80,190 (USFS)	101,122
GRAND TOTAL	59.99		123,241[6]	154,426

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[1] Both of these areas are located on National Forest lands and 79,281 cubic yards of National Forest topsoil was removed and stored from these areas. The topsoil over and above that planned for redistribution that came from National Forest lands will be redistributed on National Forest lands, as directed by the Manti-LaSal National. A total of 15,295 cubic yards located on the Portal topsoil pile came from private land and will be used where needed.

[2] 1,975 cubic yards were available on the Waste Rock disposal site prior to the reclamation of the Belina Mine Access Road, based on a rough estimate conducted in 2020. Approximately 2,929 cubic yards of cover soil was retrieved from the site as the Division removed fill from Eccles Creek. Due to contemporaneous reclamation activities a 2020 survey estimates approximately 4.55 acres needs cover soil in future reclamation. The remainder of topsoil will come from the Portal Yard stockpile or other outside source.

[3] Acreage for both the Winter Quarters and Swens Canyon ventilation facilities do not include the area occupied by the stockpiles are areas not disturbed inside the designated permit area.

[4] 5,200 cu-yds of soil cover material is represented on As-built Plate 3.2.4-3A.

[5] 3.1 acres does not include the acreage of the topsoil/subsoil pile areas or the pond area illustrated on Plate 3.2.4-4F. Approximately 5,200 cu-yds of Topsoil and 5,500 cy-yds of subsoil were estimated to be in the pile for the pad and access road areas. A 2017 Lidar survey estimated approximately 6,240 cy-yds of topsoil and 14,500 cu-yds of subsoil exist in the stockpile area.

[6] 80,190 cubic yards are needed for revegetation on National Forest lands and 43,051 cubic yards are needed for revegetation on private lands. As indicated in Section 2.11, there is 101,122 cubic yards of topsoil available for revegetation on National Forest Lands and 53,304 cubic yards of topsoil available for revegetation on private lands.

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In 2008, economic conditions allowed for the re-mining of the Waste Rock material at the site. Topsoil placed previously during contemporaneous reclamation was removed using methods outlined in 4.6.1. In the event all the topsoil is removed for re-mining of Waste Rock, an estimated 12,200 cu-yd (area x 2-ft) of topsoil will be stored for final Reclamation. The topsoil pile located in the northeast corner of the disturbed area Should accommodate all the material. If any additional topsoil storage is necessary, additional storage is available and adjacent to the Scofield cemetery.

The Waste Rock storage area was re-surveyed in 2014. Using a 3-D surveying method it was estimated approximately 12, 200 cu-yd of topsoil was still located on the pile from earlier contemporaneous reclamation activities. In the event this topsoil (that was imported to the site for reclamation) is removed for re-mining, the plan will be to collect the in-place topsoil using a trackhoe while positioned above the topsoil-covered slope on a disturbed surface. The trackhoe-collected topsoil will be trucked to the location identified adjacent to the Scofield cemetery (See Plate 3.2.8-1), where currently 2,929 cu-yds of cover soil is stockpiled. The topsoil storage area adjacent to the Scofield cemetery is a pre-SMCRA borrow pit that was approved for topsoil storage in 2007, with no preparation of the site necessary. The trucked topsoil will be placed in piles no deeper than 10 to 15 feet high with outslopes no steeper than 2h:1v. In the event the piles need to be consolidated or moved closer together, the topsoil will be pushed using a dozer or similar equipment. No heavy equipment will be allowed on the topsoil to avoid unnecessary compaction. Protection from erosion of the topsoil will be implemented using berms of subsoil, straw bales, or silt fencing for containment. In the event a topsoil berm is implemented, it will be seeded. Any placement of new topsoil at the site will be reseeded on an annual basis.

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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 horizontal strain will be spread along a longer stream path and dampen direct impacts of tensile strain; and 2) the US Bureau of Mines (USBM) criteria for subsidence classifies Woods Canyon as having class III (shaley and silty sandstone) overburden, and the appropriate overburden thickness multiplier would be 461 feet. Incidentally, the same USBM report (1979) originated the 60 times the bodies of water of 'catastrophic' potential size such as large rivers and lakes. The 60 time the extraction thickness is a conservative generalization that somewhat mis-characterizes the USBM study recommendations.

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

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

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

Appendix 4.17-1 Boulger Subsidence Monitoring Plan is a stand-alone document outlining both monitoring of the acceleration and the integrity of the dam as mining approaches. Multiple seismic stations have been set up to study acceleration while survey monuments and multiple piezometers have been installed around the reservoir to monitor dam integrity.

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Boulger Dam Subsidence Monitoring

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CHAPTER 1

LEGAL, FINANCIAL, COMPLIANCE AND RELATED INFORMATION

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USFS approval of Boulger Seismic Monitoring Plan

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110 MINIMUM REQUIREMENTS FOR LEGAL, FINANCIAL, COMPLIANCE AND RELATED INFORMATION

111 Introduction

The following pages outline monitoring associated with Mining Induces Seismicity (MIS) and subsidence due to full extraction mining as they related to the structural integrity of Boulger Reservoir. Boulger Reservoir holds approximately 19.5 acre-feet of water and is located on property managed by Manti-LaSal National Forest personnel. The primary components in the monitoring and mitigation plan are: 1) monitoring the structural integrity of the Boulger Reservoir dam (dam); and 2) monitoring the acceleration on the dam due to MIS as full extraction mining approaches BLM lease requirements for UTU-77114 include monitoring acceleration greater than 0.1g on the dam and either take the dam out of service or develop a mitigation plan . The full array of seismic monitoring stations is associated with a Mining-Induced Seismicity (MIS) study being conducted in cooperation between Canyon Fuel Company, LLC., and the National Institute of Occupational Safety and Health (NIOSH). These additional sites have been incorporated into this Boulger Dam Subsidence Monitoring program.

The monitoring program, as approved by Asst. State Engineer/ Dam Safety David K. Marble, allows for full extraction mining beneath the reservoir assuming mitigation measures are followed. In addition to the Asst. State Engineer, this monitoring plan and associated mitigation measures have been presented to both US Forest Service (USFS) and Utah Division of Wildlife Resources (DWR) personnel with their concerns being addressed in the monitoring plan. The monitoring plan as presented and approved by the Asst. State Engineer is included as Attachment A. The seismic site locations are found in Table 1-1 and are shown in Figure 1-1, Note that Site F needed to be installed in a temporary manner with no surface disturbance in late 2019; all the equipment is above-ground. Site F will be permanently installed in 2020. The sites with the exception of seismic station F were permitted in 2017 and 2018 under using a Notice of Intent (NOI) that allowed for the collection of environmental information.

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112 Identification of Interests

Refer to the same section of the General Chapter 1 for Canyon Fuel Company, LLC prepared for the Skyline Mine.

112.100 Business Entity

Refer to the same section of the General Chapter 1 for Canyon Fuel Company, LLC prepared for the Skyline Mine.

112.200 Applicant and Operator

Refer to the same section of the General Chapter 1 for Canyon Fuel Company, LLC prepared for the Skyline Mine.

112.300 Officers of the Applicant

Refer to the same section of the General Chapter 1 for Canyon Fuel Company, LLC prepared for the Skyline Mine.

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112.400 Coal Mining and Reclamation Operation Owned or Controlled

Refer to the same section of the General Chapter 1 for Canyon Fuel Company, LLC prepared for the Skyline Mine.

112.500 Legal or Equitable Owner of the Surface and Mineral Properties

Refer to Chapter 1 for Canyon Fuel Company, LLC ownership prepared for the Skyline Mine.

112.600 Owners of Record of Property Contiguous to Proposed Permit Area

Owners of record for surface and mineral properties contiguous to the proposed permit area are listed in Chapter 1 of the M&RP.

112.700 MSHA Numbers

Refer to the same section of the approved M&RP.

112.800 Interest In Contiguous Lands

Canyon Fuel Company, LLC has no interest in contiguous lands other than those currently owned as shown on Plate 1.6-1 of the approved M&RP.

112.900 Certification of Submittal Information

Information in Chapter 4, Section 4.17 – Subsidence Control Plan has been modified in the approved M&RP because of this submittal. Refer to the same section of the approved M&RP.

113 Violation Information

Refer to the same section of the General Chapter 1 for Canyon Fuel Company, LLC prepared for the Skyline Mine.

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114 Right-of-Entry Information

Refer to the same section of the approved M&RP, with the exception of both the Repeater Site and the USFS approval of the Boulger Dam Monitoring plan that included at the end of this chapter as Attachment 1-114.

See Table 1-1 for disturbed acreage for each seismic site. The disturbed acres will be added to the total disturbed acreage for the Skyline Mine when submitting the complete Boulger Dam Subsidence monitoring plan.

TABLE 1-1

Seismic Station

Disturbed Acres - Landownership

Seismic Site	Disturbed Acres	Landownership
A	0.01	USFS
B	0.01	USFS
C	0.01	Collard Family Trust
D	0.01	Collard Family Trust
E	0.01	USFS
F	0.01	USFS
U of U	Permitted by U of U	USFS
Repeater	0.01	Freedom 1625 Assoc., LLC

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115 Status of Unsuitability Claim

Refer to Chapter 1 of the approved M&RP.

116 Permit Term

Refer to Chapter 1 of the approved M&RP.

117 Insurance, Proof of Publication, and Facilities and Structures Used in Common

Refer to Appendix 1-2 of the approved M&RP and General Chapter 1.

118 Filling Fees

Refer to Chapter 1 of the approved M&RP.

120 PERMIT APPLICATION FORMAT AND CONTENTS

This amendment submittal will comply with R645-301-120.

130 REPORTING OF TECHNICAL DATA

All technical data submitted in the amendment will be accompanied by the name or organization responsible for the collection and analysis of data, dates of collection and descriptions of methodology used. Technical analyses will be planned by or under the direction of a qualified professional in the subject to be analyzed.

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140 MAPS AND PLANS

The maps and plans in the Mining and Reclamation Plan will correspond with the requirements in

R645-301-140.

150 COMPLETENESS

CFC believes the information in this permit application to be complete and correct.

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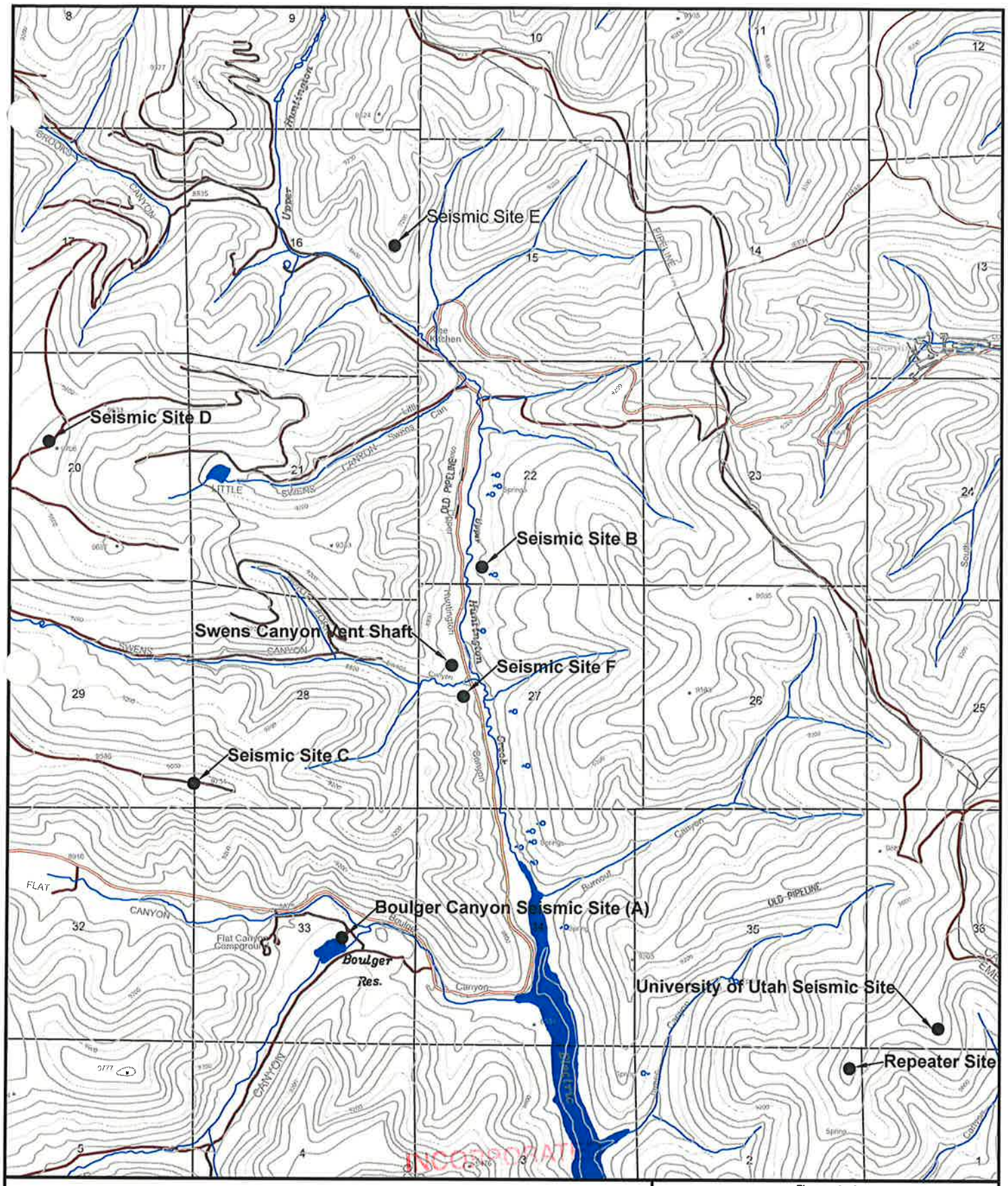

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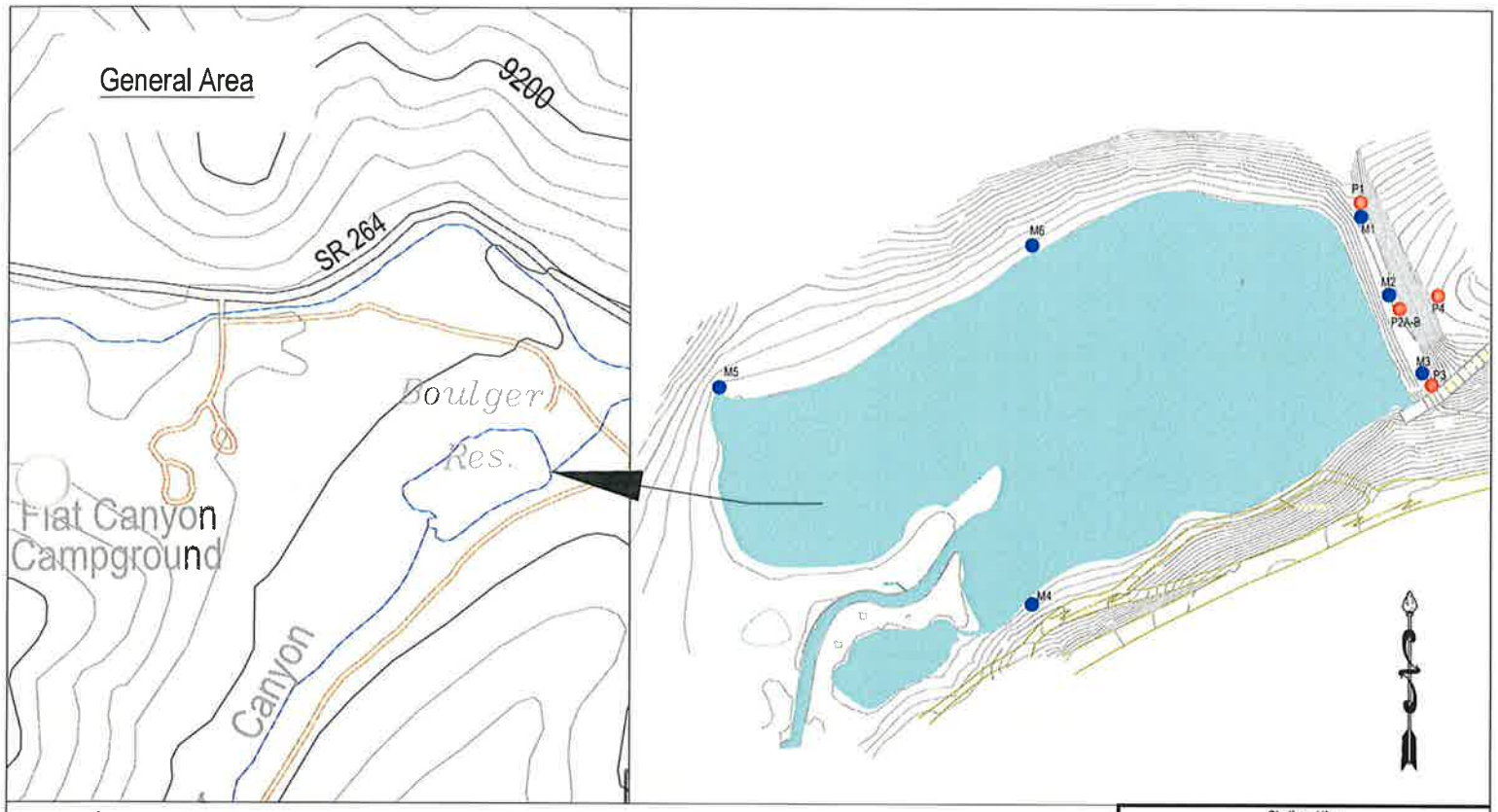
Figure 1-1
Seismic Site
Locations

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX 380, HELPER, UT, 84526 435-448-2633	DATE: 12/20/19	CK.BY: GGalecki	REVISION:
CAD FILE:	SCALE: 1"=3000'	DR.BY: TEarl	0
DWG. NO.:			



Legend

- Piezometers
- Survey Monuments

Fig. 1-2

Skyline Mine
Boulger Reservior
Piesometer and Survey Monument Locations

Canyon Fuel Company, LLC
Skyline Mines

	DATE: 9/18/2017	CK.BY: CGolecki	REVISION: 0
CAD FILE:	SCALE: 1"=100'	DR.BY: TEarl	
DWG. NO.:			

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USDA United States Department of Agriculture
Forest Service
Manti-La Sal National Forest
Ferron Ranger District
115 West Canyon Road
Ferron, UT 84523
435-384-2372
Fax: 435-384-3296

File Code: 7520
Date: March 25, 2020

Steve Christensen, Coal Program Manager
Utah Division of Oil, Gas and Mining
1594 W North Temple, Suite 1210
Salt Lake City, Utah 84116
stevechristensen@utah.gov

Dear Steve,

We have received the following documents:

1. "Boulger Dam Reservoir - Mining-Induced Seismicity (MIS) Monitoring" memorandum, prepared by Canyon Fuel Company, LLC, dated May 7, 2019.

2. "Mining-Induced Seismicity, Skyline Flat Canyon Mining Lease, Boulger and Electric Lake Dams & Reservoirs, Sanpete and Emery County, Utah," prepared by RB&G, dated June 26, 2018.

We recommend you proceed with the approval of the Boulger Reservoir monitoring as proposed with the following comments:

1. Provide the Regional Dam Safety Engineer and the Forest Engineer a copy of all information sent to the Utah State Engineer's Office as required in their approval letter.

    - "Please keep the Utah State Engineer's office informed as to the progress of the mining within 1-mile of the Boulger Dam and Reservoir, the draining of the Boulger Reservoir and the follow up integrity assessment report with any repair recommendations. Prior to any repairs, submit proposed repair plans for review and approval to the State Engineer's office."

2. Since the Forest Service is the owner of the dam, we shall be included in the evaluation of the Dam after mining and any needed remedial actions.

Sincerely,

DARREN OLSEN
District Ranger

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cc: Darren Olsen, Jeff Salow, Daniel Luke

SURFACE ACCESS AND USE AGREEMENT

This **Surface Access and Use Agreement** ("Agreement"), dated effective as of the 15 day of October, 2019, is by and between **Freedom 1625 Associates, LLC,** a Utah limited liability company, with an address of P.O. Box 971120, Orem, UT 84097 ("Owner") and **Canyon Fuel Company, LLC**, a Delaware limited liability company with an address of 1401 North 1st Street, Suite A, Grand Junction, CO 81501 ("CFC").

Recitals

WHEREAS, Owner owns all or part of the surface estate of the following described lands located in Emery County, Utah, hereinafter referred to as "Lands":

Township 14 South, Range 6 East, S.L.B.M.
Section 2: NE¼

containing approximately 159.20 acres, more or less.

Emery County Parcel # 02-0002-0001

WHEREAS, CFC desires to enter upon the Lands to construct and maintain a seismic monitor and communications tower ("Seismic Monitoring and Communications Site");

WHEREAS, Owner is amenable to allowing CFC to use the Lands for conducting such activities subject to the terms of this Agreement;

Agreement

NOW, THEREFORE, for and in consideration of the mutual promises, terms and conditions contained herein, the parties agree as follows:

1. Grant of License. Owner hereby grants to CFC the right to enter upon, access, cross, use and occupy so much of the Lands as are needed to construct and maintain a seismic monitor and communications tower ("Seismic Monitoring Activities"), subject to the limitations set forth herein.

(a) All rights to use Owner's Lands not specifically granted to CFC are retained by Owner. CFC's use rights granted hereunder are non-exclusive and are expressly subject to Owner's right to use and occupy, and to permit others to use and occupy, the Lands for any purpose not inconsistent with CFC's rights granted hereunder. CFC's rights hereunder shall be exercised so as not to unreasonably interfere with the activities of Owner or its employees, agents, representatives, invitees, licensees, contractors and subcontractors, successors and assigns.

2. Term. This Agreement shall be effective as of the Effective Date and shall automatically renew on an annual basis to and until CFC has completed its Seismic Monitoring Activities on the Lands, such term not to exceed twenty (20) years from the Effective Date. Either party may elect to terminate this Agreement at the end of a current annual term by providing 90-days written notice prior to the automatic renewal for the next anniversary of the Effective Date.

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3. Consideration. In consideration for the License and the rights granted to CFC hereunder, upon the execution of this Agreement and on or before the anniversary of the Effective Date, CFC shall pay Owner an annual rental of One Thousand Dollars ($1,000.00) as full consideration in connection with CFC's Seismic Monitoring Activities on the Lands during the Initial Term.

4. Restoration of Surface. At the conclusion of CFC's Seismic Monitoring Activities, and prior to the expiration of this Agreement, CFC shall properly remove all equipment and restore the surface of the Lands disturbed by CFC's Seismic Monitoring Activities by backfilling and reseeding, in full compliance with applicable federal and state laws and regulations and this Agreement.

5. Compliance with Law. CFC shall comply with all applicable laws, rules, regulations, ordinances and permit conditions relating to CFC's Seismic Monitoring Activities. CFC shall be solely responsible for obtaining and maintaining any necessary federal, state, and local filings, permits and other authorizations necessary to conduct the Seismic Monitoring Activities.

6. Indemnification.

(a) CFC shall indemnify, defend and hold harmless Owner from all losses, costs liabilities, penalties, claims, damages and judgments ("Claims"), including without limitation Claims for injury to or death of persons or damage to property, arising out of, related to or resulting from the activities or operations of CFC or its employees, contractors or agents, on the Lands, except to the extent that such Claims are caused by the gross negligence or willful misconduct of Owner, in which event CFC shall be responsible only for its proportional share of liability for such Claims.

(b) The provisions of this Section 6 shall survive the termination of this Agreement for a period of one (1) year past the applicable statute of limitations under Utah law, and until such claims are resolved, provided written notice of such Claims has been provided within the applicable statutory period.

7. Use Restrictions. No animals, alcohol, drugs, firearms or hunting shall be allowed on the Lands by CFC or its employees, contractors or agents. CFC shall meet applicable federal, state and local safety requirements.

8. Insurance.

(a) CFC shall maintain in full force and effect during the entire term of this Agreement with financially sound and reputable insurance companies or associations the following types and amounts of insurance: (i) Workers' Compensation Insurance, in accordance with the laws of the State of Utah and Employers' Liability Insurance in the limit of not less than $1,000,000 per person and $1,000,000 per accident; (ii) Comprehensive General Liability Insurance, including contractual liability, insuring the indemnity agreement set forth in this Agreement with limits of not less than $1,000,000 applicable to bodily injury, sickness or death in any one occurrence; and $1,000,000 for loss of or damage to property in any one occurrence; (iii) Automobile Liability Insurance covering owned, unowned and hired vehicles used by a party with limits of not less than $1,000,000 for bodily injury and property damage claims; and (iv) Excess or Umbrella Liability, inclusive of above limits, with limits of not less than $5,000,000 Combined Single Limit.

(b) Upon request, CFC shall provide to Owner certificates of insurance evidencing the insurance required hereunder.

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9. Miscellaneous.

(a) This Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective permitted successors and assigns. Neither party shall assign this Agreement, or any rights or obligations herein, without the prior written consent of the other party, which consent shall not be unreasonably withheld; provided, however, that CFC may assign this Agreement without consent to an affiliate or in connection with the sale of all or substantially all of its assets constituting the Skyline Mine.

(b) All notices and other required or permitted communications under this Agreement shall be in writing, and shall be addressed respectively as follows:

If to CFC:

Canyon Fuel Company, LLC
Attn: Land Manager
1401 North 1st Street, Suite A
Grand Junction, CO 81501
Phone: (970) 852-0110
Email: rwilson@wolverinefuels.com

If to Owner:

Freedom 1625 Associates, LLC
Attn: Mike Carson
PO Box 971120
Orem, UT 84097
Phone: (801) 367-2999

All notices shall be given (i) by personal delivery, or (ii) by electronic communication, capable of producing a printed transmission, or (iii) by registered or certified mail return receipt requested; or (iv) by overnight or other express courier service. Notices shall be effective and shall be deemed given on the date of receipt at the principal address if received during normal business hours, and, if not received during normal business hours, on the next business day following receipt. Any party may change its address by written notice to the other party.

(c) This Agreement shall be construed in accordance with and governed by the laws of the State of Utah. Each party hereto consents to the jurisdiction of any appropriate court in the State of Utah in the event there is a dispute or disagreement arising out of this Agreement.

(d) Except as otherwise provided in this Agreement, the parties shall be entitled to any and all remedies provided by law.

(e) This Agreement may be modified only by a document in writing executed by all the parties hereto.

(f) This Agreement embodies the entire agreement and understanding between the parties and supersedes all prior agreements and understandings, whether written or oral, relating to the subject matter hereof.

(g) The parties shall execute and record a memorandum notice of this Agreement in the public records in Emery County, Utah.

(h) This Agreement may be executed in counterparts.

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Signatures on Following Page

IN TESTIMONY WHEREOF, the parties have caused this Agreement to be signed and executed as of the Effective Date.

OWNER
Freedom 1625 Associates, LLC

By: _____
Mike Carson

Its: Manager

CANYON FUEL COMPANY, LLC

By: _____
Brian Settles

Its: Chief Administrative Officer

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When Recorded Return to:
Canyon Fuel Company, LLC
1401 N 1st St., Suite A
Grand Junction, CO 81501

Tax ID: 02-0002-0001 *This space reserved for recording*

MEMORANDUM OF SURFACE ACCESS AND USE AGREEMENT

NOTICE IS HEREBY GIVEN BY THIS MEMORANDUM (this "Memorandum"), that under and pursuant to a separate agreement entitled Surface Access and Use Agreement ("Agreement") dated effective as of October 15, 2019 ("Effective Date"), by and between **Freedom 1625 Associates, LLC**, a Utah limited liability company, with an address of P.O. Box 971120, Orem, UT 84097 ("Owner") and **Canyon Fuel Company, LLC**, a Delaware limited liability company with an address of 1401 North 1st Street, Suite A, Grand Junction, CO 81501 ("CFC"), Owner has granted surface access and use, and does hereby confirm a grant of surface access and use, to CFC of the following described lands located in Emery County, Utah ("Lands"):

Township 14 South, Range 6 East, S.L.B.M.
Section 2: NE¼

containing approximately 159.20 acres, more or less.

The Agreement contains the following principal terms among others:

1. Grant of Surface Access and Use. Owner has granted, and hereby confirms a grant to CFC, of a license to enter, upon, access, cross, use and occupy so much of the Lands as are needed to construct and maintain a seismic monitor and communications tower ("Seismic Monitoring Activities").

2. Term. This Agreement shall be effective as of the Effective Date and shall automatically renew on an annual basis to and until CFC has completed its Seismic Monitoring Activities on the Lands, such term not to exceed twenty (20) years from the Effective Date. Either party may elect to terminate this Agreement at the end of a current annual term by providing 90-days written notice prior to the automatic renewal for the next anniversary of the Effective Date.

3. Notice. All notices and other communications to either party shall be delivered as follows:

If to CFC:

Canyon Fuel Company, LLC
Attn: Land Manager
1401 North 1st Street, Suite A
Grand Junction, CO 81501
Phone: (970) 852-0110

If to Owner:

Freedom 1625 Associates, LLC
Attn: Mike Carson
PO Box 971120
Orem, UT 84097
Phone: (801) 367-2999

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4. Assignment. This Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective permitted successors and assigns. Neither party shall assign this Agreement, or any rights or obligations herein, without the prior written consent of the other party, which consent shall not be unreasonably withheld; provided, however, that CFC may assign this Agreement without consent to an affiliate or in connection with the sale of all or substantially all of its assets constituting the Skyline Mine.

5. No Waiver or Modification. This Memorandum is executed for the purpose of placing of record notice of the Agreement and the terms and provisions thereof. Nothing herein shall, nor shall it be interpreted to, amend, modify or waive any of the terms and conditions of the Agreement. All capitalized terms used in this Memorandum, not otherwise defined, shall have the meanings assigned to them in the Agreement.

IN WITNESS WHEREOF, the parties have caused this Memorandum to be signed and executed as of the Effective Date.

OWNER
Freedom 1625 Associates, LLC

By: _____
Mike Carson

Its: Manager

CANYON FUEL COMPANY, LLC

By: _____
Brian Settles

Its: Chief Administration Officer

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STATE OF Kentucky)
) ss.
COUNTY OF Jefferson)

On this 13th day of April, 2019, personally appeared before me **Brian Settles, Chief Administrative Officer of Canyon Fuel Company, LLC**, a Delaware limited liability company, and signer of the above Surface Access and Use Agreement, who duly acknowledged to me that he executed the same on behalf of the company.

WITNESS my hand and official seal.

Notary Public

My Commission expires: 11-24-2022

STATE OF Utah)
) ss.
COUNTY OF Utah)

On this 24 day of March, ~~2019~~ 2020, personally appeared before me **Mike Carson,** _____ of **Freedom 1625 Associates, LLC**, a Utah limited liability company, and signer of the above Surface Access and Use Agreement, who duly acknowledged to me that he executed the same on behalf of the company.

WITNESS my hand and official seal.

Brynne Bona-Miner
Notary Public

My Commission expires: Nov 4, 2021

BRYNNE BONA-MINER
NOTARY PUBLIC-STATE OF UTAH
COMMISSION# 697371
COMM. EXP. 11-04-2021

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210 INTRODUCTION

This chapter and associated attachments address the pertinent data required for the addition of Boulger Dam monitoring equipment which includes survey monuments, piezometers, and seismic monitoring stations for the Skyline Mine. Only those sections of the Division regulations that apply to the installation of the equipment have been addressed. The remainder of the regulations have already been addressed in the existing M&RP. The Chapter 4, Section 4.17 – Subsidence Control Plan and this document contain pertinent information relating to the installation dam monitoring equipment. Due to the limited disturbance no topsoil salvage was necessary for the survey monument, piezometers or seismic monitoring stations.

220 ENVIRONMENTAL DESCRIPTION

The equipment installed adjacent to the Boulger Reservoir include a seismic station, four piezometer sites and five survey monuments ranging in elevation from approximately 8740 to 8759 feet. The seismic station is centered on the dam with communication components located on the north escarpment; five survey monuments surround the reservoir, with three being located on the dam; and the four piezometer locations (three spaced across the dam, one at the toe) contain a total of six monitoring location with two of the locations being double-nested. The Mining Induced Seismicity (MIS) Seismic stations B through F, the UofU site and repeater site range in elevation from approximately 8740 to 9920 feet. The general vegetation in the area includes sagebrush, serviceberry, aspen, Douglas-fir, and snowberry. Note that Site F needed to be installed in a temporary manner with no surface disturbance in late 2019; all the equipment is above-ground. The sites with the exception of seismic station F were permitted in 2017 and 2018 under using a Notice of Intent (NOI) that allowed for the collection of environmental information.

221 Prime Farmland Investigation

Due to limiting terrain, lack of water for irrigation and no evidence of past cultivation of the sites, it is concluded that no prime farmland exists within the area of the Boulger Dam Subsidence monitoring locations. A prime farmland determination is located in Chapter 2, Section 2.14 of the M&RP.

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222 Soil Survey

222.100 Soils Map

No detailed soil work was conducted on the Boulger Dam Subsidence Monitoring equipment locations for a number of reasons: 1) some sites, the dam as an example was previously disturbed; 2) no topsoil was salvaged due to the minimal amount a topsoil disturbed; and 3) the the repeater site has been reclaimed from a previous disturbance. No soil disturbance was associated with monuments or piezometers. The disturbance associated with the seismic stations consists of two 2-foot diameter shallow holes, a hole for a pole to attach a solar panel / antenna, and a shallow trench to bury a wire connecting the equipment. Figure 2-1 illustrates the monitoring equipment locations from Plate 2.7.1-1B of the M&RP.

222.200 Soil Identification

No detailed soil classifications were done on these sites. See Section 2.11 of the approved M&RP for details.

222.300 Soil Description

No soil descriptions were developed for this amendment. Lithology associated with the piezometers located on the dam are located in the appendix of the RB&G Mining-Induced Seismicty report (Attachment B).

222.400 Soil Productivity

The depth of topsoil at each site was not measured. The amount of disturbance created by casual use (hand tools) is less than 0.01 acre. No topsoil was salvaged at the sites.

223 Soil Characterization

No Soil characterization has been conducted at the sites due to the minimal amount of disturbance.

224 Substitute Topsoil

No substitute topsoil will be used.

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230 OPERATION PLAN

231 General Requirements

231.100 Removing and Storing Topsoil Methods

No topsoil was removed at the Boulger Dam Subsidence Monitoring equipment stations due to the limited disturbance. The disturbance is limited to the seismic stations two approximately 2-foot diameter holes for the vaults and six-inch diameter hole for a pole to hold a solar panel. A wire will also be buried barely below the surface connecting the vaults to the solar panel. Note that Site F was installed in a temporary manner with no surface disturbance in late 2019; all the equipment is above-ground. The site will be permanently installed in 2020.

231.200 Suitability of Topsoil Substitutes/Supplements

No topsoil substitutes or supplements necessary

231.300 Testing of Topsoil Handling and Reclamation Procedures Regarding Revegetation

No topsoil testing, salvage or revegetation of the site is necessary to the limited disturbance. Revegetation at reclamation will follow procedures outlined in Section 2.7 of the approved M&RP.

231.400 Construction, Modification, Use, and Maintenance of Topsoil Storage Pile

No stockpiling of topsoil was necessary due to the limited disturbance.

232 Topsoil and Subsoil Removal

No topsoil or subsoil removal was necessary as part of the Seismic Station Installation

240 RECLAMATION PLAN

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241 General Information

Reclamation of the piezometers, survey monuments, and seismic stations is discussed in Sections 242, 243, and 244 respectively.

242 Soil Redistribution

At reclamation no soil redistribution will be necessary at the piezometer or survey monument stations. The piezometers will be abandoned per State regulations and the monuments will remain in place. The seismic stations will be removed and the topsoil in the area will be redistributed over the minor disturbance by raking of the site. USFS personnel have allowed concreted to be broken up, left in place, and covered with topsoil. Email correspondence is attached to the end of this section.

243 Soil Nutrients and Amendments

No Soil nutrients or amendments of the soil will be necessary due to the limited disturbance at the sites.

244 Soil Stabilization

244.100 Protection and Stabilization of Surface Area

No protection or stabilization of the area will be necessary due to the limited disturbance at the sites.

244.200 Mulch Application

Mulch/tackifier will not be applied to stabilize the soil as it is not necessary for the size of disturbance.

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244.300 Rills and Gullies

Postmining Land Use and Revegetation - Rills and gullies that are in excess of approximately nine (9) inches in depth and disrupt the postmining land use or reestablishment of vegetative cover will be regraded and seeded. In addition, the repair of rills and gullies will assist in the maintenance of water quality standards.

250 PERFORMANCE STANDARDS

251 Topsoil, Subsoil, and Topsoil Supplements Management

No topsoil management is anticipated. This will be revisited if there are problems at reclamation.

252 Stockpiled Topsoil and Subsoil

No stockpiling of topsoil was necessary do to the limited disturbance.

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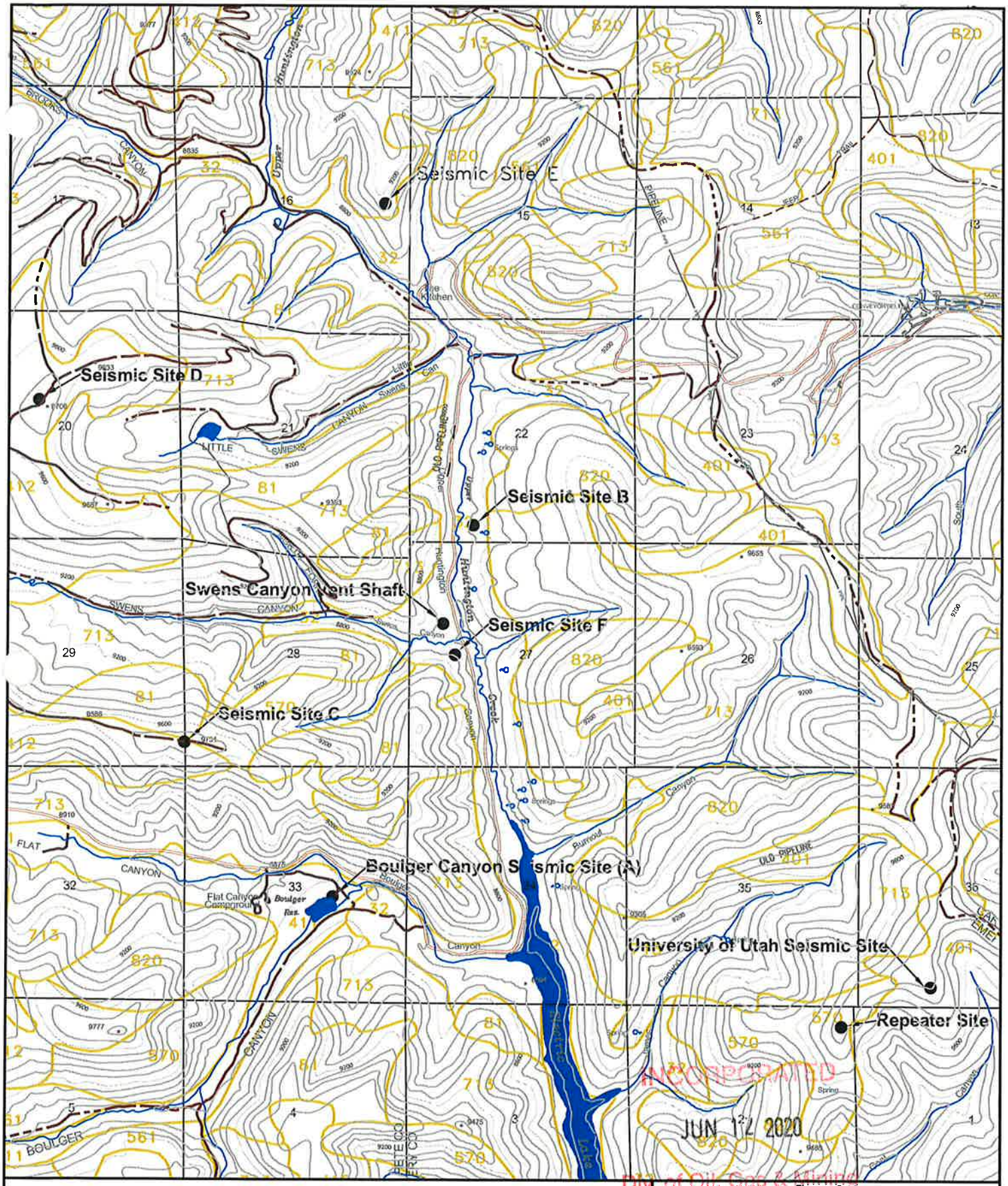

LEGEND

- PANDO - ADEL FAMILIES COMPLEX, 20 TO 60 PERCENT SLOPES
- 401 ADEL - MERINO FAMILIES COMPLEX, 8 TO 60 PERCENT SLOPES
- 411 CLAYBURN - FAIN FAMILIES COMPLEX, 5 TO 30 PERCENT SLOPES
- 412 FAIN - CLAYBURN - CASTRO FAMILIES COMPLEX, 5 TO 30 PERCENT SLOPES
- 570 GATEVIEW- ADEL FAMILIES COMPLEX, 30 TO 60 PERCENT SLOPES
- 713 LUCKY STAR - ADEL FAMILIES COMPLEX, 30 TO 60 PERCENT SLOPES

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

Figure 2-1
Soil Types
Seismic Locations

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX 380, HELPER, UT, 84526 435-448-2632	DATE: 3/27/20	CK.BY: GGalecki	REVISION:
CAD FILE:	SCALE: 1"=3000'	DR.BY: TEarl	0
DWG. NO.:			3/27/20

CHAPTER 3
BIOLOGY

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310 INTRODUCTION

This chapter presents a description of the biological resources associated with the Boulger Dam Subsidence Monitoring Plan and the installation of survey monuments, piezometers, and seismic stations (subsidence monitoring equipment). The sites with the exception of seismic station F were permitted in 2017 and 2018 under using a Notice of Intent (NOI) that allowed for the collection of environmental information. Note that Site F was installed in a temporary manner with no surface disturbance in late 2019; all the equipment is above-ground. Permanent installation will occur in 2020.

311 Vegetative, Fish and Wildlife Resources

Vegetation, fish, and wildlife resource information for the subsidence monitoring equipment is discussed in Attachments 3-1 through 3-7 at the end of this section. As the 2019 memo outlines, the area has been discussed in seven (7) separate studies from 2014 through 2019.

312 Potential Impacts to Vegetative, Fish, and Wildlife Resources

Potential impacts to vegetation, fish, and wildlife are throughout the attachments. No potential for adverse impacts were noted.

313 Description of Reclamation Plan

The reclamation plan will include removing the equipment, raking, and reseeding.

320 ENVIRONMENTAL DESCRIPTION

321 Vegetation Information

Vegetation information is discussed in the attachments 3-1, 3-2, 3-5, and 3-7. The attached reports indicates concerns with Threatened and Endangered vegetation species were addressed in other projects. In addition, seismic site F was previously disturbed, has been reclaimed, permanent installation will occur in 2020. No potential for adverse impacts were noted.

321.100 Plant Communities Within the Proposed Permit Area

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The subsidence monitoring equipment areas are either disturbed or covered in upland grasses with the adjacent area dominated by sagebrush. A detailed vegetation study was conducted on seismic site C (aka Drill site 1-18) as it was initially permitted as a drill hole.

321.200 Land Productivity Prior to Mining

No productivity data was collected on the subsidence monitoring equipment sites due to the minimal disturbance and previous activity that was reclaimed.

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322 Fish and Wildlife Information

Fish and wildlife information associated with the subsidence monitoring equipment is addressed in attachments 3-1 and 3-4 through 3-7. Attachment 3-1 outlines the multiple studies conducted in the area previously without concerns.

322.100 Level of Detail

Additional information pertaining to fish and wildlife in the permit area is located in the M&RP.

322.200 Site-Specific Resource Information

Raptors – The raptor surveys for the subsidence monitoring equipment is discussed multiple attachments and in the attached Alpine Ecological memo. No nests were noted that were affected by the various construction periods.

Threatened and Endangered Plant and Wildlife Species - There are no known federally or state listed threatened and endangered plant and wildlife species within the area of the subsidence monitoring equipment.

Federal and State Listed, Threatened, Endangered and Candidate Species Plants and Wildlife

Refer to the M&RP for current lists.

322.300 Fish and Wildlife Service Review

If requested, Skyline Mine authorizes the release of information pertaining to this application to the U. S. Fish and Wildlife Service Regional and Field Office for their review.

323 Maps and Aerial Photographs

Location of the subsidence monitoring equipment can be seen in Figure 1-1 of this submittal.

323.100 Location and Boundary of Proposed Reference Area

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A reference area was established for seismic site C (aka drill site 1-18) since it was originally permitted as a exploration drill sites. No reference areas were established for the other subsidence monitoring equipment due to the minimal disturbance.

323.200 Elevation and Locations of Monitoring Stations

No monitoring stations have been established.

323.300 Facilities for Protection and Enhancement

The currently approved M&RP contain additional discussion pertaining to protective measures to be taken by Skyline Mine on behalf of wildlife.

323.400 Vegetation Type and Plant Communities

See Section 2.7 of the currently approved M&RP for detailed information on vegetative types and plant communities outlined in the area.

330 OPERATION PLAN

331 Measures Taken to Disturb the Smallest Particle Area

The subsidence monitoring equipment sites were sized to disturb the smallest acreage possible and still meet the requirements for the equipment.

332 Description of Anticipated Impacts of Subsidence

Refer to Section 4.17 of the M&RP for the Subsidence monitoring plan. Many of the sites will be subsided due to full extraction mining. The amounts varying from zero up to three feet depending on the amount of overburden at the site (Subsidence factors listed in Section 4.17). No impacts are anticipated.

333 Plan to Minimize Disturbances and Adverse Impacts

General control and mitigation measures addressing potential related biological impacts will include the following:

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- Minimizing the total area of disturbance,
- Construction limited to approximately one day
- Predominant use of hand tools
- Reclamation of disturbed areas when they are no longer needed.

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333.100 Minimize Disturbance to Endangered or Threatened Species

Skyline Mine will apply all methods necessary to minimize disturbances or any adverse effects to threatened or endangered species.

333.200 Species and Habitats

All species and habitats within the permit area will be protected to the best of Skyline Mine's ability.

333.300 Protective Measures

Refer to Section 2.8 of the approved M&RP.

340 RECLAMATION PLAN

341 Revegetation

Revegetation of the subsidence monitoring equipment sites will include raking the topsoil back in place and hand broadcasting seed outlined in Table 3-1.

Table 3-1

Seed Mix

		Pounds PLS/acre
Western Wheatgrass	Elymus smithii	2
Basin Wild Ryegrass	Elymus cinereus	1
Intermediate Wheatgrass	Elymus hispidus	2
Yellow Sweet Clover	Melilotus officinalis	1
Blue Leaf Aster	Aster glaucodes	0.25
Silvery Lupine	Lupinus argenteus	1
True Mahogany	Cercocarpus montanus	1
Lewis Flax	Linum lewisii	0.5
Small Burnet	Sanguisorbia minor	1
	TOTAL	9.75

The pure live seed (PLS) rating will be 99% containing a maximum of 1% weeds, none of which are toxic and only seed meeting the State Seed Act will be used. Certification tags will be retained by the permittee. The vegetative cover resulting from this seed mix is considered capable of stabilizing the soil surface from erosion.

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341.100 Schedule and Timetable

The reclamation timetable has not been determined because the study is being conduction in coordination with the National Institute for Occupational Safety and Health (NIOSH).

341.200 Descriptions

Species and Amounts of Seed – See Table 3-1 for the seed mix.

Methods Used for Planting and Seeding - The seismic site will be raked to distribute and loosen soil, then seed will be hand-broadcasted over the area

Mulching Techniques - No mulching will be necessary..

Irrigation, Pest, and Disease Control - No irrigation is planned and pesticides will not be used unless previously approved by the Division.

Measures Proposed for Revegetation Success – Refer to 4.7 of the M&RP.

341.300 Greenhouse Studies, Field Trials or Other Equivalent Studies

Refer to the Section 4.7 of the approved M&RP.

342 Fish and Wildlife

342.100 Enhancement Measures

No enhancement measures will be necessary or warranted due to the limited disturbance associated with the site.

342.200 Plants Used for Wildlife Habitat

Nutritional Value - The nutritional value will be consistent with that of vegetation in the surrounding areas.

Cover - Cover will be comparable to the cover on the surrounding areas.

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342.300 Cropland

Cropland is not a postming land use.

342.400 Residential, Public Service, and Industrial Land Use

No residential, industrial or public service use is planned.

350 PERFORMANCE STANDARDS

351 General Requirements

Skyline Mine commits to conduct all operations in accordance with the plans submitted in Sections R645-301-330 through R645-301-340 of the permit application.

352 Contemporaneous Reclamation

Reclamation activities prior to final reclamation will to the extent feasible, be performed contemporaneously.

353 Revegetation: General Requirements

A vegetative cover will be established on all reclaimed areas to allow for the designated postmining land uses of wildlife, recreation, and grazing. Refer to Section 411 for additional information.

353.100 Vegetative Cover

The seed mix proposed for revegetation is intended to provide vegetative cover that will be diverse, effective, and permanent. The seed mixture was selected with respect to the climate, potential seedbed quality, erosion control, drought tolerance, and the mixture's ability for quick establishment and spreading.

Native Species - The reclamation vegetation mixture will be comprised of species indigenous to the area and capable of achieving the postmining land use. Diversity of species should allow utilization of plants by wildlife and domestic livestock. The recommended seed mix is comprised of native species.

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Extent of Cover - The vegetative cover will be at least equal in extent to the cover at the designated reference areas.

Stabilizing - The vegetative cover mixture is capable of stabilizing the soil surfaces from erosion.

353.200 Reestablished Plant Species

Compatible - The reestablished plant species have been selected to insure their compatibility with the approved postmining use.

Seasonal Characteristics - The revegetation plant species will have the same growing season as the adjacent areas.

Self-Generation - The reestablished plants are species capable of self-generation and plant succession.

Compatibility - The seed mix suggested for revegetation contains plants native to the area and compatible with the plant and animal species of the permit area.

Federal and Utah Laws or Regulations - The seed mix purchased to revegetate the subsidence monitoring equipment sites will contain no poisonous or noxious plant (see Section 234.200). No species will be introduced in the area without being approved by the Division.

353.300 Vegetative Exception

Skyline Mine does not require vegetative exception at this time.

353.400 Cropland

The permit areas contain no land designated as cropland.

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354 Revegetation: Timing

Skyline Mine will follow the recommended guidelines for revegetation and planting during the first normal period for favorable planting conditions. In Utah the planting period is usually Fall due to the precipitation events.

355 Revegetation: Mulching and Other Soil Stabilizing Practices

Mulch and/or other soil stabilizing practices (roughing, etc.) will not be necessary due to the limited disturbance.

356 Revegetation: Standards for Success

356.100 Success of Revegetation

The success of revegetation will be judged on the effectiveness of the vegetation for postmining land use.

356.200 Standards for Success

Standards of success will be applied in accordance with the approved postmining land use as described in Section 4.7 of the M&RP.

356.300 Siltation Structures

Siltation structures will not be necessary due to the limited disturbance.

357 Revegetation: Extended Responsibility Period

Skyline Mine will be responsible for the success of revegetation for a period of 10 years following seeding of the reclaimed area or upon Division bond release.

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357.100 Extended Period Begins

The period of extended responsibility will begin after disturbed areas have been reseeded.

357.200 Vegetation Parameters

Vegetation parameters will equal or exceed the approved success standard during the last 2 years of the responsibility period. The success standards are outline in Section 4.7 of the M&RP.

357.300 Husbandry Practices

The use of husbandry practices are not being requested by Skyline Mine for the subsidence monitoring equipment sites.

358 Protection of Fish, Wildlife, and Related Environmental Values

Skyline Mine will minimize disturbances and adverse impacts on wildlife and their related environments as outline in Section of the approved M&RP

358.100 Existence of Endangered or Threatened Species

The subsidence monitoring equipment sites will not be constructed or operated where it might jeopardize the existence of any endangered or threatened species.

State or federally listed endangered or threatened species will be reported to the Division upon its discovery.

358.200 Bald and Golden Eagles

Skyline Mine understands that there is no permission implied by these regulations for taking of bald or golden eagles, their nests, or eggs. If found, nests will be reported to the Division.

358.300 Taking of Endangered or Threatened Species

Skyline Mine understands that there is no permission implied by these regulations for taking of endangered or threatened species, their nests, or eggs.

358.400 Replacement of Wetland or Riparian Vegetation

Two of the survey monuments were installed adjacent to the reservoir in riparian areas on the north shore. Installation was conducted by hand with disturbance being limited to approximately one square foot.

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358.500 Manmade Wildlife Protection Measure

Electric Power Lines - No utilities exist at the subsidence monitoring equipment sites.

Potential Barriers - No potential barriers will exist at the subsidence monitoring equipment sites.

ATTACHMENT 3-1
Alpine Ecological
Wildlife and T&E Memos

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Technical Memorandum

To: Gregg Galecki
Environmental Engineer
Skyline Mine

From: Alpine Ecological
HC80 Box 570
Greenwich, UT 84732

Date: 9/25/2019

Re: **Wildlife Survey Review - 2019 Seismic Station Installation Project Area**

The following memo is to summarize the wildlife surveys that have been conducted in the area of the 2019 Seismic Station Installation Project (Project Area). The Project Area has had annual wildlife surveys from 2014 through 2019. Surveys methodology consisted of pre-field research completed by Alpine wildlife biologists who utilized GIS data from the Utah Division of Wildlife Resources' (UDWR) Utah Threatened, Endangered, and Sensitive Species Occurrences shapefiles and mapping services and the US Fish and Wildlife Services' Information, Planning and Consultation System (IPaC)(i.e., for applicable years). Research included species occurrences, historic records, species ecology, life histories, known distributions, and habitat requirements. Surveys were focused primarily on the special status species northern goshawk as the call station distribution ensures complete survey coverage. Other special status species such as American three-toed woodpecker and golden eagle were surveyed in conjunction with the completion of the northern goshawk protocol surveys. General wildlife species were also documented within the respective survey areas. Surveys in Swens Canyon have occurred each year from 2014 through 2019. The results of each of each survey are detailed in the following reports on file both the US Forest Service and UDOGM:

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- 2014 Powerline and Pad Project,
- 2015 Drill Sites Report,
- 2016 Vent Shaft Drill Site Report,
- 2017 Drill Site Report,
- 2018 Drill Sites, Areas of Potential Subsidence, and Waterline Report,
- 2019 Areas of Potential Subsidence
- 2019 Drill Sites Report

The wildlife surveys conducted in 2018 and 2019 were conducted in accordance to the Northern Goshawk Inventory and Monitoring Technical Guide using the Broadcast Acoustical Survey Methodology and meet the requirement of conducting surveys for 2 consecutive years as outlined in subsection 4. Wildlife surveys have been conducted in and around the area for 5 consecutive years and the results of those surveys are on file with both the USFS and UDOGM. There were no special status species documented in or around the proposed project area in 2018 or 2019.

PROJECT NAME: Skyline Mine Seismic Stations

DATE: 08/31/2018

PROPOSED ACTION:

Skyline Mine proposes to install up to 6 seismic monitoring stations in the areas near Huntington Creek, Flat Canyon and Swens Canyon in Sanpete County, Utah. Stations will be installed using primarily hand tools. The proposed locations are generally by roads or easily accessible from a nearby road.

PURPOSE AND NEED FOR ACTION:

The purpose of this project is it provide Skyline Mine with the ability to conduct seismic monitoring on a site specific scale which will provide more accurate data and result in more informed decisions.

LOCATION:

The project is located in both Sanpete and Emery County, Utah. The legal description is Sec. 16, 17, 20, 22, 29, 33 Township 13 S., Range 6 E., Salt Lake Meridian (see attached maps).

RANGER DISTRICT: FERRON/PRICE RANGER DISTRICT

COUNTIES: SANPETE and EMERY

EXISTING CONDITIONS:

The vegetation across the survey area is very diverse and yet 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

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bottoms of the valleys that are drier are 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. Some of the ridge tops are dominated by cluster tarweed.

Special status species which may occur within the project area were identified using the Fish and Wildlife Service's IPaC system, the INTERMOUNTAIN REGION (R4) THREATENED, ENDANGERED, PROPOSED, AND, SENSITIVE SPECIES dated June 2016, and GIS Special Status Species shapefiles. Installation of the seismic stations is scheduled for the Fall of 2018, outside of the nesting, breeding, or flowering season of any of the listed special status species. Surface disturbance is expected to be minimal at each site through the primary use of hand tools.

The following tables list the Endangered, Threatened and Sensitive species of fish, wildlife, and plants that are known to (or may) occur on the Manti-La Sal National Forest in Emery County, Utah. Depending on the specific project, the scope, magnitude and effects this checklist will be considered as documentation for assessment of these TE &S species. Determinations for each species are documented by an "X" in the appropriate block. There is also a table listing the Manti-La Sal National Forest Management Indicator Species and Migratory Birds that will serve as a Wildlife Resources Report.

Biologists and botanists have reviewed this project, used available information on species distributions and habitat (using one or more of the following: topo maps, aerial photos, field reconnaissance, previous surveys), and then assessed the potential for impacts for all federal listed and Region 4 sensitive species. If the project was determined to have **no effect** or **no impact**, this determination was based on one or more of these criteria:

1. Habitat for the species is not present in the project area.
2. Habitat for the species is present but the species does not occur in this area.
3. Habitat for the species is present, the species occurs or may occur in the project area, but the project would not have any direct, indirect or cumulative effects on this species.

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Matrix Legend

Federally Listed Species
NE - No Effect
NLAA - May Affect, Not Likely to Adversely Affect
LAA - May Affect, Likely to Adversely Affect

Status
T - Federally Listed As Threatened
PT – Federally Listed As Proposed Threatened
E - Federally Listed As Endangered
C - Federal Candidate Species
S - Regional Sensitive Species
R – Recovery

Forest Service Sensitive Species
NI - No Impact
MIIH - May Impact Individuals or their Habitat, But Will Not Likely Contribute To A Trend Towards Federal Listing or Loss of Population Viability
WIFV - Will Impact Individuals or Their Habitat That May Contribute To a Trend Towards Federal Listing or Cause A Loss of Population Viability

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MAP

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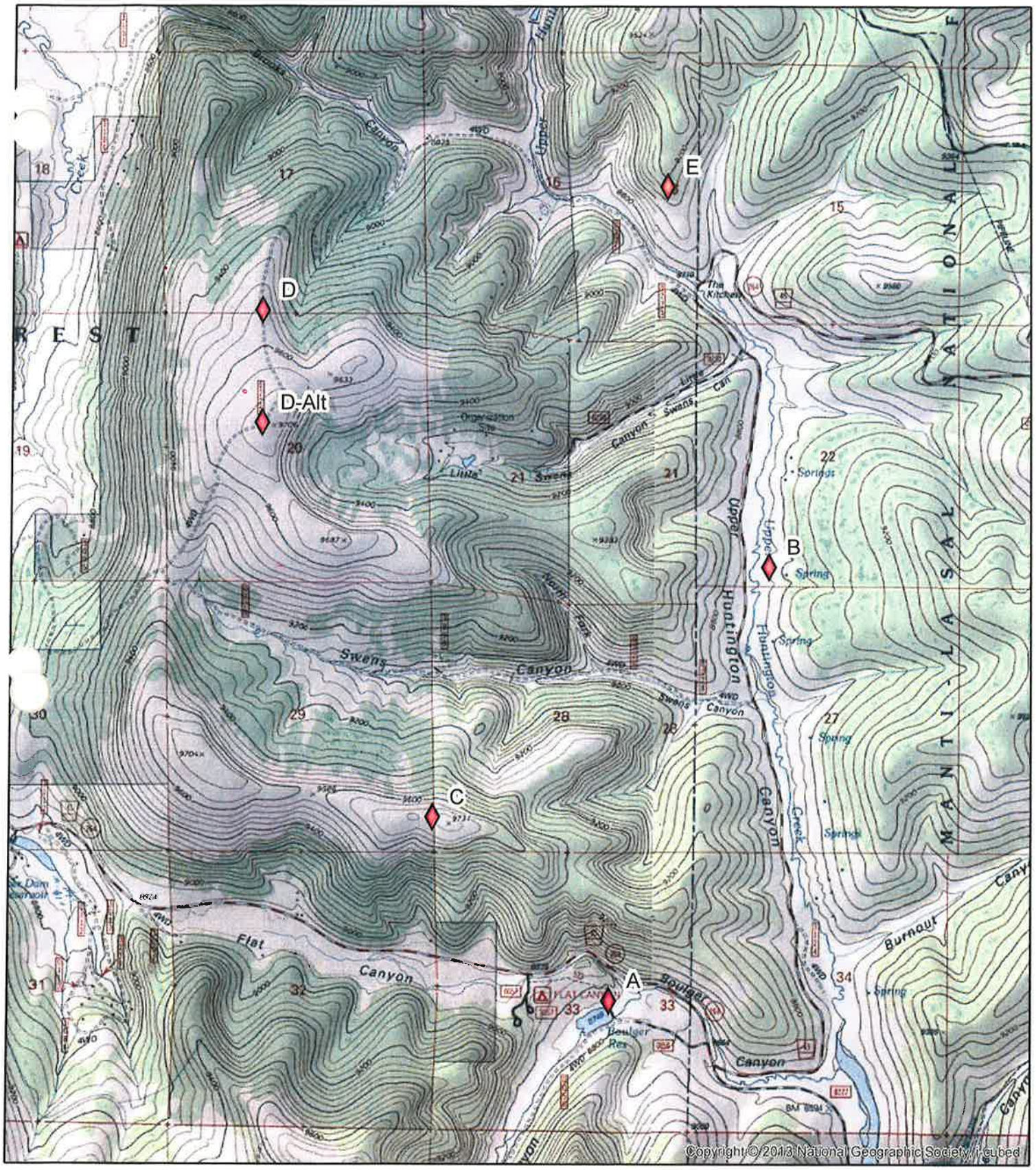

Seismic Stations

N
W E
S

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2018
Seismic Stations
Skyline Mine

Table 1 Listed and candidate plant, wildlife, and fish species that could occur on National Forest System Land in the project area.

A. PLANT SPECIES				
SPECIES	**STATUS**	**DETERMINATION**	**SPECIES DESCRIPTION AND EFFECTS**	**COUNTY LIST**
Jones Cycladenia *Cycladenia humilis var. jonesii*	T	NE	*Cycladenia humilis var. jonesii* is restricted to the canyon-lands of the Colorado Plateau in Emery, Grand, Garfield and Kane counties, as well as in immediately adjacent Arizona, Coconino County. Occurs in eriogonum-ephedra, mixed desert shrub, and juniper communities at elevations ranging from 4400 ft. – 6000 ft. in Central Emery County, Utah (off-Forest) (Welsh et al. 2003). Often on steep slopes in gypsiferous soils derived from the Summerville, Cutler, and Chinle formations (Franklin 2005, Welsh et al. 2003). This species is not found on the Manti -La Sal N.F.; therefore, the Seismic Station Project will have **No Effect** on the Jones cycladenia or its habitat.	Emery
B. TERRESTRIAL WILDLIFE SPECIES				
SPECIES	**STATUS**	**DETERMINATION**	**SPECIES DESCRIPTION AND EFFECTS**	**COUNTY**
California Condor *Gymnogyps californianus*	E	NE	California condors are opportunistic scavengers, feeding only on carcasses. Typical foraging behavior includes long distance reconnaissance flights, lengthy circling flights over a carcass, and hours of waiting at a roost or on the ground near a carcass (USDI, U.S. Fish and Wildlife Service 1996). The Vermilion Cliffs release site is on the southwestern corner of the Paria Plateau Coconino County, Arizona. This project is not within foraging distance from the release site; therefore, the Seismic Station Project will have **No Effect** on the California condor or its habitat.	Sanpete, Emery

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Mexican Spotted Owl *Strix occidentalis*	T	NE	In Utah, the Mexican spotted owl nests in steep-walled, complex rock canyons at relatively low elevations (USDI, U.S. Fish and Wildlife Service 2004). There is no suitable habitat within the project area; therefore, the Seismic Station Project will have **No Effect** on the Mexican spotted owl or its habitat.	Sanpete, Emery
Western Yellow-Billed Cuckoo *Coccyzus americanus*	PT	NE	In Utah, nesting habitats are found at elevations between 2,500 to 6,000 feet. They appear to require large tracts (100 to 200 acres) of contiguous riparian nesting habitat (Parrish et al. 2002). There is no suitable habitat within or near the project area; therefore the Seismic Station Project will have **No Effect** on the yellow-billed cuckoo or its habitat.	Sanpete, Emery
C. AQUATIC WILDLIFE SPECIES				
SPECIES	**STATUS**	**DETERMINATION**	**SPECIES DESCRIPTION AND EFFECTS**	**COUNTY LIST**
Bonytail *Gila elegans*	E	NE	Historically, the bonytail existed in warm water reaches of larger rivers in the Colorado River Basin; it is considered to be adapted to pools and eddies of mainstream rivers. It has been extirpated from most of its historic range. Currently, a small number of wild adults exist in Lake Mohave in the Lower Colorado River Basin, and there are small numbers of wild individuals in the Green River and in sub basins of the Upper Colorado River Basin (USDI, U.S. Fish and Wildlife Service 2002). The project will not affect down stream flows; therefore, the Seismic Station Project will have **No Effect** on the bonytail or its habitat.	Emery
Colorado Pikeminnow *Ptychocheilus lucius*	E	NE	The Colorado pikeminnow is endemic to the Colorado River Basin, and it historically extended from the Green River in Wyoming, to the Gulf of California; it was widespread and abundant in warm-water rivers and tributaries. It is a long-distance migrator (hundreds of kilometers to and from spawning areas). Adults require deep pool and eddie habitats in streams that have high spring flows. Currently, in Utah this species occurs in the Green River from Lodore Canyon to the confluence of the Colorado River (USDI, U.S. Fish and Wildlife Service 2002a). The proposed project has not and will not affect down stream flows; therefore, the	Emery

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			Seismic Station Project will have **No Effect** on the Colorado Pikeminnow or its habitat.	
Humpback Chub *Gila cypha*	E	NE	The humpback chub is restricted to deep, swift mainstream and large tributaries in relatively inaccessible canyons of the Colorado River Basin. Adults require eddies and sheltered shorelines in streams that maintain high spring flows that flush sediments from spawning areas and form gravel deposits used for spawning. Young require low-velocity shoreline habitats. Currently, there are six known extant populations, which are located in the Upper Colorado River, Yampa River and Little Colorado River (USDI, U.S. Fish and Wildlife Service 2002b). The project has not and will not affect down stream flows; therefore, the Seismic Station Project will have **No Effect** on the humpback chub or its habitat.	Emery
Razorback Sucker *Xyrauchen texanus*	E	NE	Historically the razorback sucker was widely distributed in warm-water reaches of the Colorado River and its tributaries from Wyoming to Mexico. Adults require deep pools, eddies and backwaters in spring; shallow water associated with sandbars in summer; and low velocity pools and eddies in winter. Young require quiet, warm, shallow water found at tributary mouths, and in coves or shorelines in reservoirs. Currently, within the Upper Colorado River Basin this species is only found in small numbers in the middle Green River, between the confluence of the Duchesne and Yampa rivers, and in the lower reaches of those two tributaries (USDI, U.S. Fish and Wildlife Service 2002c). The proposed project has not and will not affect down stream flows; therefore, the Seismic Station will have **No Effect** on the razorback sucker or its habitat.	Emery

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Table 2 Intermountain Regional Forester's list of sensitive plant, wildlife, and fish species that could occur on the Manti Division Of the Manti-La Sal National Forest (MLNF)

A. PLANT SPECIES			
SPECIES	**STATUS**	**DETERMINATION**	**SPECIES DESCRIPTION AND EFFECTS**
Arizona Willow *Salix arizonica*	S	NI	*Salix arizonica* occurs in wet meadows along perennial streams and occurs only in the Muddy Creek drainage on the MLNF (NatureServe 2015, UNPS 2015, and USDA, NRCS 2015). There are no known occurrences of this species in or near the project area; therefore, the Seismic Station Project will have **No Impact** on the Arizona willow or its habitat.
Canyon Sweet-vetch *Hedysarum occidentale var. canone*	S	NI	*Hedysarum occidentale var. canone* is found on sites with a high water table, near springs or stream beds within the pinyon/juniper vegetation type at 5,500 to 7,000 ft. elevations. River birch and squaw brush are associated species. It is endemic to Duchesne, Carbon and Emery Counties (NatureServe 2015, UNPS 2015, and USDA NRCS 2015). URPG 2015 states it can be found in pinyon/juniper, service berry, maple, mountain mahogany, and sagebrush communities 6,400-8,300 feet. There are no known occurrences of this species in the proposed project area; therefore, the Seismic Station Project will have **No Impact** on the canyon sweet-vetch or its habitat.
Carrington Daisy *Erigeron carringtoniae*	S	NI	*Erigeron carringtoniae* occurs in limestone outcrops and escarpments in subalpine vegetation type on wind-blown ridge tops and snowdrift sites at high elevations of the Wasatch Plateau (9,000 to 11,000 feet) (UNPS 2015, USU 2015, USDA NRCS 2015). There are no known occurrences of this species in the proposed project area; therefore, the Seismic Station Project will have **No Impact** on the Carrington daisy or its habitat.
Creutzfeldt-flower *Cryptantha creutzfeldtii*	S	NI	*Cryptantha creutzfeldtii* occurs in shallow, rocky, heavy silty-clay soils; on Mancos shale slopes. It is endemic to central Utah in Carbon, Emery, and Sevier Counties (Franklin 2005) at 5,000 to 6,500 ft. elevations. It grows in scattered piñon-juniper communities with an understory of black sagebrush and/or *Atriplex* (NatureServe 2015, UNPS 2015, USDA NRCS 2015, and USU 2015). There are no known occurrences of this species in the proposed project area; therefore, the Seismic Station Project will have **No Impact** on the Creutzfeldt-flower or its habitat.

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Link Trail Columbine *Aquilegia flavescens rubicunda*	S	NI	*Aquilegia flavescens* var. *rubicunda* occurs near spring seeps and perennial wetland sites within the Mesa Verde group of sandstones near coal seams on the east side of the Wasatch Plateau in Emery, Garfield, and Sevier Counties (NatureServe 2015, UNPS 2015, USDA NRCS 2015 URPG 2015). There are no known occurrences of this species in the proposed project area; therefore, the Seismic Station Project will have **No Impact** on the Link Trail columbine or its habitat.
Maguire Campion *Silene petersonii*	S	NI	*Silene petersonii* is endemic to Garfield, Iron and Sanpete counties in ponderosa pine, aspen, and spruce-fir communities on Flagstaff Limestone and Claron Formation, mainly at plateau margins from 7,000 - 11,300 ft. Occurs at high elevations on open calcareous and igneous soils (Welsh et al. 2003, NatureServe 2015, UNPS 2015, USU 2015, and USDA, Natural Resource Conservation Service 2015). There are no known occurrences of this species in the proposed project area; therefore, the Seismic Station will have **No Impact** on the Maguire campion or its habitat.
Musinea Groundsel *Senecio musiniensis*	S	NI	*Senecio musiniensis* is endemic to Sanpete county on ridge tops of Flagstaff Limestone, barrens and talus slopes at Musinea Peak and on the margins of the Wasatch Plateau from 9,700 -10,800 ft. (Welsh et al. 2003, NatureServe 2015, UNPS 2015, USDA, Natural Resource Conservation Service 2015). There are no limestone barrens or talus slopes in the project area. There are no known occurrences of this species in the proposed project area; therefore, the Seismic Station Project will have **No Impact** on the Musinea groundsel or its habitat.

B. TERRESTRIAL WILDLIFE SPECIES

SPECIES	STATUS	DETERMINATION	SPECIES DESCRIPTION AND EFFECTS
Bald Eagle *Haliaeetus leucocephalus*	S	NI	Bald eagle nests are typically located in multi-storied (uneven-aged) coniferous forest stands that contain elements of old growth structure, and are located near bodies of water that support prey species. Nest trees are generally one of the largest trees in the stand, which provides a good view of the surrounding area (Spahr et al. 1991). There is suitable fall/winter habitat near the project area but this project will not remove or disturb large roost trees which may be used by individual wintering eagles; therefore, the Seismic Station Project will have **No Impact** on the bald eagle or its habitat.

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Bighorn Sheep *Ovis Canadensis* – Includes **Rocky Mountain bighorn** (*O. c. canadensis*), **California bighorn** (*O. c. californiana*), and **desert bighorn sheep** (O. c. nelsoni).	S	NI	*Ovis Canadensis nelsoni* occurs in open rocky areas of desert mountain ranges in the southwestern United States and northern Mexico. A native Utah species, the desert bighorn sheep can be found in the southern (especially southeastern) area of the state (UDNR, 2015). The closest populations are within the San Rafael Swell, approximately 30 miles from the project area. *Ovis canadensis canadensis* is native to rugged mountainous areas of western North America. The species has been eliminated from much of its former range due to over-hunting, habitat alterations, and diseases introduced by domestic livestock (UDNR, 2015). In Utah, Rocky Mountain bighorn sheep can now be found in a number of mountain ranges. Rocky Mountain bighorn sheep prefer steep rocky slopes, and may migrate from higher elevations to lower valleys in the winter. The closest populations are located in the Book Cliff Mountains, more than 40 miles from the project area. *Ovis canadensis californiana* historically inhabited portions of the Great Basin in Nevada and Idaho. Although it is not known conclusively whether or not California bighorns inhabited Utah, recent studies indicate there is no genetic or taxonomic distinction between Rocky Mountain and California bighorns (UDWR 2015). There is some evidence to suggest that it was once native to Utah. In recent times, a population of California bighorn sheep has been established by the UDWR and the Utah Division of Parks and Recreation (UDPR) on Antelope Island, in the Great Salt Lake (UDWR 2013). This population is located more than 60 miles from the gravel pit. This species is not near the project area therefore, the Seismic Station Project will have **No Impact** on bighorn sheep.
Flammulated owl *Otis flammeollus*	S	NI	Flammulated owls are associated with mature pine or mixed conifer forests with a ponderosa pine and/or Douglas-fir component. No suitable habitat would be removed as a result of this project; therefore, the Seismic Station Project will have **No Impact** on the flammulated owl or its habitat.
Greater Sage Grouse *Centrocercus urophasianus*	S	NI	Sage grouse are generally found where there are large tracts of sagebrush habitat with a diverse and substantial understory of native grasses and forbs or in areas where there is a mosaic of sage brush, grasslands, and aspen. Wet meadows, springs, seeps, or other green areas within sagebrush shrublands are generally needed for the early brood-rearing period (Connelly et al. 2004). There is no suitable habitat affected by the proposed project. Although portions near the project area are currently mapped as priority habitat, that delineation was conducted at a very broad-scale In this case; field visits, research, and knowledge of this area has indicated that it is not suitable habitat and is not occupied by sage grouse. Therefore, the Seismic Station Project will have **No Impact** on the greater sage

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			grouse or its habitat.
Northern goshawk *Accipiter gentilis*	S	NI	In Utah, most nests can be found in mid-elevation sites occupied by quaking aspen or coniferous forest (Graham et al. 1999). Northern goshawks migrate to lower elevations during the winter months. There is suitable habitat near the proposed project area, however this project will not impact nesting or foraging habitat; therefore, the Seismic Station Project will have **No Impact** on the northern goshawk or its habitat.
Peregrine Falcon *Falco peregrinus*	S	NI	Peregrine falcons most commonly occupy habitats which contain cliffs for nesting and more open country for foraging. There is no preference to certain vegetation types (White et al. 2002). There is suitable foraging habitat near the project; however, the quality of the habitat is low based on the proximity to a high use, well-traveled FSR. Therefore, the Seismic Station Project will have **No Impact** on the peregrine falcon or its habitat.
Spotted Bat *Euderma maculatum*	S	NI	In Utah, the spotted bat is likely found throughout the state. It is known to use a variety of vegetation types from approximately 2,500 to 9,500 feet, including riparian, desert shrub, spruce-fir, ponderosa pine, montane forests and meadows (Oliver 2000). Spotted bats roost alone in rock crevices high up on steep cliff faces. There is suitable roosting habitat near the gravel pit. This project may impact foraging habitat; however, the impact would be minimal based on the size of the project, the availability of foraging habitat throughout the forest, and limited use of the project area. Therefore the Seismic Station Project will have **No Impact** on Spotted Bat
Three-toed Woodpecker *Picoides tridactylus*	S	NI	Three-toed woodpeckers use forests containing spruce, grand fir, ponderosa pine, tamarack, and lodge-pole pine. There is no suitable habitat for three-toed woodpeckers within the project area; therefore, the Seismic Station Project will have **No Impact** on the three-toed woodpecker or its habitat.
Townsend's Big-eared Bat *Plecotus townsendii pallescens*	S	NI	Townsend's big-eared bats use buildings, caves, and mines as day roosts, night roosts, and maternity roosts. In Utah, wintering habitats of this species is better known than any other bat species, where it is well known as a hibernator in Utah utilizing caves and mines as hibernaculum (Oliver 2000). This species uses a variety of habitat in Utah including: desert scrub, pinyon/juniper, sagebrush, mountain brush, mixed forest, and ponderosa pine. No habitat will be affected by the proposal. Therefore, will have **No Impact** on Townsend's Big-eared Bat.

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C. AQUATIC WILDLIFE SPECIES			
SPECIES	STATUS	DETERMINATION	SPECIES DESCRIPTION AND EFFECTS
Bonneville Cutthroat Trout *Oncorhynchus clarki utah*	S	NI	Bonneville cutthroat trout (BVCT) range from high-elevation streams with coniferous and deciduous riparian trees to low-elevation streams in sage-steppe grasslands containing herbaceous riparian zones to lakes. BVCT primarily occur in small headwater streams and slow, deep water with vegetated stream banks which provide shade, and bank stability (NatureServe 2015). There are no streams on or near the land occupied by the gravel pit and the proposed project will not affect BCT; therefore, the Seismic Station Project will have **No Impact** on the Bonneville cutthroat trout or its habitat.
Colorado River Cutthroat Trout *Oncorhynchus clarki pleuriticus*	S	NI	Colorado River cutthroat trout (CRCT) require cool, clear water with well vegetated stream banks which provide cover, shade, and bank stability. CRCT tend to occupy headwater stream areas, especially when other trout species are present (NatureServe 2015). There are no streams on or near the land occupied by the gravel pit; therefore, the Seismic Station Project will have **No Impact** on the Colorado River cutthroat trout or its habitat.
Columbia Spotted Frog *ana luteiuentris*	S	NI	Spotted frogs are most commonly found in cold, still, permanent water in such habitats as marshy edges of ponds or lakes, in algae-grown overflow pools of streams, and near flat-water springs with emergent vegetation. The Columbian spotted frog may move considerable distances from water after breeding, often frequenting mixed conifer and sub alpine forests, grasslands, and brush lands of sage and rabbit brush. There is no suitable habitat in or near the project area; therefore, the Seismic Station Project will have **No Impact** on the Columbian spotted frog or its habitat.
Southern Leatherside Chub *Leidomeda aliciae*	S	NI	Southern leatherside chubs inhabit desert streams of the Bonneville Basin. Southern leatherside chubs require flowing water and do not persist in lakes or reservoirs. Southern leatherside chub have been documented in three 4th level HUCs (Hydrologic Unit Code) in the Utah Lake drainage and six 4th level HUCs in the Sevier River Drainage (UDWR 2009). There are no streams near the project area containing leatherside chub; therefore, the Seismic Station Project will have **No Impact** on the Southern Leatherside Chub or its habitat.
Western Boreal Toad *Bufo boreas boreas*	S	NI	The western boreal toad inhabits western Canada and much of the western (especially northwestern) United States. It occurs throughout most of Utah, and can be found in a variety of habitats, including slow moving streams, wetlands, desert

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			springs, ponds, lakes, meadows, and woodlands (UDNR 2015). There is no suitable habitat in or near the project area; therefore, the Seismic Station Project will have **No Impact** on the western boreal toad or its habitat.

Table 3 Manti-La Sal National Forest Management Indicator Species (MIS)

SPECIES	STATUS	DETERMINATION	COMMENTS
Golden Eagle *Aquila chrysaetos*	MIS	NI	Golden eagles generally inhabit mountainous or hilly terrain, but can also be found in valleys and western plains, especially during migration and winter. They generally nest on cliffs, but they also nest in trees. Golden eagles hunt over open country for small mammals, snakes, birds and carrion. Surveys for nesting raptors have been conducted in and around the project area for multiple years. There were no documented golden eagle nest sites near the project area.
Macro-invertebrates Aquatic Insects	MIS	NI	Macro-invertebrates (aquatic insects) are ecological indicator species in aquatic habitats. Habitat requirements for aquatic macroinvertebrates vary with species; habitat requirements for any one species are very specific. Many macro-invertebrates are the larval form of flying insects such as mayflies, stonflies, and caddisflies. There is no suitable aquatic habitat affected by the Seismic Station Project.
Mule Deer *Odocoileus hemionus*	MIS	NI	Mule deer use a wide array of habitat types and exhibit seasonal movement (elevational migration) in response to snow cover. There is no identified key or general winter range within the gravel pit. This area does seem to serve as transition range for big game, moving from higher elevations in the late fall to lower winter ranges in the winter with a return in the early spring. Movements depend on snowfall amounts. There will be no impacts to big game as installation will be conducted during the Fall 2018 outside of crucial fawning season.
Rocky Mountain Elk Cervus canadensis	MIS	NI	Elk tend to occupy the higher elevation aspen and mixed conifer habitats from spring through early fall, and move to lower elevation mixed shrub, pinyon/juniper, and sagebrush habitats for winter. There is no identified key or general winter range within the gravel pit. This area does seem to serve as transition range for big game, moving from higher elevations in the late fall to lower winter ranges in the winter with a return in the early spring. Movements depend on snowfall amounts. There will be no impacts to big game as installation

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			will be conducted during the Fall 2018 outside of crucial calving season.

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2018 Wildlife Survey Report

2018 Drill Sites, Areas of Potential Subsidence, And Waterline

Northern Goshawk, other Raptors, and
General Wildlife Surveys

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07.31.2018

1.0 Introduction

The following narrative is submitted pursuant to requirements regulating potential impacts to threatened, endangered, candidate and sensitive species and their associated habitats. The following report details the results of the northern goshawk (*Accipiter gentilis*), American three-toed woodpecker (*Picoides dorsalis*), general raptor, and general wildlife surveys conducted for the 2018 Exploration Drilling Program and to meet UDOGM survey requirements over the areas of potential subsidence. Areas of potential subsidence included the surface above panels which are scheduled to be mined in 2018, 2019, and 2020. No other special status species were identified to have suitable habitat within these project areas. The areas surveyed are displayed on the attached maps.

Pre-field research was completed by Alpine wildlife biologists who utilized GIS data from the Utah Division of Wildlife Resources' (UDWR) Utah Threatened, Endangered, and Sensitive Species Occurrences shapefiles and mapping services. The US Fish and Wildlife Services' species by County list was reviewed and a search was conducted in their Information, Planning and Consultation System (IPaC) on May 27th, 2018. Research included species occurrences, historic records, species ecology, life histories, known distributions, and habitat requirements. Coordination with UDOGM and Forest Service Wildlife Biologists was conducted in the spring prior to survey initiation. Survey requirements were discussed and are in accordance with the Northern Goshawk Technical Guide. American three-toed woodpecker surveys were conducted using the same methodology as the Forest Service; conducted along northern goshawk transects in suitable habitat. Northern goshawk protocol surveys, nesting raptor surveys, American three-toed woodpecker, and general wildlife surveys have been conducted in or near the project area by both professional and federal biologists over the past several years.

There are no threatened, endangered, or candidate species known to occur within the project area. State or Federally listed sensitive species which were identified as species of concern included raptors, with emphasis on northern goshawk, golden eagle, and American three-toed woodpecker. The remaining special status species were dismissed from further consideration, as a result of the multiple agency review, because there is no suitable habitat or the project is outside of the species known distribution.

2.0 Project Description

The 2018 wildlife survey area included the following areas: six drill sites 1-18, 2-18, 2-18a, 3-18, 4-18, 5-18, and 7-18 and a 0.5 mile buffer around each drill site (See Attachment 1, 2, and 3); the surface areas above mine panels scheduled to be mined in 2018, 2019, and 2020 (See Attachment 4); and a potential waterline route from the Vent Shaft in Swens Canyon (See Attachment 5). Northern goshawk protocol surveys, general raptor surveys, American three-toed woodpecker, and general wildlife surveys were conducted in and around the areas as displayed on the attached maps.

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3.0 General Habitat Overview

The vegetation across the survey area is very diverse and yet 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 the valleys that are drier are 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. Some of the ridge tops are dominated by cluster tarweed.

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 throughout the survey area which extended 0.5 miles beyond the project footprint. Broadcast calling stations were then established every 200 meters along each transect. Calling stations were then overlaid on aerial imagery in a GIS and call stations not located in suitable habitat were removed from the survey. 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 Technical Guide and were based on local knowledge of nesting chronologies in the area and coordination with the US Forest Service. Additionally, surveyors searched for foraging raptors between calling stations when vantage points were available.

American three-toed woodpecker surveys are conducted simultaneously with the northern goshawk survey. Biologists listened for drumming activity while at the call stations and inventoried for three-toed woodpeckers in suitable habitat while walking linear transects between call stations. This methodology is also commonly used by the USFS.

General wildlife surveys include the identification of general terrestrial wildlife species and were conducted along transects between call stations. The results of the general survey are listed at the beginning of Section 5.

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5.0 Survey Results

Species observed during the course of the inventories included, but are not limited to, red-tailed hawk (*Buteo jamaicensis*) (REHA), common raven (*Corvus corax*) (CORA),

dark-eyed junco (*Junco hyemalis*), brown creeper (*Certhia americana)*, black-capped chickadee (*Poecile atricapillus*), Stellar's jay (*Cyanocitta stelleri*), red-naped sapsucker (*Sphyrapicus nuchalis*), Clark's nutcracker (*Nucifraga columbiana*), American robin (*Turdus migratorius*), mountain chickadee (*Poecile gambeli*), ruby-crowned kinglet (*Regulus calendula),* white-crowned sparrow (*Zonotrichia leucophrys),* western tanager (*Piranga ludoviciana)*, tree swallow (*Tachycineta bicolor)*, Townsend's solitaire (*Myadestes townsendi),* Rocky Mountain elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), and MacGillivray's warbler (*Geothlypis tolmiei*).

Information such as species, call station observed, and type of observation (e.g., aural (A) or visual (V)) were documented for species of concern; other species listed were observed and listed herein for reference only.

Table 1 summarizes the results of the survey by call station, raptor species, and type of observation. Only key observations are summarized. Common raven (CORA) observations are not listed in Table 1.

Station#	Survey	Aural	Visual	Species	Notes
188	1		X	REHA	REHA soaring to the E
778	1		X	GHOW	GHOW flying from tree. No nest located.
518	1		X	REHA	REHA seen soaring to the S
550	1		X	REHA	REHA soaring S of call station 150 yards.
452	1	X	X	REHA	REHA pair seen hiking to call station. Did not respond to to call.
444	1		X	REHA	REHA soaring over Flat Canyon
445	1		X	REHA	REHA soaring over Flat Canyon
446	1		X	REHA	REHA soaring over Flat Canyon
613	1		X	Unknown	Unknown raptor couldn't see through the trees.
710	1		X	Unknown	Raptor soaring down drainage, could not identify through trees, REHA?
744	1		X	REHA	REHA soaring to the east
465	1		X	OSPR	Osprey over bulger res. Flying E to Electric Lake
685	1	X	X	TUVU	Turkey Vulture soaring to the North
526	1		X	REHA	REHA responded to call down slope a long distance.
496	1		X	REHA	REHA responded to call down slope a long distance.
501	1		X	CORA, REHA	CORA and REHA both seen flying down canyon.
576	1	X	X	REHA	REHA Pair soaring to the S
574	2		X	REHA	REHA soaring to the E
498	2	X	X	REHA	REHA soaring over

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516	2	X	X	REHA	REHA soaring over call station
459	2		X	REHA	REHA responded to call, stopped calling.
449	2		X	REHA	Soaring over call station to the N. Territory defense display, might have territory in area. Observed until out of sight.

During the first survey, at call station 603 biologist elicited a response from a northern goshawk to the east in Burnout Canyon. Biologist searched for the individual for over two hours using a combination of calling and listening for a response. The individual became less responsive as it moved to the east. Biologists did not locate a nest during the initial nest search. The Burnout Canyon northern goshawk territory was determined to be active by FS biologists; monitoring conducted by the FS was a part of their annual monitoring surveys. The territory is east of the survey area and shaded from drilling activity by topography. During the second inventory some call stations were not called to reduce potential effects on the nesting pair from conducting the survey.

Golden eagle activity was observed multiple times during both the first and second surveys. Most of the activity was observed in Flat and Huntington Canyons. Individuals were observed soaring over the open areas as listed in the results table. Red-tailed hawks were observed on multiple occasions and are listed in the results table. One great-horned owl was documented at UTM 12 S 0477959-4390417. The individual flew from a snag tree to the south east. The nest search was conducted around the snag tree but was unsuccessful.

There were no American three-toed woodpeckers observed during either survey. There were no other special status species observed during either survey.

The drilling areas are classified by the Utah Division of Wildlife Resources as crucial elk calving and mule deer fawning areas. Both elk calves and mule deer fawns were observed during the course of the inventory.

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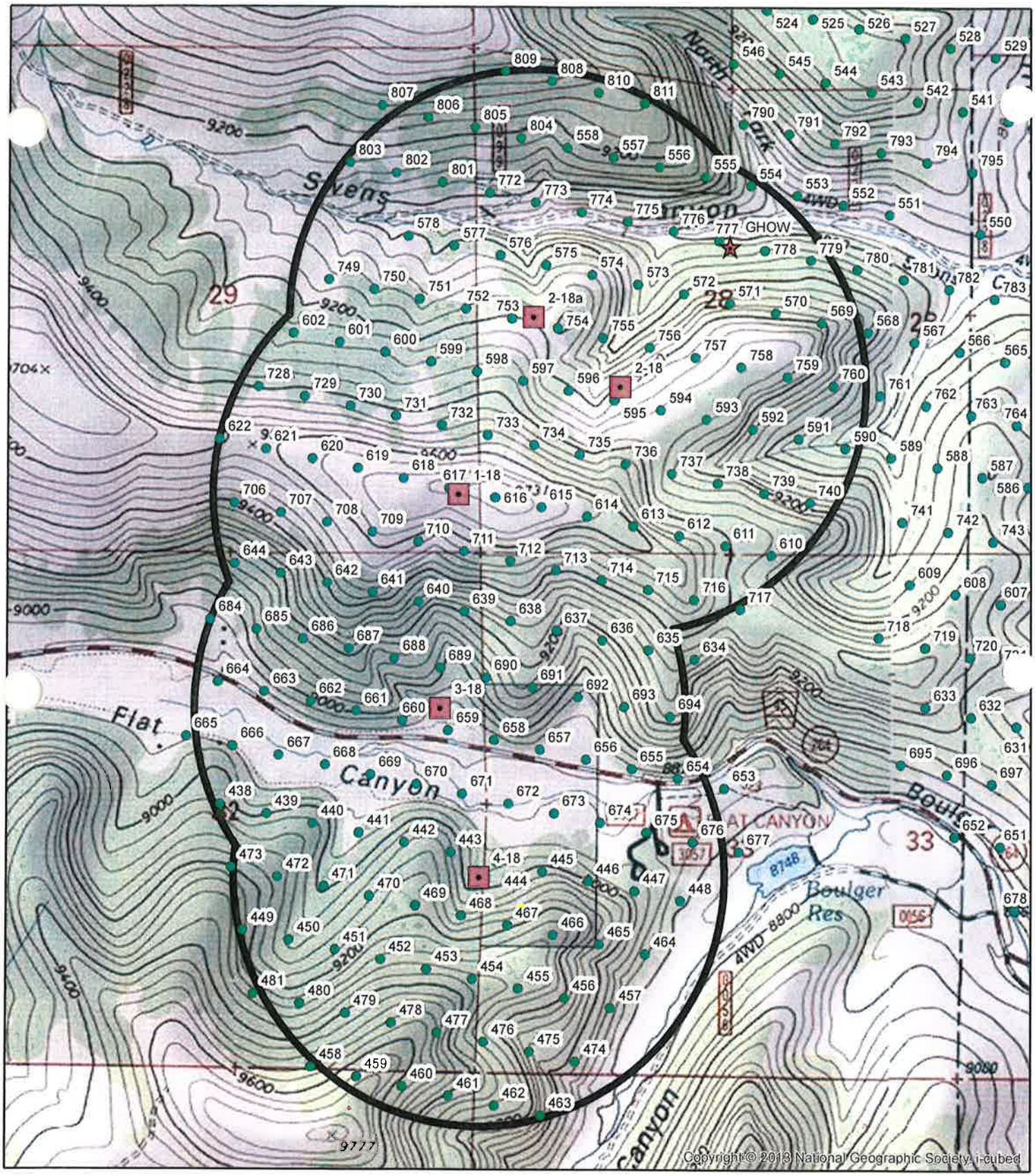

☆ 2018 Survey Results

2018 Drill Sites

2018 Call Stations

0.5 Mile Buffer

N
W E
S

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2018 Drill Sites
Attachment 1

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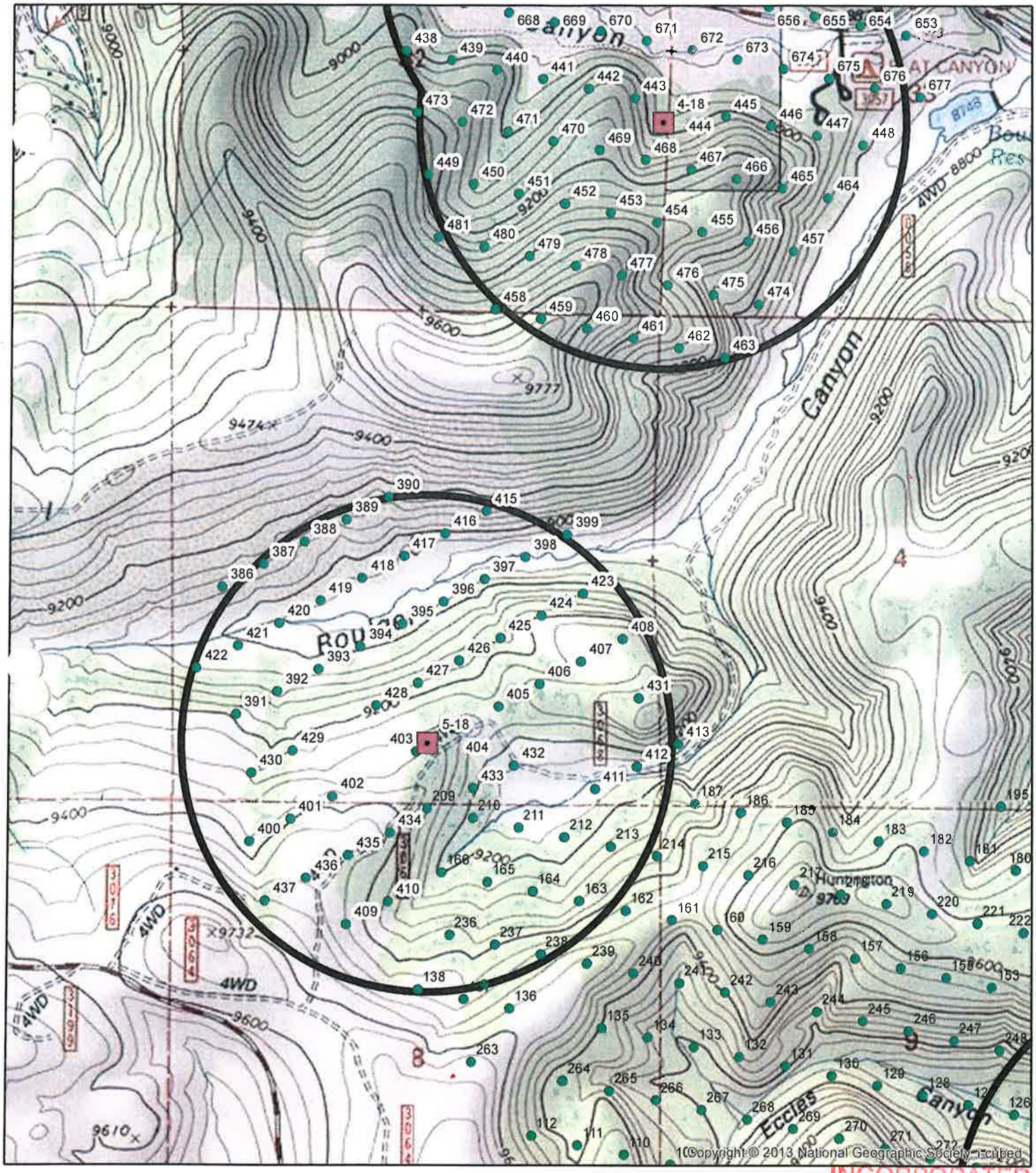

2018 Survey Results

2018 Drill Sites

2018 Call Stations

0.5 Mile Buffer

N
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2018 Drill Sites
Attachment 2

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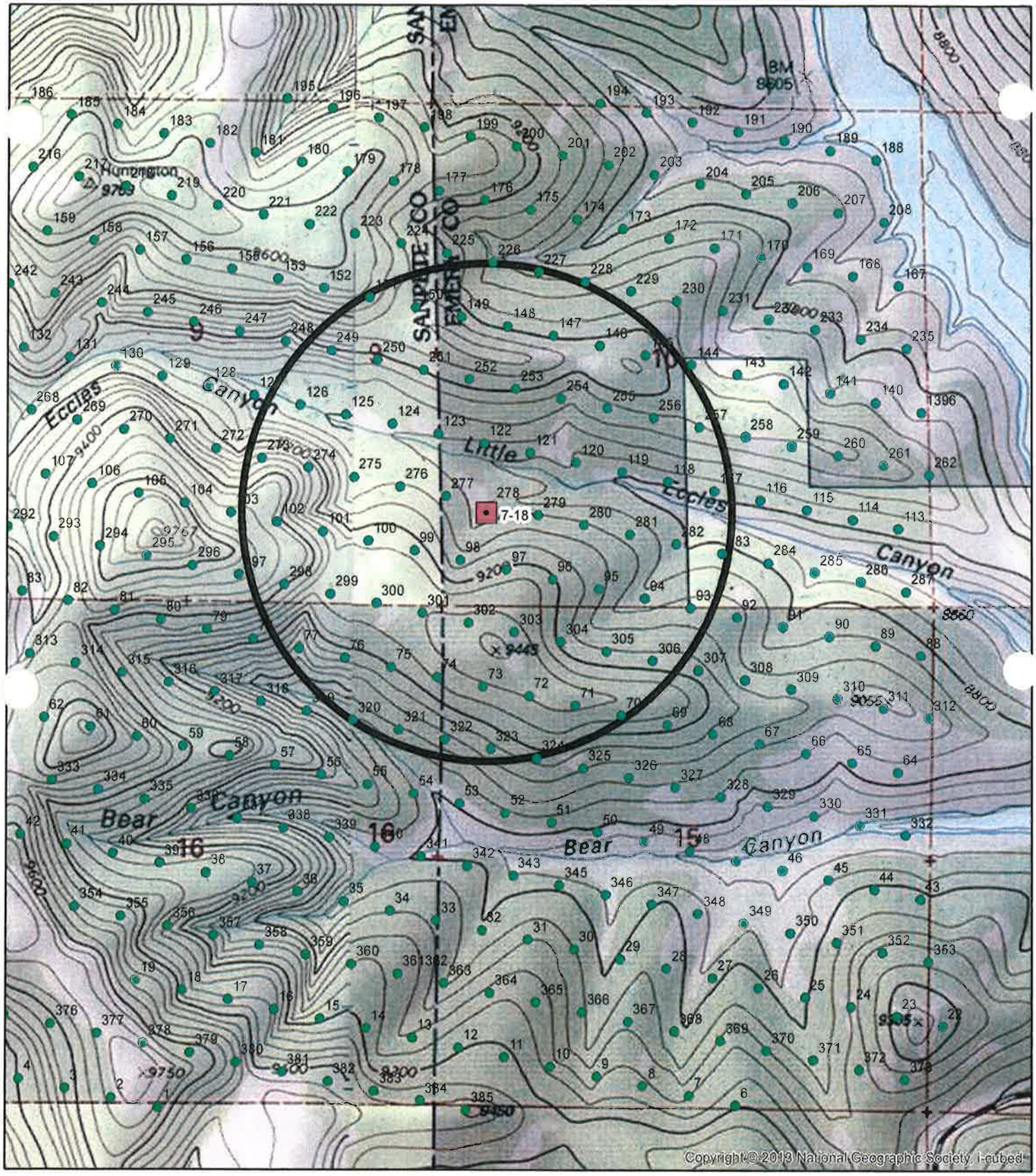

2018 Survey Results

2018 Drill Sites

2018 Call Stations

0.5 Mile Buffer

N
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2018 Drill Sites
Attachment 3

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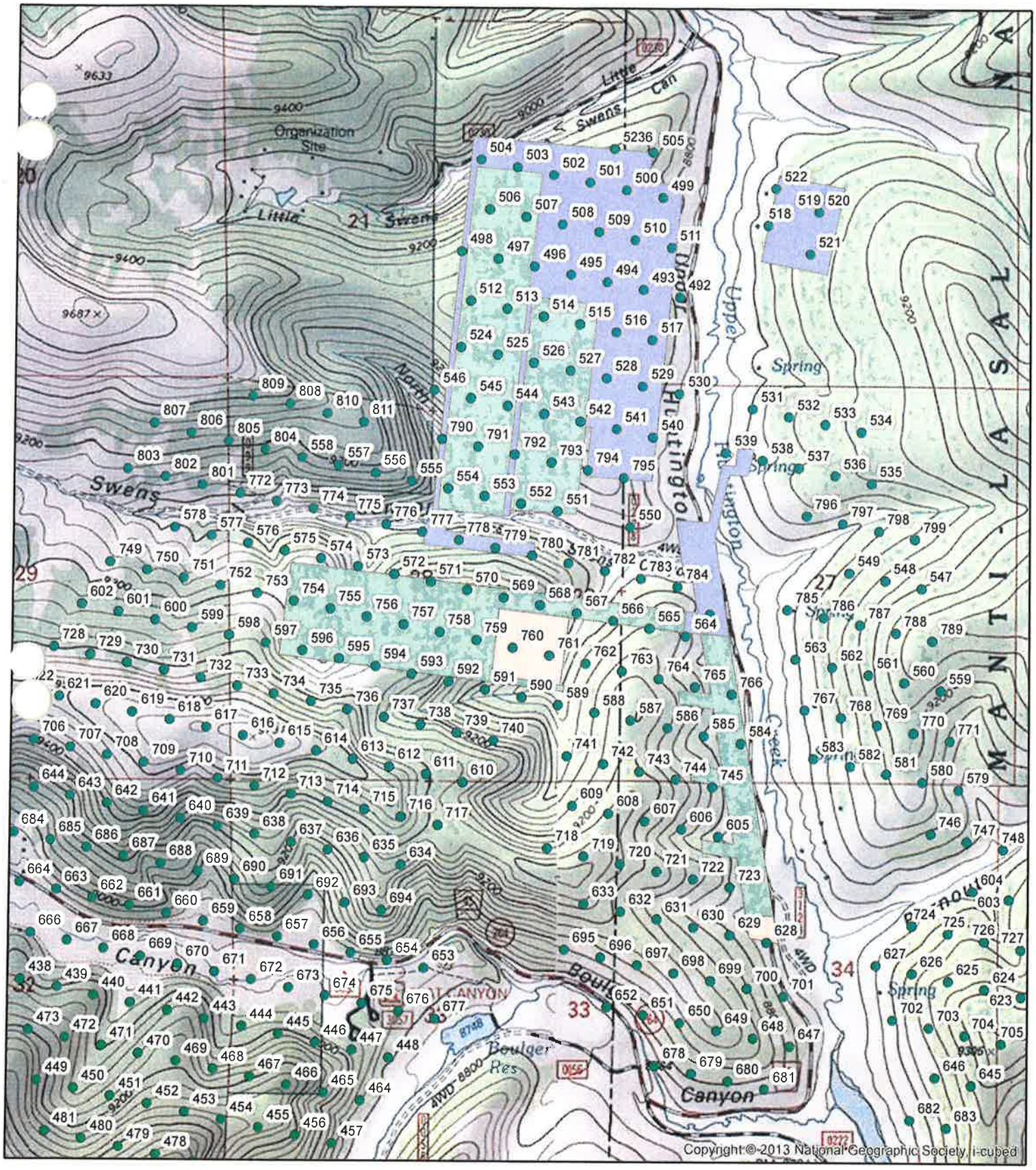

2018 Call Stations

Mine Plan Year

- 2018
- 2019
- 2020

N W E S

2018 Areas of Potential Subsidence Survey

Attachment 4

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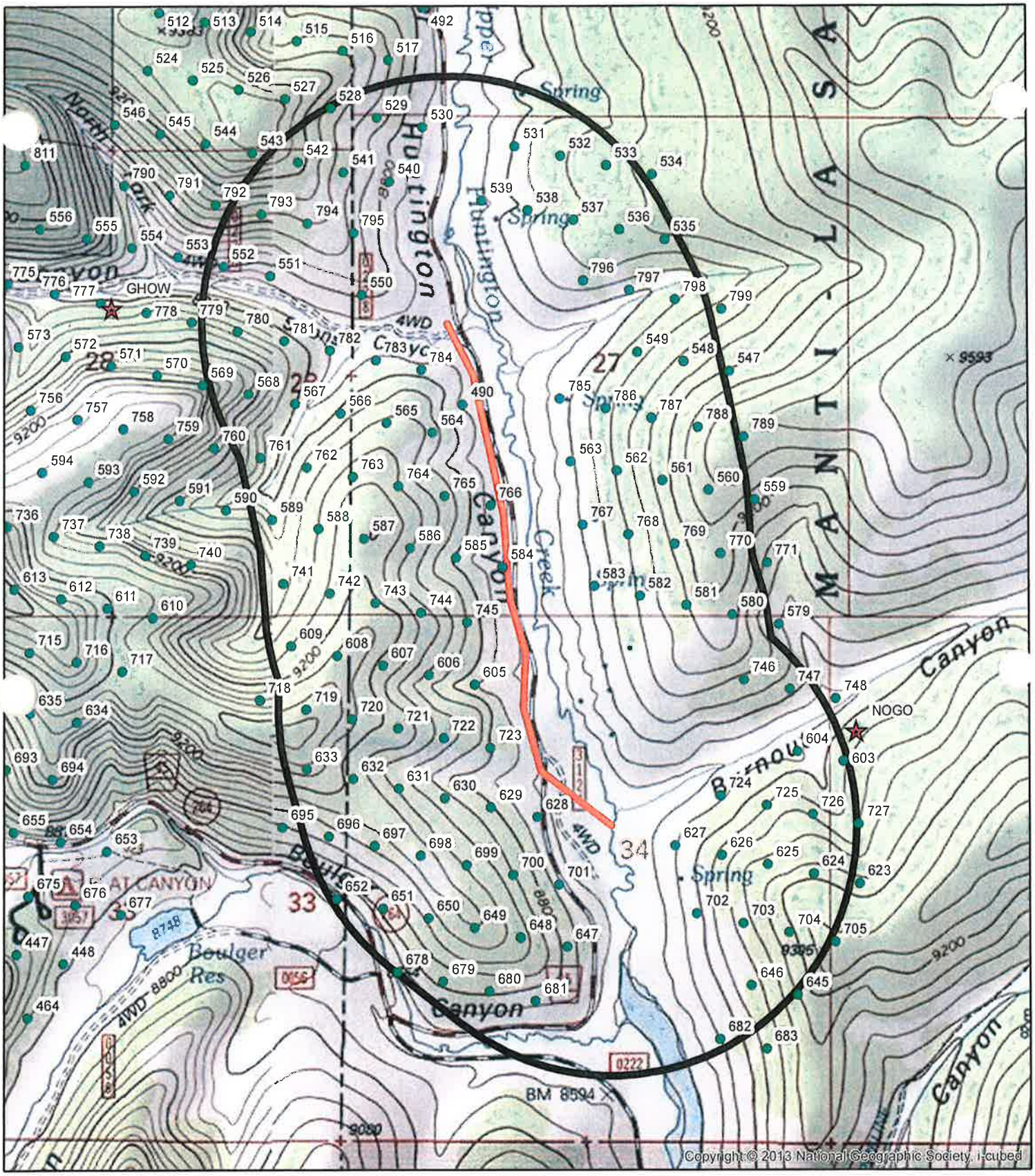

2018 Survey Results

2018 Call Stations

0.5 Mile Buffer

Waterline Route

N
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S

2018 Waterline Route
Attachment 5

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To: Gregg Galecki
Environmental Engineer
Bowie Resources Partners LLC
HC35 Box 380

From: Alpine Ecological
HC80 Box 570
Greenwich, UT 84732

Date: 9/18/2017

Re: **Special Status Wildlife Species, Regulatory Compliance and Records Review for the Burnout Canyon Heli-portable Drill Site Project and the Boulger Reservoir Piezometer Installation Project**

Introduction

Skyline Mine proposes to install up to five piezometer, six brass monuments and a seismic monitoring station around Boulger Reservoir in the Fall of 2017; to monitor both the water levels in the reservoir and the integrity of the dam. In areas around the reservoir, the monuments will be installed using a small light duty tractor with a drilling unit attached on the back. This will reduce potential disturbance to the soils and vegetation surrounding the reservoir. The remaining piezometers will be installed using a conventional drilling rig. The seismic monitoring station will be installed using foot traffic and a portable trencher to install conduit to the site. The project is estimated to be completed within three days.

Skyline Mine also proposes to install two water monitoring wells within 50 of each other, at one well site located between Highway 264 and west of Huntington Creek; across from the opening of Burnout Canyon. Drilling will be done using a heli-portable drill rig to minimize any surface disturbance to the soil and surrounding vegetation. This project is estimated to be completed within two weeks.

Records and Literature review was completed by Alpine wildlife biologists who utilized GIS data from the Utah Division of Wildlife Resources' (UDWR) Utah Threatened, Endangered, and Sensitive Species Occurrences shapefiles and mapping services. The US Fish and Wildlife Services' Information, Planning and Consultation System (IPaC). Research also included species occurrences, historic records, species ecology, life histories, known distributions, and habitat requirements. Previous survey wildlife surveys have been conducted on and around both project areas during 2015, 2016, and 2017.

Results and Recommendations

The only special status species of concern of both projects is western (boreal) toad *Bufo boreas)*. Other special status species such as northern goshawk (*Accipter gentilis*) and American three-toed woodpecker (Picoides dorsalis) were not considered further because

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the project areas do not occur within suitable habitat or the project will be implemented outside of established sensitive time periods (i.e., raptor or migratory bird nesting seasons).

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 as follows:

> *"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.*

A survey for western toad was conducted in 2014 by Alpine biologist Allan Stevens, PhD around Boulger Reservoir. The survey results did not report any findings of boreal toads. Inventories were conducted in June, July, and August of 2014. 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 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.

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Although no boreal toads were observed in the area of Boulger Creek, both project areas have ecological attributes required by boreal toad. Therefore, we make the following recommendations to minimize impacts to those attributes:

1. Do not travel through mesic habitats between drill sites. Approach drill sites from the xeric, upland areas. Only travel the minimum distance necessary in damp or wet soils.
2. Use drill mats, or a suitable alternative to reduce the pounds per square inch rating on equipment at the drill site location; and access route if necessary.

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CHAPTER 4

LAND USE AND AIR QUALITY

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Attachment 4-2 U18TD0309_Skyline 2018 Drill Sites CRI Report
Attachment 4-3 U18TD0497_Skyline 2018 Seismic Sites CRI Report
Attachment 4-4 U17EO0426small_2017 Dam and well site
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410 LAND USE

411 Environmental Description

A statement of the conditions and capabilities of the land to be affected by mining and reclamation operations follows in this section.

411.100 Pre-mining Land Use

The area is utilized for private uses including hunting and as open range for livestock and wildlife.

411.110 Land Use Map and Narrative

Refer to the same section of the approved M&RP.

411.120 Land Capability

The major plant communities at the subsidence monitoring equipment locations are identified in Section 321. No cultivated lands lie within the well boundaries, due to the limiting terrain and lack of water for irrigation. The subsidence monitoring equipment areas are located on the dam, surrounding shoreline, and flatter ridge top with generally flat terrain. The flatter ridge tops and generally flat terrain receives heavier pressure because of more available forage and easier movement by livestock and the upland grasses. Seismic site F encompasses a site from previous reclamation activities.

411.130 Land Use Description

The subsidence monitoring equipment sites are located on both land administered by the Manti-LaSal National Forest and private land. Both are managed as open range for livestock and wildlife. No industrial or municipal facilities are located on or immediately adjacent to the subsidence monitoring equipment sites.

411.140 Cultural and Historic Resources Information

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Cultural and Historic Resource Maps - Archaeological surveys were conducted as part of the subsidence monitoring equipment areas. No sites of historic significance were documented. archeological and SHPO clearance are included with this chapter as Attachments 4-1 through 4-6.

Table 4.1 - SHPO Cultural Clearance

Seismic Site	Report Attachment	SHPO Letter	SHPO report
A	Attachment 4-4	Attachment 4-5	17-1832
B	Attachment 4-3	Attachment 4-7	18-1856
C	Attachment 4-2	Attachment 4-6	18-1790
D (D-alt. – alias)	Attachment 4-3	Attachment 4-7	18-1856
E	Attachment 4-3	Attachment 4-7	18-1856
F	Conducted by USFS	Attachment 4-1	19-2774

411.200 Previous Mining Activity

Skyline Mine has no knowledge of the removal of coal or other minerals in the Boulger Dam Subsidence Monitoring equipment areas. The area will be mined in the future by Skyline Mine.

412 Reclamation Plan

412.100 Postming Land-Use Plan

All uses of the land prior to the subsidence monitoring equipment areas and the capacity of the land to support prior alternate uses will remain available throughout the life of the sites.
Skyline Mine intends the postmining land use to be livestock and wildlife grazing and other uses as dictated by the Manti-LaSal National Forest. Final reclamation activities will be completed in a manner to provide the lands able to parallel the pre-mining land use.

412.200 Land Owner or Surface Manager Comments

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The public land is managed by the US Forest Service. The subsidence monitoring equipment sites are predominantly on lands managed by the USFS, with seismic sites C and D on private property. Canyon Fuel Company, LLC has been in contact USFS personnel for any specific requirements necessary at the sites. No specific modifications were requested.

413 Performance Standards

413.100 Postmining Land Use

Postmining land uses are discussed in Section 4.12 of the M&RP. The postmining lands will be reclaimed in a timely manner and capable of supporting such uses as outlined in the M&RP.

413.200 Determining Pre-mining Uses of Land

Refer to Section 2.12 of the M&RP.

413.300 Criteria for Alternative Postmining Land Uses

No alternative postmining land uses have been planned.

414 Alternative Land Use

No alternative postmining land uses have been planned.

420 AIR QUALITY

421 Air Quality Standards

Skyline Mine activities will be conducted in compliance with the requirements of the Federal Clean Air Act and the Utah Air Conservation Rules.

422 Compliance Efforts

Not applicable.

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423 Monitoring Program

Not applicable.

424 Fugitive Dust Control Plan

Not applicable.

425 Additional Division Requirements

Not applicable.

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CHAPTER 5
ENGINEERING

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Attachment 5-4 Mining-induced Seismicity – Skyline Flat Canyon Mining Lease, Boulger and Electric Lake Dam and Reservoirs, Sanpete and Emery County, Utah, RB&G Engineering, Inc., 2018
Attachment 5-5 Boulger Dam Reservoir – Mining-Induced Seismicity (MIS) Monitoring, memorandum, prepared by Canyon Fuel Company, LLC, May 7, 2019
Attachment 5-6 Boulger Dam (UT00695) Skyline Mining-Induced Seismicity Monitoring and Mitigation Plan, David K. Marble, Asst. State Engineer/Dam Safety, July 22, 2019
Attachment 5-7 NIOSH temporary seismic pod deployment summary

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510 INTRODUCTION

This chapter provides a discussion of general engineering aspects, an operation plan, a reclamation plan, design criteria, and performance standards related to the subsidence monitoring equipment sites. The activities associated with the construction and reclamation of the subsidence monitoring equipment sites have been or will be designed, located, constructed, maintained, and reclaimed in accordance with the operation and reclamation plans.

511 General Requirements

The permit application includes descriptions of construction, maintenance, and reclamation operations of the subsidence monitoring equipment sites with maps and plans. Note that all the subsidence monitoring equipment sites were permitted and installed under Notice of Intent (NOI) exploration permits that allow for the installation and collection of environmental data. The one exception is seismic station F that was installed with temporary equipment due to the need to have the station installed in late 2019. Potential environmental impact as well as methods and calculations utilized to achieve compliance with the design criteria are also presented.

512 Certification

Where required by the regulations, cross sections and maps in this permit application has been prepared by or under the direction of, and certified by, qualified registered professional engineers or land surveyors. As appropriate, these persons were assisted by experts in the fields of hydrology, geology, biology, etc.

512.100 Cross Sections and Maps

The seismic station locations are illustrated on Figure 1-1. Designs for the seismic station are shown on Attachment 5-1. Seismic station photos are illustrated in Attachment 5-2.
Boulger survey monuments and piezometer locations are illustrated on Figure 1-2. Typical monument and piezometer designs are illustrated in Attachment 5-3.

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512.200 Plans and Engineering Designs

Excess Spoil - No excess spoil will be generated from the subsidence monitoring equipment sites.

Durable Rock Fills - No durable rock fills will exist at the subsidence monitoring equipment sites.

Coal Mine Waste - No coal mine waste will exist at the subsidence monitoring equipment sites.

Impoundments – No impoundment will exist at the subsidence monitoring equipment sites.
Primary Roads – No primary roads will exist at the subsidence monitoring equipment sites.

Variance from Approximate Original Contour - No variance from approximate original contour is required for the subsidence monitoring equipment sites.

513 Compliance with MSHA Regulations and MSHA Approval

513.100 Coal Processing Waste Dams and Embankments

No coal processing waste dams and embankments will exist at the subsidence monitoring equipment sites.

513.200 Impoundments and Sedimentation Ponds

No Impoundments or sedimentation ponds exist at the subsidence monitoring equipment sites as defined by the qualifying criteria of MSHA, 30 CFR 77.216.

513.300 Underground Development Waste, Coal Processing Waste, and Excess Spoil

No underground waste, coal processing waste, and excess spoil will exist at the subsidence monitoring equipment sites.

513.400 Refuse Piles

No refuse piles will exist at the subsidence monitoring equipment sites.

513.500 Underground Openings to the Surface

No underground Openings to the surface will exist at the subsidence monitoring equipment sites.

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513.600 Discharge to Underground Mine

No discharge to the underground mine will occur at the subsidence monitoring equipment sites.

513.700 Surface Coal Mining and Reclamation Activities

No surface coal mining, or reclamation activities associated with surface coal mining will occur at the subsidence monitoring equipment sites with the exception of removing the seismic equipment when the study is complete and the proper abandonment of the piezometers according to State regulations.

513.800 Coal Mine Waste Fire

No coal waste will be developed, therefore, no coal waste fires exist at the subsidence monitoring equipment sites.

514 Inspection

514.100 Excess Spoil

No excess spoil will be stored at the subsidence monitoring equipment sites.

514.200 Refuse Piles

No refuse piles will exist at the subsidence monitoring equipment sites.

514.300 Impoundments

No Impoundment exist at the seismic recording sites with no inspections or monitoring necessary.

515 Reporting and Emergency Procedures

515.100 Slides

Numerous precautions are outlined in the Skyline monitoring plan (Attachment 5-6). The Boulger Dam Reservoir MIS monitoring initiates a full series of monitoring procedures once full extraction mining is within 1-mile of the dam. See Chapter 6, Section 632 Subsidence Monitoring, and attachments 5-4 and 5-5 of this document for details.

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515.200 Impoundments Hazards

No impoundments will exist at the seismic sites. The USFS is the surface-managing agency for the reservoir and the Utah Division of Water Rights – Utah State Safety Engieer, Dam Safety regulates the integrity of the dam. Boulger dam was originally constructed in 1937 as an eartrhen dam with a reservoir capacity of 30 acre-feet. Based on a 2017 licensed survey, the reservoir contains approximately 19.4 acre-feet due to sediment buildup over 80+years. The dam/reservoir has a Low Hazard Rating.

515.300 Temporary Cessation of Operations

If temporary cessation of the mining operations does occur, the existing the Boulger subsidence monitoring equipment will remain in operation as long as the National Institute of Occupational Safety and Health (NIOSH) want to continue the study.

520 OPERATION PLAN

521 General

See Figures 1-1 and 1-2 for the location of the Boulger subsidence monitoring equipment locations.

521.100 Cross Sections and Maps

Existing Surface and Subsurface Facilities Features - No buildings are located on or within 1,000 feet of the seismic stations. A USFS outhouse is located approximately 500 feet from the dam. No other surface or subsurface facility features exist in the area.

Landowner, Right-of-Entry, and Public Interest - The land which the subsidence monitoring equipment is located on is managed by the Manti LaSal National Forest, with the exception of seismic sites C and D located on Collard property and the Repeater site located on ??? property.

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Mining Sequence and Planned Subsidence - Mining sequence maps are submitted to the BLM and UDOGM as part of their annual reports. Plate 4.17.3-1A in the approved M&RP has been updated with this document to include both the Mining Sequence and Planned Subsidence for this area.

Land Surface Configuration - Surface contours are shown on Figure 1-1

Surface Facilities - No permanent surface facilities will exist at the seismic site; a USFS outhouse is located approximately 500 feet from the dam, and a cement 'fish ladder' functions as the spillway for the reservoir. Both the outhouse and fish ladder will be surveyed prior to undermining.

521.200 Signs and Markers

Mine and Permit Identification Signs – No Mine and Permit identification signs are located at any of the subsidence monitoring equipment locations.

Perimeter Markers - No perimeter markers are located at any of the subsidence monitoring equipment locations.

Buffer Zone Markers – No buffer zone markers are necessary at any of the subsidence monitoring equipment locations.

Topsoil Markers - Markers are not necessary as not topsoil will be removed.

Construction Markers - Not applicable.

Hazard Signs - Not applicable

522 Coal Recovery - Not applicable

523 Mining Methods

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Full extraction mining will be conducted in the vicinity of the Boulger Reservoir. Plate 4.17.3-1A_rev10 of the approved M&RP has been updated with this submittal to illustrate the proposed mining plan.

524 Blasting and Explosives

No explosives are to be used at any of the subsidence monitoring equipment locations.

525 Subsidence

Subsidence could occur at the seismic site because of underground mining see current mine plan in the Annual Report and the approved M&RP.

Plate 4.17.5-1 of the approved M&RP provides the location of survey control monuments for the entire permit area. These control monuments and will be extended as the annual aerial subsidence surveys progress south prior to mining being conducted. Figure 1-2 illustrates the survey monuments specific for the monitoring surrounding Boulger Reservoir. Section 4.17.4 – Mitigation of Subsidence Effects of the M&RP outlines measures to be taken to mitigate impacts to structures, roads, etc. Plate 4.17.3-1A_rev10 of the approved M&RP has been updated with this submittal to illustrate the proposed mining plan to include undermining of Boulger Reservoir and the anticipated subsidence of the area. This report focuses solely on potential material damage related to the undermining of Boulger dam. Material damage to structures (USFS outhouse) or interruption of State-appropriate water supplies is not likely as no impacts have been observed in the water monitoring program since 1981. A survey of the USFS outhouse will be conducted prior to undermining, piezometers and survey monuments monitor any chances in the dam and reservoir, and the water monitoring program monitors impacts to the water supply.

As surveyed in 2017, Boulger Reservoir retains approximately 19.4 acre-feet of water which is classified as a low hazard facility. In the highly unlikely event of a catastrophic failure of the dam, the 19.4 acre-feet would report to Electric Lake located approximately ¾-mile downstream. The 19.4 acre-feet of the Boulger Reservoir represents less than one-percent of the volume of Electric Lake, with Boulger Reservoir being drawn down prior to undermining.

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Per stipulation #25 of Federal Lease UTU-77114, Skyline Mine is required to develop a plan for undermining Boulger Reservoir. The plan must "include, but not limited to, type of mining, when and how the dam will be taken out of service while undermining and /or subjected to mining-induced acceleration of 0.1g and greater, and what mitigation measures will be taken to place the dam and reservoir back into full service." Attachment 5-4 is a comprehensive report conducted by RB&G Engineering, Inc., that evaluates the anticipated effects to both the Electric Lake dam and Boulger Reservoir dam due to Mining-Induced Seismicity (MIS) as related to mining. The report is predominantly focused on Boulger dam due to the proximity of mining. The report evaluates and proposed mitigation measures for both mining up to, and surrounding the reservoir with full extraction mining, and complete full-extraction mining beneath the reservoir. Attachment 5-5 contains the proposed mitigation to conduct full-extraction mining. The plan, "Boulger Dam Skyline Mining-Induced Seismicity Monitoring and Mitigation Plan" was drafted by Skyline personnel and has been approved by the Utah State Dam Safety Engineer (Attachment 5-6 – Dam Safety Approval). Chapter 6, Section 632 of this report details the mitigation and monitoring that will take place while mining in the vicinity of the Boulger Reservoir.

526 Mine Facilities

526.100 Mine Structures and Facilities

No buildings exist at the seismic site.; therefore, no existing building will be used in connection with or to facilitate this proposed coal mining and reclamation plan.

526.200 Utility Installation and Support Facilities

No utilities are to be installed at the seismic stations. Only a pole and solar panel for power will be installed at each location. No other facilities exist for the subsidence monitoring equipment.

527 Transportation Facilities

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527.100 Road Classification

Not applicable

527.200 Description of Transportation Facilities

Not applicable.

528 Handling and Disposal of Coal, Excess Spoil, and Coal Mine Waste

No disposal of coal, excess spoil, and coal mine waste will occur at the subsidence monitoring equipment sites.

529 Management of Mine Openings

Not applicable.

530 OPERATIONAL DESIGN CRITERIA AND PLANS

531 General

This section contains the general plans for the construction and maintenance of the subsidence monitoring equipment sites. The seismic stations serves a dual purpose: 1) help monitor acceleration associated with subsidence as mining approaches Boulger dam; and 2) a study conducted by NIOSH monitoring mining induces seismicity related to full-extraction mining and how to increase safety of miners. The piezometers and survey monuments monitor the integrity of the dam and reservoir as mining approaches.

532 Sediment Control

Sediment control measures for the subsidence monitoring equipment are described in Sections 732 and 742 of this submittal. Sediment control is minimal at the seismic sites due to the very limited disturbance that includes two 2-foot diameter vaults, a pole holding a solar panel, and a wire connecting all three. Sediment yields at all the subsidence equipment sites were minimized by:

- Disturbing the smallest practicable area during the construction of the well site and
- Contemporaneously reclaiming areas suitable for such reclamation.
- Not removing topsoil or vegetation.

533 Impoundments

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Boulger Reservoir was constructed in 1938, is managed by the US Forest Service and inspected by the Utah State Engineer – Dam Safety. A thorough evaluation of the dam was conducted by RB&G Engineering in 2017. The report (Attachment 5-4) outlines the integrity of the dam.

534 Roads

Not applicable.

535 Spoil

No spoil will be generated at the subsidence monitoring equipment sites.

536 Coal Mine Waste

No coal mine waste will be stored at the subsidence monitoring equipment sites.

537 Regraded Slopes

537.100 Division Approval

No mining or reclamation activities will be conducted in the permit area that requires approval of the Division for alternative specifications or for steep cut slopes.

537.200 Regrading of Settled and Revegetated Fills

Not applicable as no regrading will occur.

540 RECLAMATION PLAN

541 General

541.100 Commitment

Upon the permanent cessation of the study, Skyline Mine will remove the equipment and reclaim all affected areas in accordance with the R645 regulations and this reclamation plan.

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541.200 Surface Coal Mining and Reclamation Activities

Not applicable.

541.300 Underground Coal Mining and Reclamation Activities

Upon completion of the studies the subsidence monitoring equipment sites will be reclaimed.

541.400 Environmental Protection Performance Standards

The plan presented is designed to meet the requirements of R645-301 and the environmental protection performance standards of the State Program.

542 Narratives, Maps, and Plans

542.100 Reclamation Timetable

No timetable has been established for the reclamation of the subsidence monitoring equipment sites as the end of the study has not been determined by NIOSH. Reclamation will start after the completion of the study.

542.200 Plan for Backfilling, Soil Stabilization, Compacting, and Grading

Reclamation of the seismic will be done by hand as very little backfilling, soil stabilization, compaction and grading will be necessary for the small site. Abandonment of the piezometers will require only backfilling of the wells and removal of the surface casing. No surface disturbance will be required.

Sedimentation Pond Removal and Interim Sediment Control – Not applicable.

542.300 Final Surface Configuration Maps and Cross Sections

The sites will be regraded to the approximate original contour. No maps are necessary due to the small area being disturbed.

542.400 Removal of Temporary Structures

The subsidence monitoring equipment sites will not have surface structures.

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542.500 Removal of Sedimentation Pond

No sediment pond will be constructed at the seismic site.

542.600 Roads

Not applicable.

542.700 Final Abandonment of Mine Openings and Disposal Areas

Not applicable.

542.800 Estimated Cost of Reclamation

It is anticipated that the cost of reclamation of the subsidence monitoring equipment sites is adequately covered by the Skyline Reclamation Bond, refer to Section 4.2, Demolition page 45 of the M&RP for additional details. Seismic equipment will be recovered by NIOSH with assistance from Skyline personnel to be used in future studies.

550 RECLAMATION DESIGN CRITERIA AND PLANS

551 Casing and Sealing of Underground Openings

Not applicable

552 Permanent Features

552.100 Small Depressions

No permanent small depressions will be created as part of the subsidence monitoring equipment sites construction and reclamation.

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552.200 Permanent Impoundments

Not applicable

553 Backfilling and Grading

553.100 Disturbed Area Backfilling and Grading

Approximate Original Contour - The seismic site will be returned to their approximate original contour after reclamation is completed. No contour modifications were conducted with the installation of the piezometers.

Erosion and Water Pollution - Sediment controls will consist hand-raking the disturbed area. As vegetation becomes established on the reclaimed surface, erosion potential will be further minimized.

Post-Mining Land Use - The disturbed area will be reclaimed in a manner that supports the approved post-mining land use. Refer to Sections 411 and 412 for additional detail.

553.200 Spoil and Waste

Spoil - No spoil will be generated within the subsidence monitoring equipment sites.

Coal Processing Waste - No coal processing waste will be generated within the subsidence monitoring equipment sites.

553.250 Refuse Piles

No refuse piles will exist at the subsidence monitoring equipment sites.

553.300 Exposed Coal Seams, Acid and Toxic Forming Materials and Combustible Materials

No coal seams will be left exposed at the subsidence monitoring equipment sites.

553.400 Cut and Fill Terraces

No cut and fill terraces will be constructed at the subsidence monitoring equipment sites.

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553.500 Highwall From Previously Mined Areas

No highwalls exist or will be built at the subsidence monitoring equipment sites.

553.600 Previously Mined Area

No previously mined areas exist at the subsidence monitoring equipment sites.

553.700 Backfilling and Grading - Thin Overburden

No surface mining and reclamation activities involving thin overburden will occur at the subsidence monitoring equipment sites.

553.800 Backfilling and Grading - Thick Overburden

No surface mining and reclamation activities involving thick overburden will occur at the subsidence monitoring equipment sites.

553.900 Regrading of Settled and Revegetated Rills

If settlement or rills occur at the seismic site, they will be regraded and revegetated. Refer to Section 244.300.

560 PERFORMANCE STANDARDS

The Skyline Mine seismic site will be conducted in accordance with the approved permit and the requirements of R645-301-510 through R645-301-553.

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ATTACHMENT 5-1

Example of Cross section of Seismic Site

The seismic station consists of two vaults approximately 3 feet apart and 20 feet from the Solar / Antenna Mast. Vaults are 30" diameter galvanized culverts placed approximately 24" deep, fitted with locking lids.

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Seismic Site Photos

Site A

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Site B

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Site D

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Site E

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Repeater Site: Left panel is Skyline; Right panels are PacifiCorp

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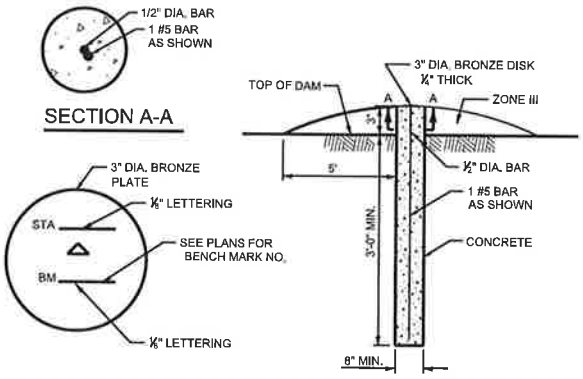
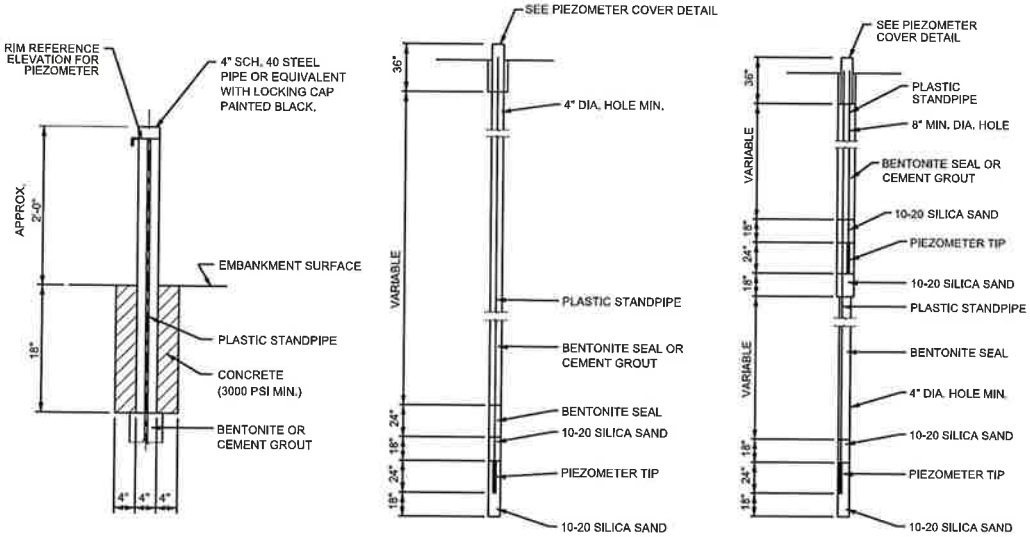


BENCH MARK DETAIL



PIEZOMETER COVER
NOT TO SCALE

SINGLE PIEZOMETER DETAILS

DOUBLE PIEZOMETER DETAIL

PIEZOMETER DETAIL

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Bench Mark and Piezometer Details

MINING-INDUCED SEISMICITY

SKYLINE FLAT CANYON MINING LEASE

BOULGER AND ELECTRIC LAKE DAMS & RESERVOIRS

Sanpete and Emery County, Utah

Prepared for:
Canyon Fuel Company, LLC

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June 2018

RB&G ENGINEERING, INC.

201701-022

ADDENDUM NO. 1

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SKYLINE FLAT CANYON
MINING LEASE
BOULGER AND ELECTRIC LAKE
DAMS AND RESERVOIRS

RB&G ENGINEERING, INC.

Sanpete and Emery County, Utah

Mining-Induced Seismicity
June 26, 2018

ADDENDUM NO. 1

March 1, 2019

Add the following to the end of page 22:

The recommendations for monitoring when mining is within one mile of the Boulger Dam and Reservoir apply to extraction mining which allows collapse of the mine roof. These monitoring frequencies are not required during activities which include design of the mine roof to prevent collapse, such as development mining. Prior to extraction mining within one mile of the dam and reservoir, we recommend the site reconnaissance and instrument monitoring be performed at least quarterly to establish conditions prior to mining activity; however, it is our opinion that this baseline monitoring can be discontinued during winter months when access to the dam is difficult.

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RB&G
ENGINEERING, INC.

June 26, 2018

Canyon Fuel Company LLC
Attn: Gregg Galecki, Environmental Engineer
HC 35, Box 380
Helper, UT 84526

Subject: Skyline Flat Canyon Mining Lease
Boulger and Electric Lake Dams & Reservoirs
Mining-Induced Seismicity

Gentlemen:

A Mining-Induced Seismicity Study has been completed for the Skyline Flat Canyon Mining Lease Boulger and Electric Lake Dams & Reservoirs in Sanpete and Emery County, Utah. The results of the study are summarized in the report transmitted herewith. Personnel involved in preparation of this report include the following:

Bradford E. Price, Principal Geotechnical Engineer
Michael N. Hansen, Professional Geologist
Brandon D. Horrocks, Geotechnical Engineer

We appreciate the opportunity of providing this service for you. If there are any questions relating to the information contained herein, please call.

Sincerely,

RB&G ENGINEERING, INC.

REGISTERED PROFESSIONAL ENGINEER
NO. 162291
BRADFORD E. PRICE
7/12/18
STATE OF UTAH

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Brandon D. Horrocks, P.E.

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MINING-INDUCED SEISMICITY

Skyline Flat Canyon Mining Lease

Boulger and Electric Lake Dams & Reservoirs

Sanpete and Emery County, Utah

Prepared for:
Canyon Fuel Company, LLC

June 2018

RB&G ENGINEERING, INC.

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SKYLINE FLAT CANYON MINING LEASE
MINING-INDUCED SEISMICITY

BOULGER AND ELECTRIC LAKE
DAMS & RESERVOIRS
SANPETE AND EMERY COUNTY, UTAH

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DIRECT SHEAR TESTS
STABILITY ANALYSES
SEISMIC DEFORMATION ANALYSES

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SKYLINE FLAT CANYON MINING LEASE MINING-INDUCED SEISMICITY

BOULGER AND ELECTRIC LAKE DAMS & RESERVOIRS SANPETE AND EMERY COUNTY, UTAH

1 INTRODUCTION

Canyon Fuel Company, LLC, a subsidiary of Bowie Resource Holdings, LLC, contracted with RB&G Engineering, Inc. to evaluate the potential impacts to Boulger and Electric Lake dams and reservoirs from mining-induced seismicity (MIS) relating to mining associated with the Skyline Mine Flat Iron Canyon mining lease.

The evaluation included a review of the geologic setting, previous seismic activity in the area, dam and reservoir construction, and previous dam safety studies. Field and laboratory investigations have been performed at Boulger Dam, and instrumentation has been installed. Anticipated ground motions were evaluated based on regional historical seismicity and site-specific conditions. Using the data obtained, embankment slope stability and deformation analyses have been performed for Boulger Dam, along with an evaluation of the potential for (1) internal erosion of embankment materials, (2) increased reservoir seepage, and (3) landslide activity along the perimeter of the reservoir.

The project area is shown on the vicinity map in Figure 1. It will be noted that the Boulger Dam and Reservoir is located in Sanpete County Utah and is within the Wasatch Plateau geologic region. Boulger Dam is about 10 miles east of Fairview, Utah and about 25 miles northwest of Huntington, Utah. The reservoir is owned and maintained by the U.S. Forest Service. The dam is located in Section 33, Township 13 South, Range 6 East, Salt Lake Base and Meridian. Records available from the Dam Safety Section of the Utah Division of Water Rights indicates that the earth dam embankment was completed in 1937, and that the dam has a structural height of 17 feet, hydraulic height of 13 feet, a crest length of 274 feet, a crest width of 15 feet, and a reservoir

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storage capacity at the spillway crest elevation of 30-acre feet. It is our understanding that a recent survey performed by a Utah licensed surveyor shows the reservoir capacity to be just over 19 acre-feet. The reservoir does not have a low-level outlet and is primarily used as a fishing pond. A toe drain was installed near the downstream toe of the dam in 1994 at the same time the existing spillway was constructed.

Boulger Dam is about one mile west of the upper end of Electric Lake Reservoir. Electric Lake Dam is owned and maintained by PacificCorp. The dam is located in Huntington Canyon, Emery County, and is about 4 miles southeast of Boulger Dam in Section 17, Township 14 South, Range 6 East, Salt Lake Base and Meridian. Based upon the information contained in the Utah State Dam Safety database, the earthen dam was completed in 1974, has a structural height of 229 feet, a hydraulic height of 217 feet, a crest length of 920 feet, a crest width of 30 feet, and stores 31,500-acre feet at the spillway crest elevation.

1.1 PLANNED MINING

A map of the planned mining activity that was provided to us during this study is shown on Figure 2. The proposed mining plan is for an area referred to as the "Flat Canyon Coal Lease". The planned mining will be adjacent to Electric Lake Reservoir but will be at least 2 miles (horizontal distance) from the Electric Lake Dam. The planned mining will be adjacent to the Boulger Dam on the north, east, and south sides, and the horizontal distances from these planned mining panels will be 402, 697, and 746 feet, respectively (Canyon Fuel Company Memorandum, April 17, 2017). Within the immediate vicinity of Boulger Dam, it is anticipated that the mining will be performed at depths between about 1,100 and 1,200 feet below the ground surface.

We understand that consideration is being given to extending the mining operations beneath Boulger Dam. The discussion throughout the majority of this report assumes that mining will be as described in the previous paragraph, and will not be directly beneath the dam. Considerations for mining activity closer to Boulger Dam than described above are discussed in Section 6.4 and Section 8 of this report.

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2 GEOLOGY AND SITE CONDITIONS

2.1 REGIONAL GEOLOGY

The study area is located within the Wasatch Plateau region of the Basin and Range Colorado Plateau Transition Physiographic Province. The Wasatch Plateau is capped entirely by sedimentary rocks. The area is bounded on the west by the Sanpete - Sevier Valley region, and by

the Mancos Shale region on the east. The north end of the plateau is marked by the Price and Spanish Fork Rivers, and the southern margin is Ivy Creek and the Salina Canyon.

The Wasatch Plateau has been incised by numerous creeks which flow through canyons which have, in part, been carved by Pleistocene glacial activity and contain various glacial moraine deposits. Erosion of the Plateau is occurring predominately to the east and west. A large portion of the summit of the plateau is protected by a thin layer of resistant limestone of the Flagstaff Limestone Formation, and the North Horn Formation. The Flagstaff Limestone was deposited during the Eocene to Paleocene Epochs of the Tertiary Period between 55 and 66 million years ago. The North Horn Formation is slightly older (Paleocene to Upper Cretaceous). The western side of the plateau is marked by the Wasatch Monocline. Joes Valley is a prominent feature of the plateau. It consists of a long straight down dropped graben which trends from the northwest down to the southeast end of the plateau (Stokes,1986).

2.2 SITE GEOLOGY

Boulger Dam and Reservoir are located within Boulger Canyon. The deposits within the canyon bottom consist of Holocene age alluvium (Qal), which is bounded on either side by Quaternary, Pleistocene age glacial deposits (Qm), as shown on the geologic maps in Figures 3 and 3a. Figure 3a is a closeup of the geologic map surrounding Boulger Reservoir. The glacial deposits are located in the bottom of the wash along with the younger alluvium. A description of the units is shown on Figure 3b. Bedrock in the area consists of Cretaceous age sedimentary rocks which dip down to the west between 3 and 8 degrees. As shown on Figures 3 and 3a, bedrock around the reservoir is mapped as the Blackhawk Formation (Kbh) which consists of sandstone, shaly siltstone, shale, carbonaceous shale and coal. The lower part of the formation has many thin and thick coal seams. A major coal zone is located near the base of the formation where it overlies the Star Point Sandstone. Above the Blackhawk Formation is the Castlegate Sandstone, then the Price River Formation, which is topped by the North Horn Formation. Various geologic maps of the area show some minor landslide deposits in Boulger Canyon, but no slide deposits are mapped at or near the dam.

Electric Lake Dam and Reservoir are located within Upper Huntington Canyon, and are east and southeast of Boulger Dam. The Electric Lake Dam is located about 3.8 miles southeast of Boulger Dam. A geologic map of the area shows the dam to be located on the Blackhawk Formation (Kbh) (Upper Cretaceous) as shown on Figure 3. This is the same formation that underlies the alluvial deposits at Boulger Dam. Other maps of the area show numerous springs and possible landslide deposits along the east side of Upper Huntington Canyon and Electric Lake. The increased number

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of springs and slides along the east side of the canyon is likely due to the westerly dip of the bedrock down toward the canyon.

2.3 GEOLOGIC HAZARDS

Published and non-published geologic hazard information for the area have been reviewed during this study. The review included maps of Soil and Rock Causing Engineering Geologic Problems in Utah, The Landslide Map of Utah, UGS Quaternary Fault and Fold map, Nephi 30x60 Quadrangle Landslide map, and several other non-published maps. Based on the data reviewed, there are no mapped landslide or surface fault rupture hazards within the immediate area of the Boulger Dam and Reservoir.

While there are no landslide deposits mapped within the immediate area of the Boulger reservoir, up the canyon to the southwest approximately 1.1 miles is a deposit that has been mapped on the Nephi 30x60 Landslide map as a "*Landslide and/or landslide undifferentiated from talus, colluvial, rock-fall, glacial, and soil-creep deposits. May include deep or shallow landslides mapped with talus, colluvial, rock-fall, glacial, and/or soil-creep deposits.*" The Landslide Map also shows other potential landslide areas farther up the canyon, as shown on Figure 5. These areas may be mapped as slides because they are glacial deposits, and glacial deposits were not differentiated from landslides, as steep glacial deposits may be prone to instability. It should be noted that these deposits are in an area where the canyon is much narrower and steeper compared to the immediate vicinity of Boulger Dam. Where the reservoir is located, the topography is significantly less steep and more open. While the mapped landslides, or potential slides, do not pose any risk to the dam, movement of a slide upstream of the reservoir, due to natural movement or caused by mining induced seismicity, could interrupt or block the stream coming into the reservoir.

Upper Huntington Canyon is less than a mile east of the Boulger Dam. Much of the east side of the canyon, near the upper end of Electric Lake, is mapped as Deep or Unclassified Landslide deposits, as shown on Figure 5. A letter from Canyon Fuel discussing "Subsidence Effects - Boulger Reservoir" (Craig Brown to DOGM, April 21, 2017) mentions that the surface survey points located above the previous mined area "12LB" are located on an actively slumping hillside with movement pre-dating mining. They mention that there are similar slide features throughout the Upper Huntington drainage in areas absent of mining. Natural or MIS slide movement could potentially disrupt or block the drainage of Upper Huntington Creek into Electric Lake; however, the planned mining being considered during this study, which is on the west side of the canyon, is not significantly closer to these mapped slides compared to mining which has already been

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completed beneath the eastern side of the canyon. It is our understanding that past mining has not induced unacceptable movement of these slide areas; therefore, the probability that unacceptable movement of these slides will occur as a result of the planned future mining is reduced.

The Nephi 30x60 landslide quadrangle map also shows landslide deposits classified as "Deep or Unclassified Landslide" at the right abutment of Electric Lake Dam as shown on Figure 4. The past experience with mining in the area and the distance of the planned mining from the Electric Lake Dam result in a low potential that the mining will adversely affect the mapped landslide near the Electric Lake Dam right abutment.

There are several inactive faults mapped in the area of Electric Lake Dam. The nearest potentially active fault is the east trace of the Joes Valley Fault Zone. The far northern trace of the fault is located only 0.55 miles west of the dam. The Joes Valley Fault is a relatively large fault zone and may be capable of generating a seismic event with a magnitude greater than 7.0. The locations of the mapped faults in the project area considered to be potentially active are shown in Figure 4.

The closest mapped fault to Boulger Dam which is considered potentially active is a trace of the Gooseberry Graben faults, which is about 2.7 miles west of the dam.

2.4 GEOLOGY OF PLANNED MINING ACTIVITY

Based on maps and information provided by the mine, mining in this area is done by retreating longwall panels. The coal seam being mined is the Lower O'Connor B seam of the Blackhawk Formation. The Blackhawk Formation was deposited during the Upper Cretaceous and consists predominantly of light-brown, locally light-gray, thin- to medium-bedded, fine- to medium-grained quartzose sandstone, interlayered with shaly siltstone, shale, carbonaceous shale, and several coal seams. In this area, maps show the Blackhawk Formation to be bounded by the Castlegate Sandstone Formation above, with the Starpoint Sandtone below (Witkind, Weiss, 1991).

It is our understanding that the coal seam within the area previously mined to the east ranged from about 8.5 to 10 feet thick. It has been reported to us that the coal seam to be mined is expected to be 9 to 14 feet thick within the Flat Canyon Coal Lease area proposed mining. Based on the geologic map and a contour map of the projected top of the coal provided by Skyline Mine, bedrock and the coal appear to be dipping down to the west at about 3 to 8 degrees with a strike at about north-south. Due to this westerly dip, the top of coal seam in the Blackhawk Formation passes

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beneath the dam at an elevation of about 7,650 feet (MSL) and drops down to about elevation 7,610 feet at the west end of the reservoir, assuming a 3-degree dip.

3 SEISMIC HISTORY AND MINING INDUCED SEISMICITY

The Boulger and Electric Lake dams are subject to seismic shaking resulting from naturally occurring fault activity. During historic times the largest naturally occurring seismic event in the general region occurred on August 14, 1988, when an earthquake with a magnitude of 5.2 was recorded in Emery County. The epicenter was about 30 miles south of Price and about 40 miles southeast of Boulger Dam. The event, which is believed to have occurred on a hidden, unmapped fault, caused numerous rockfalls in central eastern Utah.

Using probalistic methods, naturally occurring earthquakes with Peak Ground Accelerations (PGA) between 0.34 and 0.36g have return intervals of 5,000 years at the Boulger and Electric Lake dams. Past deterministic studies of the Electric Lake Dam have estimated that a maximum credible earthquake at Electric Lake may have a PGA value of 0.76g (URS, 2014).

The faults within the area of the planned mining are shown on Figure 2. The mine plan shows several east and west dipping normal faults within the area of mining, with down dropped offsets between 10 and 400 feet. The largest offset is in the southwest corner where the Gooseberry Graben fault offset is 300 to 400 feet. As mentioned previously the Gooseberry Graben faults are considered potentially active.

Numerous factors influence the seismicity associated with longwall mining, including the lithology and characteristics of bedrock above and below the coal seam, the strength and thickness of the coal seam, and the depth of cover above the seam. Also, the mining methods used may influence the MIS, including extraction rates, the width and placement of panels and pillars, the time between the mining activity and the collapse of the mine roof, and the amount of mine roof that collapses at a given time.

A joint agency study by members of the University of Utah Seismograph Stations, U.S. Bureau of Reclamation Seismotectonics and Geophysics Group, University of Utah Department of Mining Engineering, and the U.S. Geological Survey was conducted on the potential ground motion shaking hazards at Joes Valley Dam due to the MIS in the Cottonwood Coal Tract at Trail Mountain Mine (Arabasz etal, 2002, 2005). The Trail Mountain mine location is located less the

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25 miles south of Skyline Mine. Although these studies were specifically for the Trail Mountain-Joes Valley Reservoir area, much of the information gathered was taken from an overall study of the geologic conditions and MIS in the Wasatch Plateau and Book Cliffs (WP-BC) mining region. While the overall mining region is about 50 miles wide, the general geologic conditions and bedrock formations are similar. Information gathered during these previous detailed studies have been applied to this Boulger and Electric Lake Dams study where appropriate.

3.1 MINING INDUCED EARTHQUAKE MAGNITUDE

In assessing the potential earthquake magnitude that may occur within the study area as a result of MIS we have considered historical earthquake data from three principal areas within the WP-BC mining region. These areas are the Skyline Mine, Willow Creek Mine, and Trail Mountain Mine.

3.1.1 SKYLINE MINE

For this study, we have obtained seismic information available from the University of Utah Seismograph Stations (UUSS) and have evaluated the seismic history of the area from 1962 through September 2017. Figure 6 shows the recorded earthquakes and magnitude ranges within about a 50-mile radius of Boulger and Electric Lake. This area extends from Utah Valley on the west to Price and San Raffle Swell areas to east. The largest seismic event shown, which was discussed in the previous section of this report, was a magnitude 5.2 (5.17-5.3) event which occurred southeast of Castle Dale in 1988. This event was regarded as a natural seismic event on a hidden fault, and not an MIS event. It should be noted from the figure that many of the large clusters of events in the southeastern quadrant are likely mining related.

Figure 7 shows past seismic events within about a 9.5-mile radius of Boulger Dam. Within the area shown in the figure, there have been 2,051 seismic events recorded between 1962 and September, 2017. The events ranged in magnitude from about 0.25 to 3.45, with an average of 1.76 and a mode of 1.63. This figure also shows the number of events reported within each magnitude category. The majority (1,477) of the events had magnitudes between 1.0 and 1.9. Within the studied time range, 536 events were recorded with magnitudes between 2.0 to 2.9, and 3 events were recorded with magnitudes between 3.0 and 3.9. The largest event shown is a magnitude 3.45 located about 9.5 miles west of the dam near Oak Creek and Fairview (10/9/87, depth: 0.65 km). This event does not appear to be related to the Skyline Mine. The largest seismic event recorded directly within the area of mining was a magnitude 2.94 on March 24, 1993 at a depth 0.47 km. The second largest event had a magnitude 2.92 on May 25, 1995 (depth 1.16 km).

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These may have been MIS events. The events shown in the southeastern region of Figure 6 may be related to MIS associated with the Deer Creek Mine.

Figure 8 shows the number of events recorded per year from 1962 to September of 2017. It will be noted that there were relatively few seismic events reported between 1962 and 1987, and there were a large number of events recorded between 1993 and 1996, with over 380 events in 1995. Since 1997, there have been less than 100 seismic events recorded per year.

Figure 9 illustrates the magnitudes of all of the events within about 9.5 miles of Boulger Dam that were recorded between 1962 and 2017.

Based on Figure 2, the nearest that mining has previously come to Boulger Dam was in September of 2003. At that time, the Skyline Mine operations were taking place about a mile east to northeast of Boulger Dam. The Flat Canyon lease proposes mining within about 400 feet of the dam, and the area to be mined extends 2.5 miles north and 1.5 miles south of the dam.

As shown on Figure 2, and from information taken from Table 2 of a Subsidence Effects Memorandum (April 21, 2017), operations will come within a horizontal surface distance of 402 feet north of the dam, 697 feet to the east, and 746 feet to the south of the dam. The coal seam in this proposed area is estimated between 9 and 14 feet thick (personal communication, Gregg Galecki). The amount of overburden above the coal varies somewhat for each of these panels. Both the northern and southern panels have approximately 1,200 feet of overburden, while the panel to the east the dam would have about 1,100 feet of cover. Figures 10a, 10b and 10c show generalized cross-section views of the distances between Boulger Dam and the proposed mining.

3.1.2 Willow Creek Mine

The Willow Creek Mine is located approximately 20 miles east-northeast of Boulger Dam. A magnitude 4.2 seismic event was recorded in March 2000 near the Willow Creek Mine. While some uncertainty exists as to the source of this event, the 4.2 earthquake is currently considered the maximum mining-induced magnitude that has been documented by instruments in Utah since 1962 (Arabasz et al. 2002, 2005).

3.1.3 Trail Mountain Mine

The Trail Mountain Mine is located about 23 miles south of Boulger Dam. This area was the subject of detailed seismic analysis by McGarr and Fletcher (2005), Arabasz et al. (2002, 2005) and others to assess potential hazards at Joe's Valley Dam induced by mining in the Cottonwood Tract.

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Arabasz et al. (2002, 2005) assessed the probable maximum magnitude earthquake for mining-induced seismicity in the Joe's Valley/Trail Mountain area. With consideration of topography, depth of cover, tectonic structures, potential mining methods, and historical mining-induced seismicity data, the authors developed an "informed consensus" probability distribution. The distribution employed upper and lower bounds of 4.6 and 2.7, respectively, with a mode of 3.1. The upper bound of 4.6 allowed for the possibility of a 4.2 event similar to the Willow Creek event, plus some necessary conservatism due to uncertainties regarding that event. For engineering analysis, the researchers proposed using the 84th percentile value of the cumulative distribution function, which corresponds to a probable maximum magnitude of 3.9.

3.1.4 MIS Design Parameters

In 2004-2005, while working on a previous MIS study for Grassy Trail Reservoir/West Ridge Mine in the Book Cliffs area, Dr. Arabasz (Arabasz and Burlacu 2004) had suggested that a probability study for the Grassy Trail/West Ridge Mine area would likely employ the same lower and upper bounds and mode as the Joe's Valley/Trail Mountain study, and would likely arrive at virtually the same conclusion. They indicated that, in general, mines within the Wasatch Plateau and Book Cliffs region would have similar parameters as the Trail Mountain study. With Boulger Dam and Electric Lake being located significantly closer to Trail Mountain, the study would be even more appropriate for these facilities. Based on these considerations, we have used 3.9 as the probable maximum magnitude (PMM) earthquake for engineering analysis relating to MIS.

It should be emphasized that the probable maximum 3.9 magnitude represents the largest anticipated event based on an "informed consensus" probability distribution, and that recorded MIS events in the vicinity of Boulger and Electric Lake Reservoirs have historically had much lesser magnitudes. As discussed previously, the largest recorded magnitude in the Skyline mine area was 2.94. The magnitude 2.94 event in 1993 had a source depth of about 0.47 km. Earthquake magnitudes are measured on a base-ten logarithmic scale, meaning that each whole-number increase in magnitude indicates a tenfold increase in amplitude. As an estimate of energy, each whole-number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole-number value. Therefore, the event 3.9 magnitude event used for analysis during this study has about 30 times more energy than the 2.94 magnitude event previously recorded.

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3.2 PEAK GROUND ACCELERATION

While many empirical ground motion attenuation relationships exist, most of these were developed primarily from event magnitudes greater than 4.0 and based on ground accelerations recorded at distances greater than 1 km (0.62 miles) from the seismic source. For the relatively low magnitudes and small hypocentral distances involved in this study, the available relationships result in widely varying predicted PGA values. Noting that existing prediction equations (NGA-West) were unsuitable for low-magnitude, near-source events, McGarr and Fletcher (2005) revised the general ground motion equation to fit mining-induced seismicity in the Joe's Valley/Trail Mountain area. The regression considered seismic data recorded near Trail Mountain, along with the magnitude 4.2 event recorded at Willow Creek.

McGarr and Fletcher noted a good correlation between their new PGA relationship and both the SEA '99 (Spudich et al. 1999) and the Joyner-Boore (1993) equations for a magnitude 4.0 event at distances less than 1 km (0.62 miles). For a consistent comparison at close distances, McGarr and Fletcher used the hypocentral distance for the distance parameter in all of the equations, acknowledging that the SEA'99 and Joyner-Boore relationships were not intended for direct use of hypocentral distances. The attenuation relationship to estimate site PGA developed by McGarr and Fletcher is:

$$\log y = -0.9892 + 0.8824M - 1.355 \log R - 0.1363R + s$$

Where: y = PGA (cm/sec^2)
M = Earthquake magnitude
R = Hypocentral site to source distance (km)
s = site factor

For the study completed by McGarr and Fletcher, an s value of 0.337 was used in the attenuation relationship. During our study of the MIS at Grassy Trail Dam, mining was performed as close as about 1,900 feet from the dam. Accelerometers on the dam and near the dam recorded more than 1,500 events which appeared to be related to MIS. University of Utah seismic instruments near the study area recorded more than 300 events during the monitoring period with magnitudes between 1.1 and 2.6. During our study, it was observed that the accelerations predicted by the above equation using an s value of 0.337 underestimated the accelerations recorded. Analysis of the records indicated that an s value of 1.0 resulted in predicted accelerations closer to recorded accelerations at that site for the events recorded.

The methods developed by McGarr and Fletcher have been used to estimate PGA values which may occur at Electric Lake and Boulger dams as a result of MIS. For the Electric Lake Dam, we have estimated that the hypocentral distance from the nearest planned mining to the dam will be

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about 3.8 km (2.36 miles). Using the described attenuation relationship, the predicted PGA values would be 0.03 and 0.14g for s values of 0.337 and 1.0, respectively.

PGA values significantly greater than those calculated for Electric Lake Dam are possible at Boulger Dam due to the shorter hypocentral distance. Potential accelerations calculated for various event magnitudes and distances are shown in Figure 11. The figure shows that the maximum considered event of magnitude 3.9, at the minimum considered hypocentral distance of 0.357 km (1,171 feet) from the dam for the planned North Panel may result in a PGA of about 2.27g at the dam, assuming an s value of 0.337 in the attenuation relationship.

The actual peak ground accelerations which may occur at the Electric Lake and Boulger dams may be significantly different from the values described above. As illustrated on Figure 11, the attenuation relationship is somewhat sensitive to the event magnitude, and predicted PGA values increase substantially for site to source distances less than about 1 km (0.62 miles). MIS events with magnitudes no greater than 3.0 would not be expected to produce ground accelerations greater than 0.36g assuming an s value of 0.337 as being representative of the Boulger Dam site; however, PGA values as high as about 1.7g may occur during a magnitude 3.0 event if site conditions are better represented by an s value of 1.0. If the attenuation relationship is used to consider a magnitude 3.9 event with a hypocentral distance of 0.357 km (0.222 miles) from the dam and a site s factor of 1.0, the predicted PGA would be 10.4g. We believe it is highly unlikely that an MIS event will produce ground accelerations greater than about 2g at Boulger Dam. We also believe it is unlikely that the planned mining activity will result in ground accelerations greater than 0.1g at Electric Lake Dam.

4 FIELD AND LABORATORY TESTING PROCEDURES

Subsurface investigations were completed at Boulger Dam to obtain information for evaluation of the dam. The subsurface investigation was performed using a CME 55 rotary drill rig with hollow stem auger used to advance the boring. During the subsurface investigation, sampling was performed at three- to five-foot intervals throughout the depth investigated. Disturbed samples were obtained by driving a 2.5-inch O.D. split spoon sampling tube through a distance of 18 inches using a 140-pound weight dropped from a height of 30 inches. The number of blows required to drive the sampling spoon through each 6 inches of penetration is shown on the boring logs, which are provided in the appendix. The sum of the last two blow counts, which represents the number of blows to drive the sampling spoon through 12 inches, is defined as the standard penetration

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value. The standard penetration value, corrected for overburden and hammer energy, provides a good indication of the in-place density of sandy material; however, it only provides an indication of the relative stiffness of the cohesive material, since the penetration resistance of materials of this type is a function of the moisture content. The corrected blow counts are shown on the boring logs as the $(N_1)_{60}$ values. Considerable care must be exercised in interpreting the standard penetration value in gravelly-type soils, particularly where the size of the granular particle exceeds the inside diameter of the sampling spoon. If the spoon can be driven through the full 18 inches with a reasonable sample recovery, the standard penetration value provides a good indication of the in-place density of gravelly-type material.

It will be noted from the boring logs that the sampling spoon was not driven through the full 18 inches at some sampling locations due to the excessive number of blows required to advance the sampling spoon. Where the sampling tube was not be driven through the full 18 inches, the number of blows to drive the spoon through a given depth of penetration is shown on the boring logs.

Miniature vane shear tests, which provide an indication of the undrained shearing strength of cohesive materials, were performed on samples of clayey soil during the field investigations. The results of these tests are shown on the boring logs as the torvane value in tsf.

Each sample obtained in the field was classified in the laboratory according to the Unified Soil Classification System. The symbol designating the soil type according to this system is shown on the boring logs. A description of the Unified Soil Classification System is presented in the appendix, and the meaning of the various symbols, shown on the logs, can be obtained from this figure.

Piezometers were installed in each of the boring holes. Graphics illustrating the piezometer installations are included in Figure 14.

Laboratory tests performed during this investigation to define the characteristics of the subsurface material at the site included in-place dry unit weight, natural moisture content, Atterberg Limits, mechanical analyses, unconfined compressive strength, unconsolidated undrained triaxial shear, and direct shear tests. The results of the laboratory tests are provided in the appendix. Testing was performed following procedures outlined in the American Society for Testing and Materials (ASTM) standards.

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Survey monuments were installed at three locations across the crest of the dam and at three other locations along the reservoir shore near the high-water level. The locations of the survey monuments are shown on Figure 13.

5 SUBSURFACE SOIL AND WATER CONDITIONS

The locations of the borings completed at Boulger Dam are shown on Figure 12. Each of the borings are identified with the prefix "17" to indicate the year drilling was completed. Borings 17-1 and 17-3 were drilled near the left and right abutments of the dam, respectively. Boring 17-2 was drilled through the embankment near the maximum section of the dam. The boring logs are included in the appendix.

The embankment materials encountered during the subsurface investigations were classified as silty sand (SM) or silty clayey sand (SC-SM). Laboratory classification tests were performed on five samples obtained from the existing embankment. The samples had natural moisture contents between 6.1 and 12.5%, and had 14 to 31% gravel, 38 to 50% sand, and 31 to 43% fines passing a No. 200 sieve. The minus No. 40 sieve portion of two of the samples tests were non-plastic, and the other three had liquid limits between 19 and 21 and plasticity indexes between 3 and 5. Based upon the results of the standard penetration tests performed during the subsurface investigations, the existing embankment materials appear to be relatively dense and well compacted

The dry density of two intact silty sand embankment samples obtained from Boring 17-2 was measured in the laboratory. These samples had dry unit weights of 123.5 and 133.4 pcf. Direct shear tests were also performed on these materials. In order to estimate the strength characteristics of these embankment materials, the samples tested in direct shear were remolded to dry densities similar to the measured densities of the intact samples. The tests resulted in measured internal friction angles of 37.0 and 37.2 degrees with 3 and 1 psi cohesion, respectively.

The native soil materials encountered beneath the embankment at the boring locations predominantly classified as silty or clayey sand. Gravel size particles were present within the sandy soils in varying amounts. Laboratory classification tests were performed on nine samples of the native sandy and gravelly material. These samples had natural moisture contents between 10.0 and 22.9%, and had 9 to 42% gravel, 33 to 61% sand, and 20 to 47% fines passing a No. 200 sieve. The minus No. 40 fraction of four of these samples was non-plastic, and the other five samples had liquid limits between 17 and 25 and plastic indexes between 3 and 11.

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At the time of the field investigations, the reservoir was filled to the spillway elevation, which is about elevation 8746 feet. The groundwater level was measured between 10 and 17 feet below the ground surface in Borings 17-2 and 17-3 during the field investigations. These ground water level measurements correspond to elevations between 8734 and 8740 feet. The higher ground water level measurement was obtained from Boring 17-3, which was located near the spillway and right abutment of the dam.

6 ENGINEERING ANALYSES

Engineering analyses were performed for the Boulger Dam site. Due to the distance between the planned mining activity and the Electric Lake Dam, we do not expect that ground motions, subsidence, or other effects of mining activity will significantly impact Electric Lake Dam.

6.1 STATIC SLOPE STABILITY

Slope stability analyses were performed for the upstream and downstream slopes of the existing Boulger Dam embankment. The existing embankment geometry was obtained from topographical survey data of the dam and reservoir that was provided to us. Based upon the topographical information provided to us, the upstream embankment slope within the upper five vertical feet (freeboard of the existing dam) appears to be sloped between about 3.4H:1V and 4.2H:1V. Below this upper portion, the upstream slope of the embankment transitions to a slope of about 5H:1V. The downstream slope of the existing embankment has a slope of about 2.4H:1V.

Embankment and foundation material properties were estimated based upon the results of the field and laboratory testing. The strength parameters used for the static condition stability models are summarized below:

Material/Zone	Total Unit Weight (pcf)	Effective Stress Strengths	
		Drained Friction Angle (deg)	Drained Cohesion (psf)
Embankment	135	35	100
Foundation – Clayey Sand	130	28	200
Foundation – Silty Sand	130	34	0

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The phreatic surface assumed for the slope stability models was conservatively estimated. At the time of the field investigations (October 2017), the water level within Boring 17-2, which was drilled through the dam crest near the maximum section of the embankment, was measured at a depth of 16.9 feet. This measured water surface was about 4 feet below the elevation of the downstream dam toe. The reservoir was filled to the spillway elevation, about five feet below the dam crest, at the time of the investigations.

Slope stability calculations were performed using the computer program SLOPE/W. Factors of safety for potential failure surfaces were computed using Spencer's Method, which satisfies both force and moment equilibrium. Searches for critical circular failure surfaces were performed using a grid and radius approach. After the critical failure circle was selected, the program performed an optimization routine in which points on the circle were iteratively adjusted, which usually resulted in a factor of safety somewhat less than that of the critical circular surface. The computed factors of safety were compared to Utah State Dam Safety design requirements.

Condition	Required Minimum Factor of Safety	Slope	Assumed Reservoir Level	Calculated Factor of Safety
Static	1.5	Upstream	Full	3.83
Steady-State Seepage		Downstream	Full	2.17
Instantaneous Drawdown	1.2	Upstream	Full Drawdown	2.93

It will be noted from the table above that the computed factors of safety exceed the minimum required values for all static condition cases evaluated. Graphics illustrating each of the slope stability analyses performed for this study are included in the appendix of this report.

6.2 SEISMIC STABILITY AND DEFORMATION

Subsurface investigations encountered materials with high amounts of fines which demonstrated relatively little resistance during standard penetration tests. Of particular note are the soils encountered at depths of 35 and 40 feet in Boring 17-1 and at depths of 18 and 21 feet in Boring 17-2. Laboratory tests were performed on three samples obtained at these locations. These materials were classified as silty sand (SM), silty clayey sand (SC-SM) or clayey sand (SC). The samples tested in the laboratory had 36 to 46 percent plastic fines, and had moisture contents between 10.0 and 19.4%, which were 55 to 78% of the liquid limits determined by Atterberg tests. Due to the relatively high percentages of material passing the No. 200 sieve, the plasticity of the fines, the relatively low moisture contents in relation to the liquid limits, and the short duration

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expected for MIS events, strength loss of these soils due to liquefaction during a MIS event is unlikely.

An initial assessment of embankment seismic stability can be made by computing the yield acceleration of the embankment slopes and comparing the computed yield acceleration to the design seismic accelerations. The yield acceleration is the pseudo-static acceleration with a calculated factor of safety of 1.0 against slope failure. Studies have shown that dam embankments will not generally experience dangerously large deformations during a seismic event with a peak ground acceleration up to twice the yield acceleration (Hynes-Griffin and Franklin, 1984). Estimates of the anticipated deformation are generally required for conditions where the design peak ground acceleration exceeds twice the yield acceleration. Utah State Dam Safety also requires that seismic event embankment deformations be estimated for design seismic events with a peak ground acceleration greater than 0.35g.

Seismic condition slope stability analyses were performed using models similar to the static stability models discussed above. In order to account for the buildup of pore pressures within embankment and foundation materials, a $\bar{B}$ value was assigned within the stability models. The $\bar{B}$ function within the stability models increases the pore water pressure by an amount equal to the $\bar{B}$ value times the principal effective stress. $\bar{B}$ values of 0.05, 0.10, and 0.05 were assigned to the existing embankment, clayey sand foundation, and silty sand foundation layers, respectively. We consider these assigned $\bar{B}$ values to be conservative given the short duration for which MIS events generally occur.

Yield accelerations of 0.30 and 0.27g were computed for the upstream and downstream slopes, respectively. Minimal deformation of the Boulger Dam embankment would be expected to occur as a result of a naturally occurring earthquake having a return interval of 5,000 years and a peak ground acceleration of 0.34g; however, these yield accelerations are significantly less than the maximum acceleration which could occur at the site as a result of MIS.

Deformations of the Boulger Dam embankment that could occur as a result of a MIS event having a magnitude of 3.9 and PGA of 2.27g have been estimated using Newmark sliding block analyses. Dynamic parameters for the dam embankment and foundation zones, including shear moduli and damping ratios, were estimated using correlations (Seed and Idriss, 1970 or Vucetic and Dobry, 1988) with laboratory test results and general properties of the materials. The parameters assigned to each soil type are summarized below:

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Material	Shear Modulus and Damping Functions	Dynamic Soil Stiffness Model	K_G	G_{max} Independent of Depth (psf)
Existing Embankment	Seed & Idriss, avg. sand	f(effective stress)	61,000	n/a
Clayey Sand Foundation Soil	Vucetic & Dobry, PI = 15	Constant stiffness	n/a	1,650,000
Silty Sand Foundation Soil	Seed & Idriss, avg. sand	f(effective stress)	52,000	n/a

The K_G values listed above were used during the seismic modeling to determine the shear modulus of the granular embankment and foundation zones as a function of the average confining stress. The shear modulus was calculated using the following relationship proposed by Seed et at. (1986):

$$G = 1000(K_2)_{max}\,(\sigma'_m)^{1/2},$$

with $(K_2)_{max}$ constants specified 52 for medium dense to dense sandy foundation soils with a relative density in the order of 60 percent and 61 for dense embankment soils with a relative density in the order of 75 percent.

A constant G_{max} of 1,650,000 psf was assigned to the clayey foundation soils, assuming the soils have an undrained shear strength in the order of 1,500 psf. This value was estimated based on the relationship proposed by Weiler (1988):

$$G_{max} = 1{,}100S_u$$

The Newmark analyses were conducted for three historical earthquake time histories that were recorded at the Grassy Trail Dam, and had magnitudes between 1.7 and 2.6. These events had recorded PGA values between 0.235 and 0.348g. The 2D propagation of the ground shaking through the dam foundation and embankment was modeled in the finite-element computer program QUAKE/W by Geo-Slope International, which is commonly used for deformation analyses by the US Bureau of Reclamation (USBR, 2015). Initial stress conditions were established using a SIGMA/W finite element analysis.

Equivalent linear shear modulus and damping relationships were assigned to each embankment and foundation material type within the QUAKE/W models. From the results of the QUAKE/W analyses, acceleration time histories were taken from nodes near the upper, middle, and lower thirds of the critical failure surfaces for both the downstream and upstream embankment slopes. These time histories were then double integrated in an Excel spreadsheet to estimate the permanent

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deformation that would occur during moments that the acceleration at a given point exceeds the yield acceleration.

The time histories generated by QUAKE/W at the selected points along the critical failure surfaces were not significantly different than the input motions. The lack of amplification or damping indicated by the QUAKE/W model is likely due to the relatively small embankment height and the relatively stiff soil parameters modeled for the embankment and lower foundation zones.

Two of the earthquake events modeled had PGA values of about 0.24g. These events were recorded at the hillside adjacent to the Grassy Trail Dam on March 2, 2006 and March 24, 2006. These input motions did not amplify within the model above the calculated embankment yield accelerations, which were 0.27 and 0.30g; therefore, no permanent embankment deformation was calculated during analysis of these events. The third event modeled, which was recorded at the hillside adjacent to the Grassy Trail Dam on March 11, 2006, had a magnitude of 2.6 and PGA of 0.348g. Although the modeled accelerations exceeded the calculated yield accelerations during this analysis, the modeled length of time the yield accelerations were exceeded resulted in calculated embankment deformations less than 0.01 foot.

In order to estimate the embankment deformation which may occur as a result of a MIS event having a PGA of 2.27g, the 2.6M March 11, 2006 event was scaled to this design PGA value. Although the analyzed PGA value is much greater than the calculated yield accelerations, the calculated deformation after summing the computed upstream and downstream deformations was 0.04 feet. Graphs illustrating this Newmark analysis are included in the appendix of this report. It should be noted that earthquake events are not generally scaled by the magnitudes used for this analysis; and actual ground motions at Boulger Dam during an event having a magnitude of 3.9 and PGA of 2.27 may be significantly different than modeled; however, we believe it is unlikely that permanent embankment deformation more than 0.5 feet will occur as a result of MIS.

Considering the size of Boulger Dam, the small storage capacity of the reservoir, and the estimated deformation magnitudes, it is our opinion that deformation of the dam caused by MIS will not result in unacceptable embankment deformation.

6.3 SUBSIDENCE

Longwall mining activity has the potential to cause subsidence of the ground surface in the area above the mining. As the mine roof collapses, subsidence of the ground surface can occur. Based on correspondence from Canyon Fuel Company, we understand that subsidence is not generally expected in areas located outside a 22 degree angle from vertical projection from the mining

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activity. Based on this 22 degree angle of draw, for mining activity 1,100 to 1,200 feet below the ground surface, subsidence would not be expected at the ground surface for areas located more than 444 or 448 feet horizontally from the mining activity. We also understand that the projection from Boulger Dam to the nearest proposed mining north of the dam will be about 19 degrees, and that the projection from the nearest proposed mining on the east or south sides of the dam will be at least 32 degrees. Based upon this information, there appears to be very little risk that subsidence due to the proposed mining on the east and south sides of the dam will have any impact on the dam embankment; however, there is some risk that the dam will be within the subsidence zone of the proposed mining on the north side of the dam.

In a memorandum dated April 21, 2017 that was prepared by the Canyon Fuel Company, it is reported that past monitoring of subsidence zones have indicated angle of draw at the Skyline Mine between 9 and 23 degrees, with an average measured angle of draw of about 14.5 degrees. The memo also indicates that past angle of draw of 23 degrees that was reported may have been affected by natural slope movement. Excluding the 23 degree measurement, the next flattest reported angle of draw was 18 degrees.

Based upon the information available, we recommend that the survey points installed during this study be monitored regularly as the mining activity approaches the Boulger Dam and Reservoir. Regular monitoring of the area in the vicinity of the Flat Canyon Coal Lease area will provide information to better assess the potential impact to the Boulger Dam. We understand that no mining is planned within 4500 horizontal feet of the dam until the year 2020.

Due to the distance between Electric Lake Dam and the proposed mining activity, it is unlikely that subsidence will have any impact on the performance or operation of the dam.

6.4 Mining in Close Proximity to Boulger Dam

We understand that consideration is being given to modifying the mining plan illustrated on Figure 2, and that mining may extend beneath Boulger Dam. If mining extends beneath Boulger Dam, the potential PGA calculated using the methods described in Section 3.2 of this report increases from 2.27g to 2.37g. The deformation analyses described in Section 6.2 were repeated for this higher possible acceleration, and the deformation estimate was equivalent to the estimate calculated for a PGA value of 2.27g (0.02 ft for upstream and downstream slopes).

The potential for Boulger Dam to be affected by subsidence increases if mining operations are performed in closer proximity than discussed above in Section 6.3. For the conditions at the

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Boulger Dam site, which consist of a 9- to 14-foot thick coal seam 1100 to 1200 feet below the ground surface, we understand that surface subsidence up to 4.2 feet (0.3*coal seam thickness) is expected to occur within the angle of draw from the mining activity. If mining operations are to be performed that result in Boulger Dam being within the angle of draw, we recommend mitigation of the effects of subsidence be performed. In our opinion, subsidence poses the greatest potential for adverse effects of mining activity to the Boulger Dam.

Mining in close proximity to Boulger Dam has the potential to damage the structure due to differential ground displacements and cracking. For the subsidence estimates discussed above, we recommend that Boulger Reservoir be drained if mining is to occur in closer proximity to the dam than shown in Figure 2. An evaluation of the dam site should be completed after the mining and subsidence have occurred to determine the need for remedial action before refilling the reservoir.

It is anticipated that monitoring within the vicinity of the Flat Canyon Coal Lease area will be performed while mining activity is being performed at relatively far distances from Boulger Dam, and that the estimated effects of the mining activity in the area can be refined based upon the observations. If it can be demonstrated that subsidence at the Boulger Dam and Reservoir greater than two feet is unlikely, it is our opinion that the risk for an uncontrolled release of water from the dam can be adequately reduced provided that, prior to and during mining in close proximity to the reservoir, the reservoir level is controlled and an internal filter is installed within the dam embankment as illustrated in Figure 13. If this alternative is incorporated into the mining plan, we recommend the reservoir be maintained at an elevation below the dam crest at least twice the amount of estimated subsidence. For an estimated subsidence of 2 feet, we recommend the reservoir be maintained at an elevation at least 4 feet below the dam crest. The internal filter should be installed by excavating the downstream portion of the existing embankment, installing a filter blanket as illustrated in Figure 13, and then replacing the embankment materials. We recommend that the embankment be excavated on a 1.5H:1V (Horizontal:Vertical) slope, and that the vertical height of the filter zone adjacent to the existing embankment slope be at least equal to the amount of estimated subsidence. We also recommend that the filter zone be connected to the existing toe drain, as illustrated on Figure 13. We have estimated that installation of the filter within the dam embankment can be completed for a cost of about $150,000. The design of the dam modifications, including the filter zone, must be approved by the State Engineer prior to construction.

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7 INSTRUMENTATION

The UUSS has a seismograph station located about 3 miles east of the dam in the mountains above Electric Lake. It is reported to be located at Latitude 39.64° North, Longitude 111.20 ° West, and at an elevation of about 2970 meters (9,744 feet) above sea level. The sensor type is a Mark Products L-4c seismometer, with a 1 channel, short period sensor. This instrument has recently been brought online so the Webicorder data can now be viewed on the UUSS website as part of their "Live Seismograph Network". It is labeled with the initials ELU.

Skyline Mine installed an accelerometer on the Boulger Dam in October, 2017. The instrument installed on the dam is identified as Boulger Seismic Station ID 5516 and will provide continual monitoring.

Survey monuments were installed at three locations across the crest of the dam and at three other locations along the reservoir shore near the high-water level. The locations of the survey monuments are shown on Figure 14.

Piezometers were installed in each of the boring holes. Graphics illustrating the piezometer installations are included in Figure 15.

8 CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of this study, it does not appear that the proposed Flat Canyon Coal Lease mining will create unacceptable risk to the Electric Lake or Boulger dams. Mining-induced seismicity is expected to generate a maximum credible earthquake (MCE) event of 3.9, based on the Richter Scale. We conclude that peak ground accelerations will not exceed 2g at Boulger Dam and 0.1g at Electric Lake Dam. A computed deformation of 0.04 feet was determined for Boulger Dam, while zero deformation was determined for Electric Lake Dam. Due to the limitations of modeling, the estimate for Boulger Dam may be unconservative; however, we would consider an upper bound of 0.5 feet of deformation. This results in a factor of safety of 8 against overtopping due to deformation.

We recommend that monitoring of the dams be performed prior to and throughout the mining activity to measure the effects which may occur at the dam sites; to provide information relevant to future analyses which may be required; and to ensure the continued safe performance of the

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dams. We understand that Skyline Mine or the Owners of the dams will perform all dam inspections. We recommend that the inspection and monitoring schedule for Electric Lake Dam and Reservoir continue to follow the requirements of the Utah State Dam Safety Engineer. For Boulger Dam and Reservoir, we recommend that the inspection and monitoring schedule include the following when Flat Canyon Coal Lease mining is occurring:

- When mining is within one mile of reservoir - Monthly site reconnaissance to observe any change of conditions in the embankment crest or slopes. Particular attention should be given to cracking, seepage and or deformation. Electronic photographs at predetermined designated viewpoints.
- When mining is within one mile of reservoir - Monthly measurement of reservoir level and piezometers.
- When mining is within one mile of a ground motion monitoring device (accelerometer) - The recorded data should be downloaded and reviewed weekly. It is recommended that an accelerometer be installed above a panel of active mining where similar hypocentral distances will exist, compared to when panel mining approaches the reservoir
- If seepage areas exist or develop which do not have measurement devices, weirs should be installed to measure the seepage on a monthly basis.
- Annual survey of the dam and reservoir control points (elevation and horizontal).
- Daily monitoring of the UUSS list of recent seismic events whenever mining is within one mile of Boulger Dam or Reservoir. A daily record should be maintained of the recorded events within 5 miles of the site. The UUSS information can be obtained from: http://quake.utah.edu/earthquake-center/quake-map
- When an event greater than 3.0 occurs within 5 miles of the site, a site reconnaissance of the embankment crest, slopes and basin should be performed within 24 hours, including a review of the ground motion recordings. If recorded ground acceleration exceeds 0.1g on the dam, instrumentation readings should be performed.
- Site reconnaissance and instrumentation reports should be forwarded to RB&G Engineering and the Utah State Dam Safety Engineer with 24 hours, and the daily monitoring record should be submitted on a monthly basis.

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In addition to the recommendations provided in the bullet points above, we recommend the following, if mining activity is to be performed in closer proximity to the Boulger Dam than illustrated in Figure 2.

- Boulger Reservoir should be drained while mining closer to the dam than illustrated in Figure 2 until subsidence is complete. Alternatively, prior to mining activity closer to the dam than illustrated in Figure 2, the reservoir should be drawn down below the crest of the dam a distance twice the estimated subsidence, and the filter zone described in Section 6.4 should be installed.
- An evaluation of the dam site should be made after mining and subsidence to determine the need for remedial action. The evaluation should be submitted to Utah State Dam Safety for review and acceptance.

9 LIMITATIONS

The information contained in this report is provided for the specific location and purpose of the client named herein and is not intended or suitable for reuse by any other person or entity whether for the specified use, or for any other use. Any such unauthorized reuse, by any other party is at that party's sole risk and RB&G Engineering, Inc. does not accept any liability or responsibility for its use.

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FIGURES

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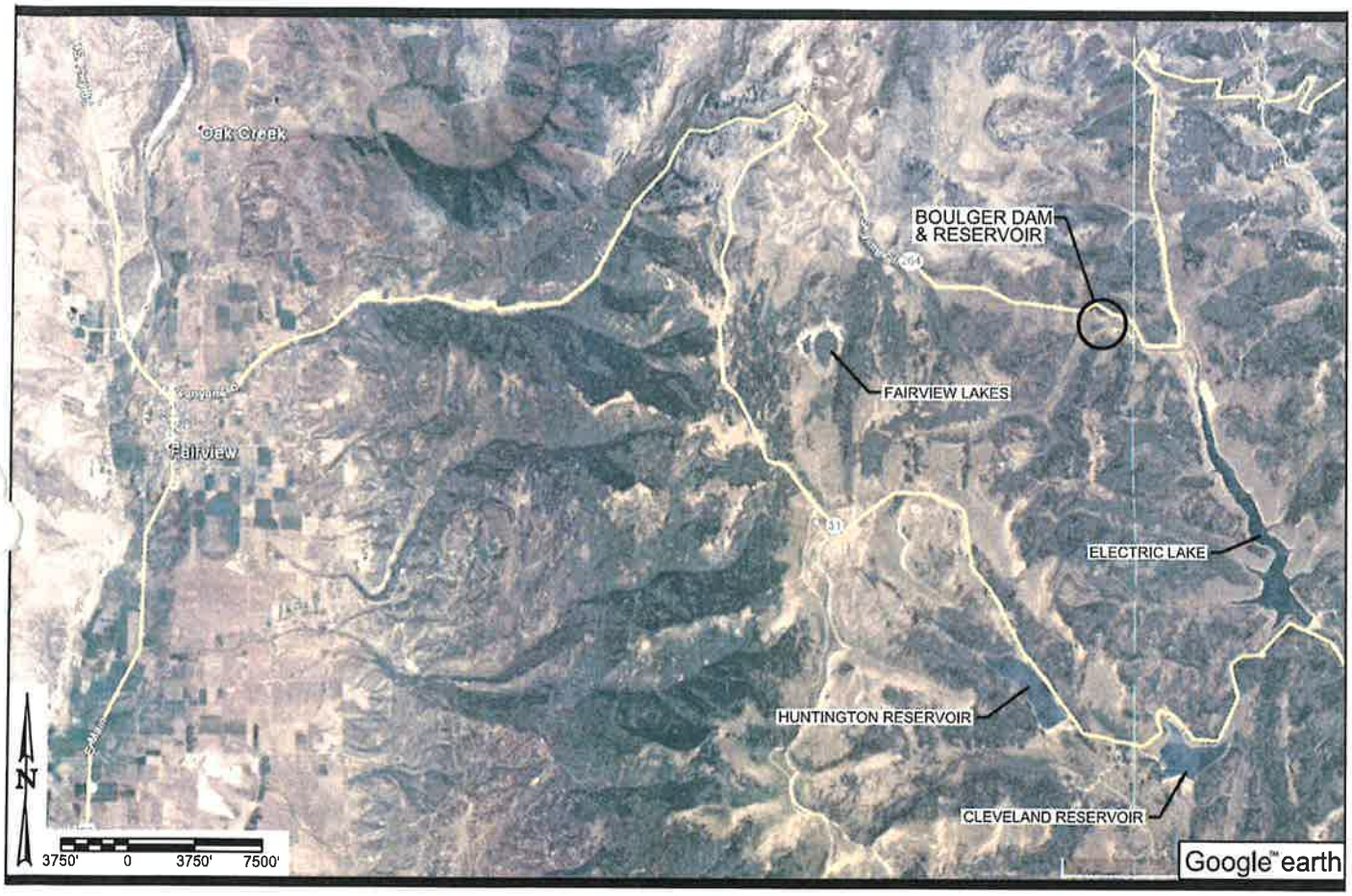

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Figure 1 VICINITY MAP

Skyline Flat Canyon Mining Lease Mining-Induced Seismicity

Sanpete & Emery Counties, Utah

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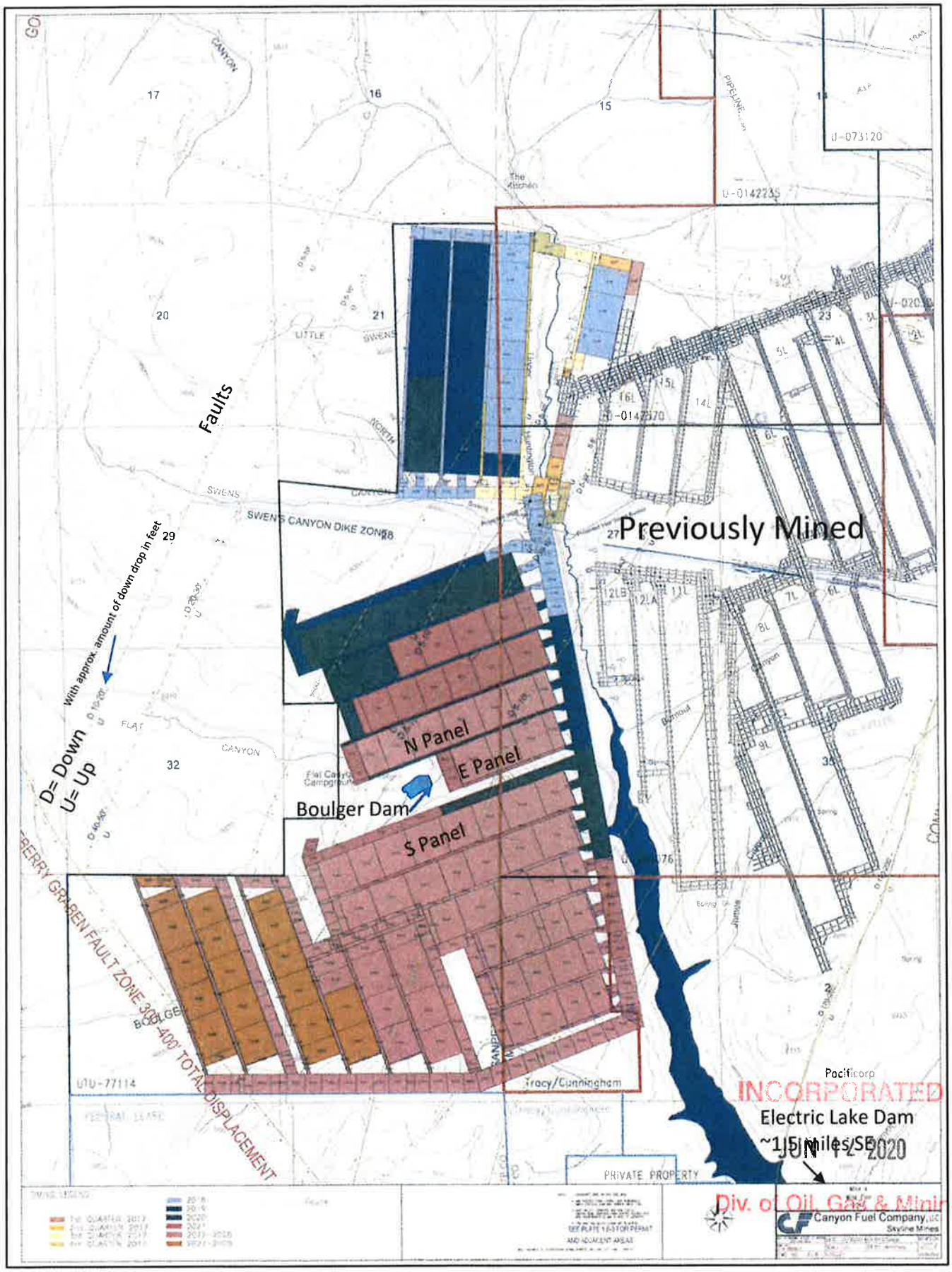

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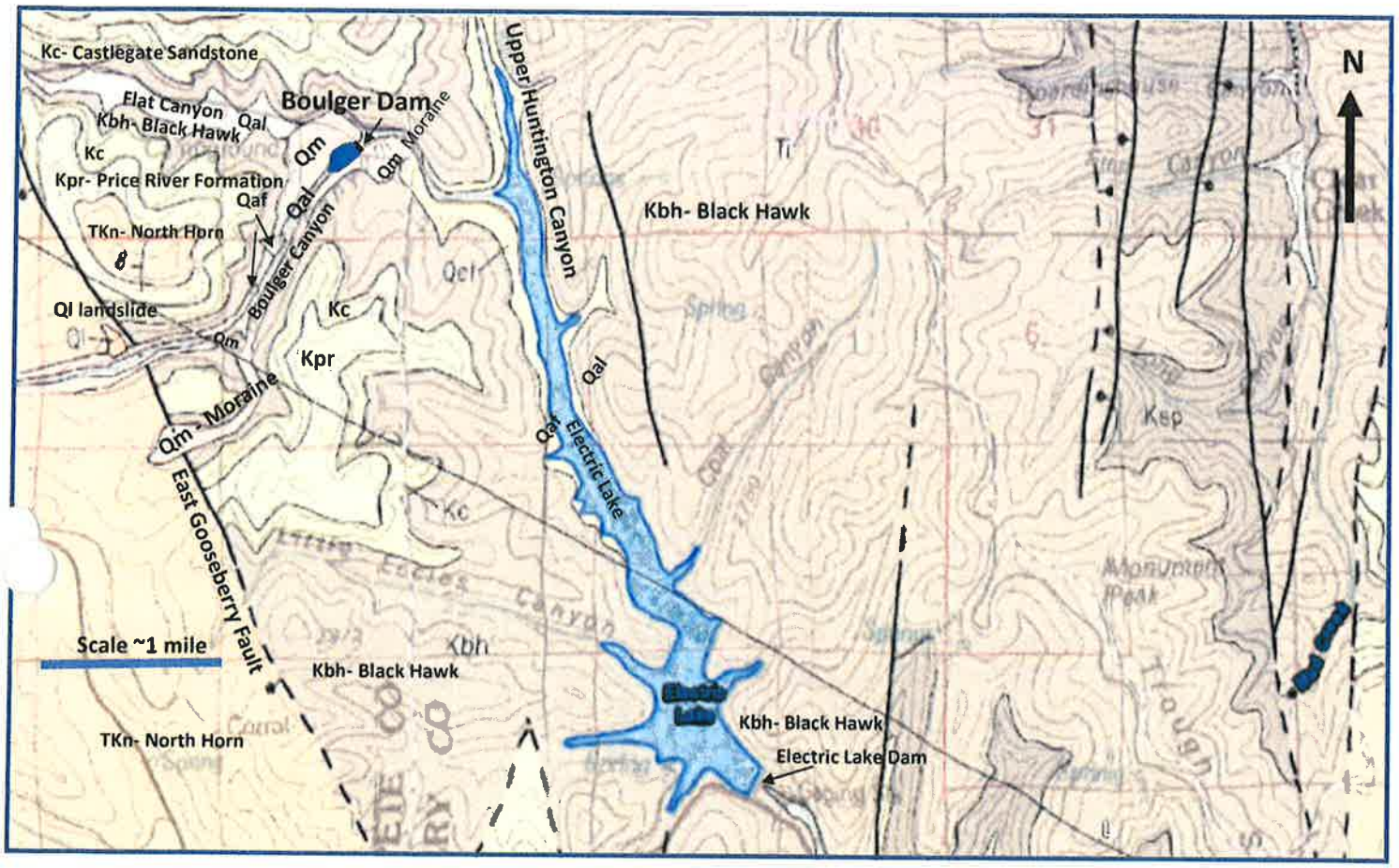
Figure 2 Mine Plan (3.1.8-3)
Project Skyline Flat Canyon Mining Lease Mining Induced Seismicity
Location Sanpete County, Utah



Taken and modified from
Geologic map of the Nephi 30'x60' quadrangle, Carbon, Emery, Juab, Sanpete, Utah and Wasatch Counties, Utah: Utah, Geological Survey, Witkind and Weiss, 1991, Map 189, scale 1:100,000

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Figure 3
Project Location

Site Geologic Map
Skyline Flat Canyon Mining Lease Mining Induced Seismicity
Sanpete County, Utah

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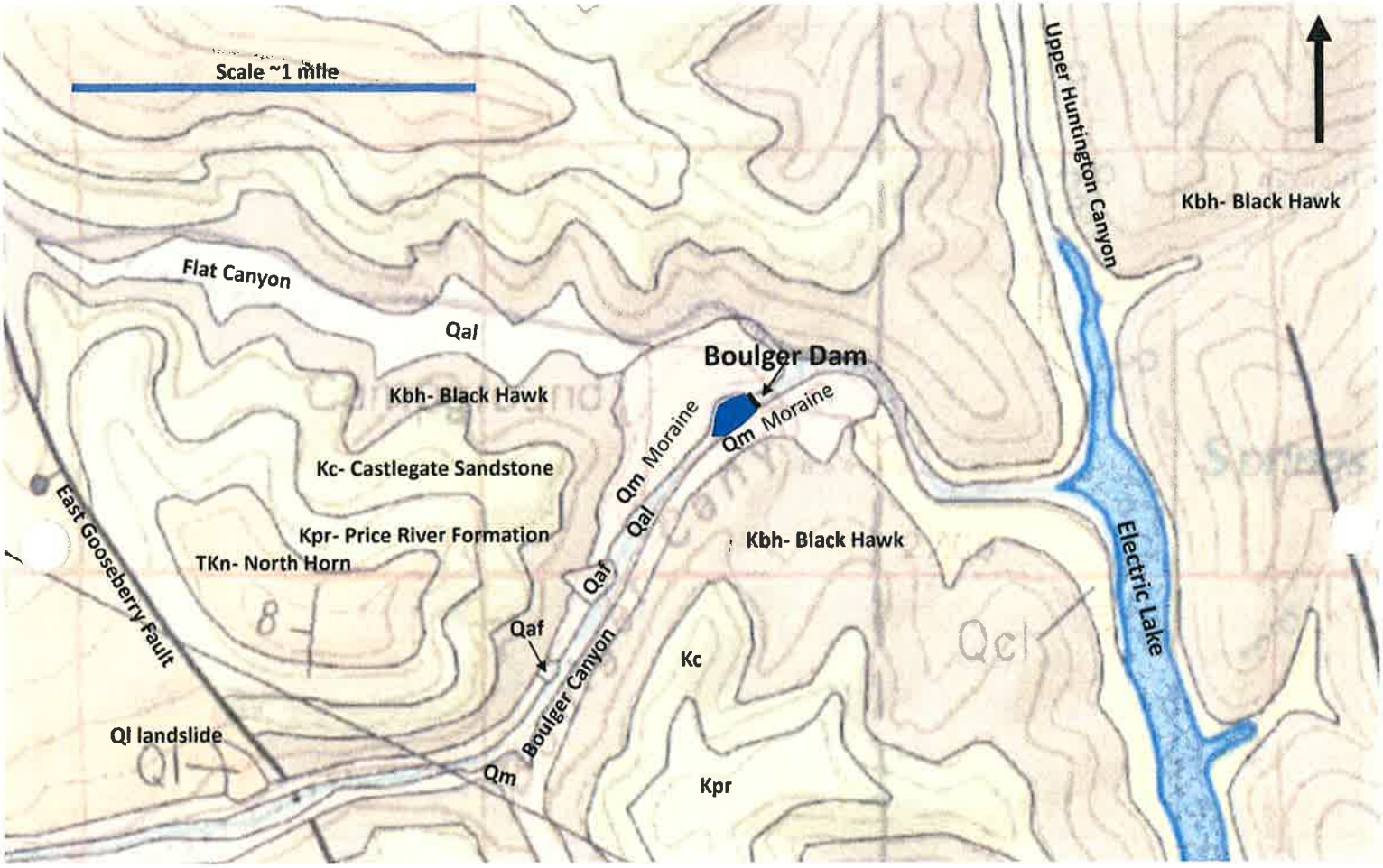

Taken and modified from
Geologic map of the Nephi 30'x60' quadrangle, Carbon, Emery, Juab, Sanpete, Utah and Wasatch Counties, Utah: Utah, Geological Survey, Witkind and Weiss, 1991, Map 189, scale 1:100,000

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Figure 3a *Site Geologic Map*
Project *Skyline Flat Canyon Mining Lease Mining Induced Seismicity*
Location *Sanpete County, Utah*

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Geologic Description of Units

Qf: Alluvial Fan Deposits (Holocene)
Light-brown to brown, locally gray, unconsolidated to semiconsolidated, moderately well sorted silt, sand, granules, pebbles, and cobbles at stream mouths. Of fluvial origin. Deposits commonly lobate. Thickness uncertain, probably as much as 15 m (50 ft) locally.

Qcl: Colluvium (Holocene)
Brown to dark-brown, heterogeneous, unsorted mixture of fragments of many sizes that locally mantles lower valley walls and accumulates at the base of some steep cliffs. Unconsolidated to semiconsolidated. Thickness ranges from a few centimeters (1 in) to as much as 15 m (50 ft).

Qal: Alluvium (Holocene)
Dark brown to gray, thin to thick bedded locally massive, crossbedded in places. Unconsolidated. Consists of clays, silt, sand, granules, pebbles, and sparse cobbles of fluvial origin. Deposits form narrow to broad even surfaces of low relief. Locally includes higher patches of older alluvium (Qao). Thickness ranges widely, generally less than 15 m (50 ft) thick.

Ql: Lanslide Deposits (Quaternary)
Brown to dark-brown and gray, heterogeneous mexture of fragments of diverse size and shape. Forms irregular to lobate masses of bedrock that have slid downslope to form chaotic, hummocky accumulations of rubble. Some deposits form concentric ridges. Thickness varies widely; may be as much as 45 m (150 ft) thick locally.

Qmw: Mass Wasting Deposits (Quaternary)
B[illegible]n to dark-brown, heterogeneous masses of mixed country rock of diverse size and shape that have slid [illegible]lope repeatedly as both small slumps and large debris flows. Locally includes small and large [illegible]s. Locally includes water-saturated till that flowed downslope. Thickness varies widely; probably d[illegible]exceed 61 m (200 ft).

Qm: Morainic Deposits (Pleistocene)
Brown to dark-brown masses of unsorted, unconsolidated to semiconsolidated morainal rubble of glacial origin. Fragments range in size from clay to boulders. Characterized by lobate outlines and knob-and-kettle topography. Water-saturated till that flowed downslope locally mapped as mass-wasting deposits (Qmw). Thickness as much as 61 m (200 ft).

TKn: North Horn Formation (Paleocene and Upper Cretaceous)Mudstone, claystone, sandstone, conglomeratic sandstone, conglomerate, and sparse fresh-water limestone; units alternate irregularly. Mudstones are thick bedded to massive; sandstones range from thin to thick bedded; commonly crossbedded; fine to medium grained. Limestone beds are thin and dense, locally arenaceous. Contains minor coal beds along east flank of San Pitch Mountains near Wales (south of this quadrangle). Fluvial and some fresh-wather lacustine deposits. Unstable, marked by many slumps, landslides, earthflows, and other mass-wasting deposits. Ranges in thickness from about 150-915 m (500-3,000 ft).

Kpr: Price River Formation (Upper Cretaceous)Gray to light-gray conglomerate, conglomeratic sandstone, and sandstone; minor shale. Thin to thick bedded; locally massive; commonly well cemented. Coarse conglomerates contain well-rounded clasts of light-brown and purple quartzite, light-gray quartz, light-grah and black chert, and sparse dark-blue limestone. Sandstones are fine to coarse grained. Fluvial deposits. Forms steep slopes and low cliffs. In western part of area consists chiefly of conglomerate beds that probably contain equivalents of Castlegate Sandstone. Ranges in thickness from a pinch out to about 366 m (1,200 ft).

Castlegate Sandstone
Kc: Sandstone, light brown to brownish-gray; locally conglomeratic; irregularly bedded; massive; fine to coarse grained. Locally includes some thin, dark-gray, shaly siltstone units and some carbonaceous material. Fluvial deposits. Ranges in thickness from about 15 m (50 ft) to about 150 m (500 ft).

Kbh: Blackhawk Formation (Upper Cretaceous)
Sandstone, shaly siltstone, shale, carbonaceous shale, and coal. Sandstones, light-gray, light-brown, and brownish-gray; locally reddish brown; thin to medium bedded; crossbedded, fine to medium grained. Many thin to thick coal zones in lower part; major thick coal zone at base directly overlies Star Point Sandstone. Continental and deltaic deposits. Ranges in thickness from about 213 m (700 ft) to about 305 m (1,000 ft).

Ksp: Star Point Sandstone (Upper Cretaceous)
Not shown on the surface
Light-brown to brown sandstone, shale, and shaly siltstone; thin to medium bedded; fine to medium grained. Consists of three sandstone units (in descending order) as follows: Spring Canyon, Storrs, and Panther Tongues. Sandstone units separated by beds of shaly siltstone. Fluvial deposits. Formation ranges in thickness from about 61-305 m (200-1,000 ft); generally about 107 m (350 ft) thick.

Descriptions Taken and modified from
Geologic map of the Nephi 30'x60' quadrangle, Carbon, Emery, Juab, Sanpete, Utah and Wasatch Counties, Utah: Utah, Geological Survey, Witkind and Weiss, 1991, Map 189, scale 1:100,000

Contact--Approximately located or inferred

Gradational contact--Areas in which adjacent units grade into one another

Intrusive sedimentary contact--Approximately located or inferred. Rectangles rest on intrusive sedimentary unit

Fault--Dashed where approximately located; dotted where concealed. Bar and ball on downthrown side. Hachures indicate Holocene fault scarp. Arrows in cross sections indicate direction of relative movement

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Figure 3b Project Location

Geologic Map Descriptions
Skyline Flat Canyon Mining Lease Mining Induced Seismicity
Sanpete County, Utah

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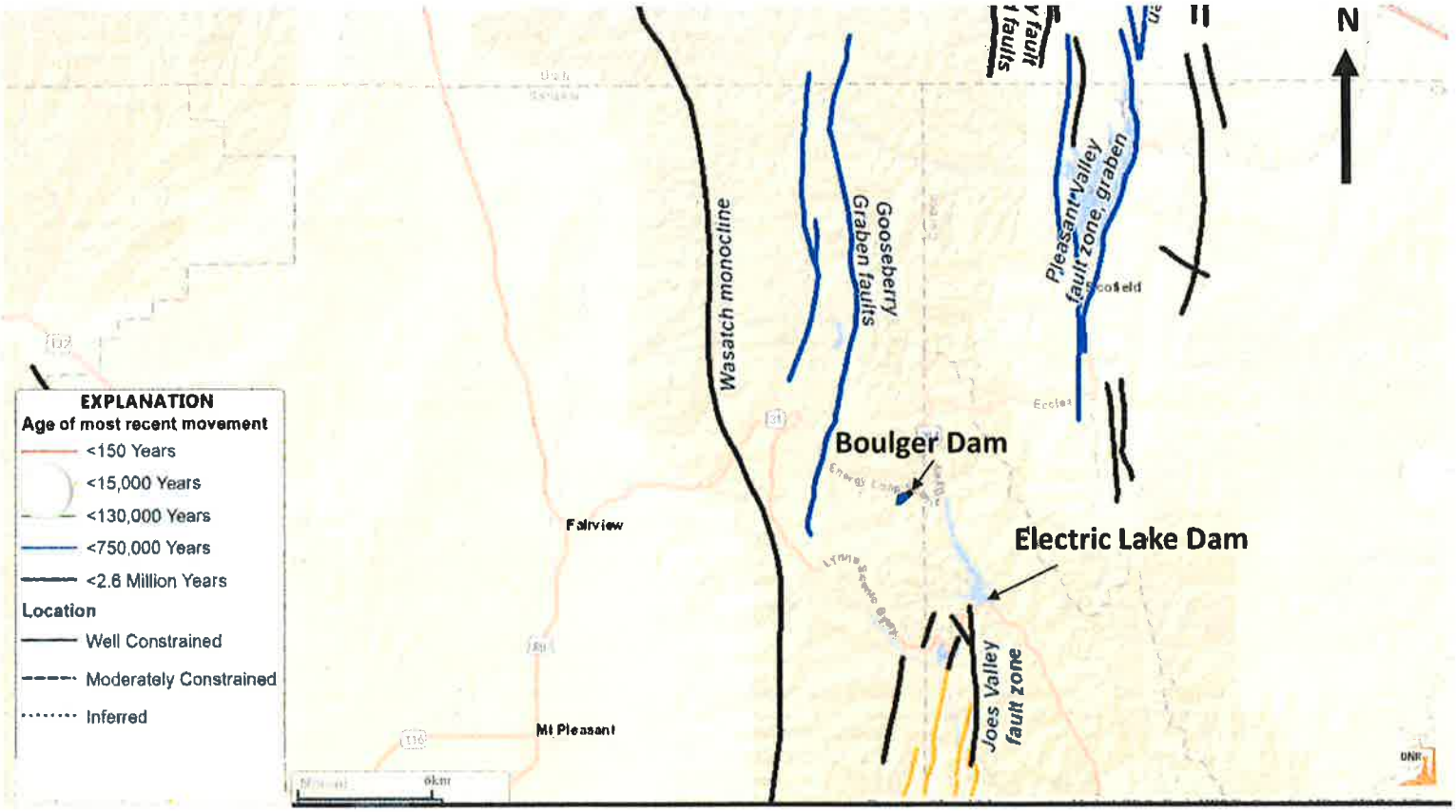

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Figure 4
Project Location

Quaternary Faults and Folds
Skyline Flat Canyon Mining Lease Mining Induced Seismicity
Sanpete County, Utah

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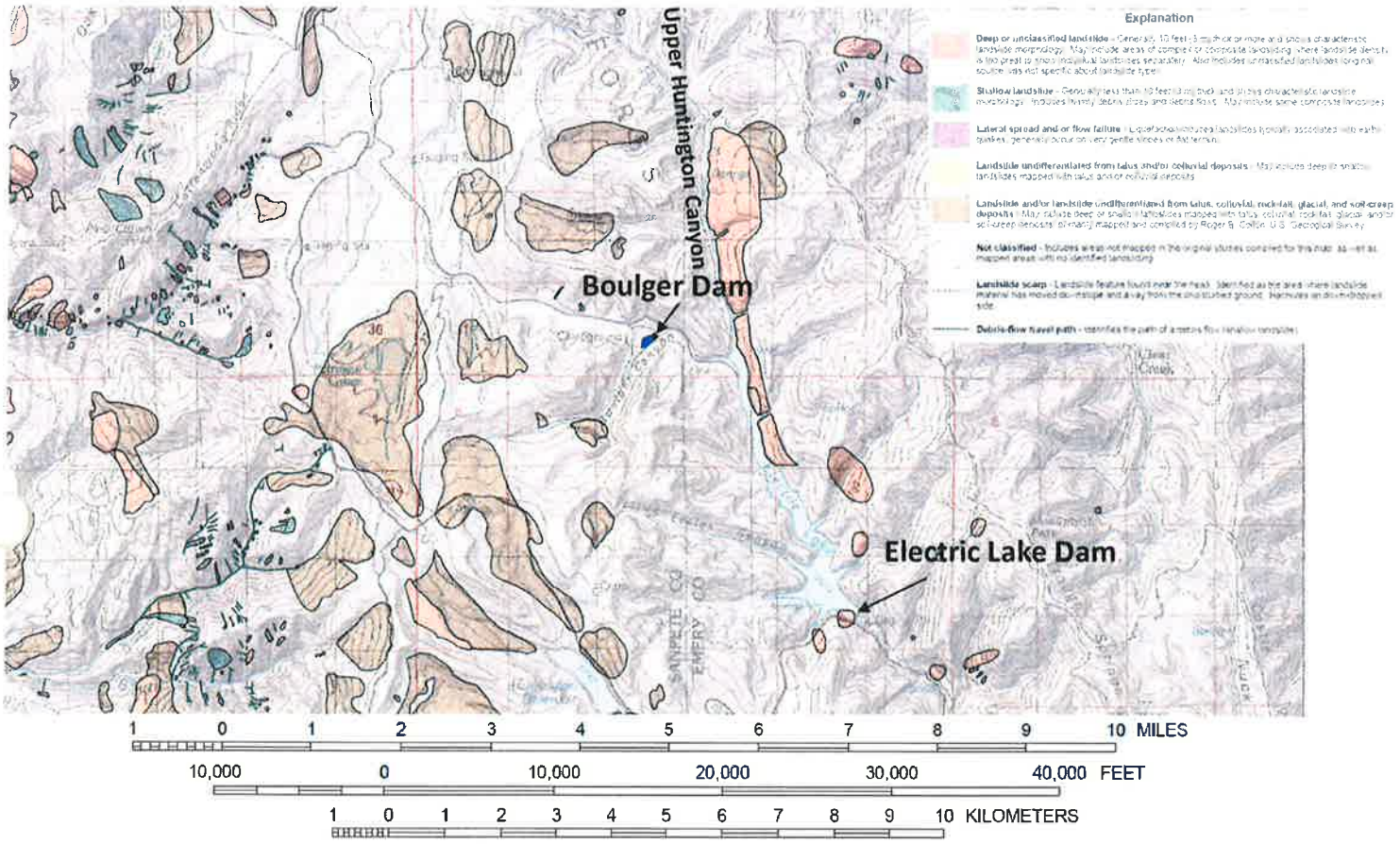

Map Taken and modified from
Landslide Maps of Utah Nephi 30'x60' Quadrangle, Utah: Utah Geological Survey, Elliott and Harty, 2010, M-246DM, scale 1:100,000

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Figure 5
Project Location

Landslide Map
Skyline Flat Canyon Mining Lease Mining Induced Seismicity
Sanpete County, Utah

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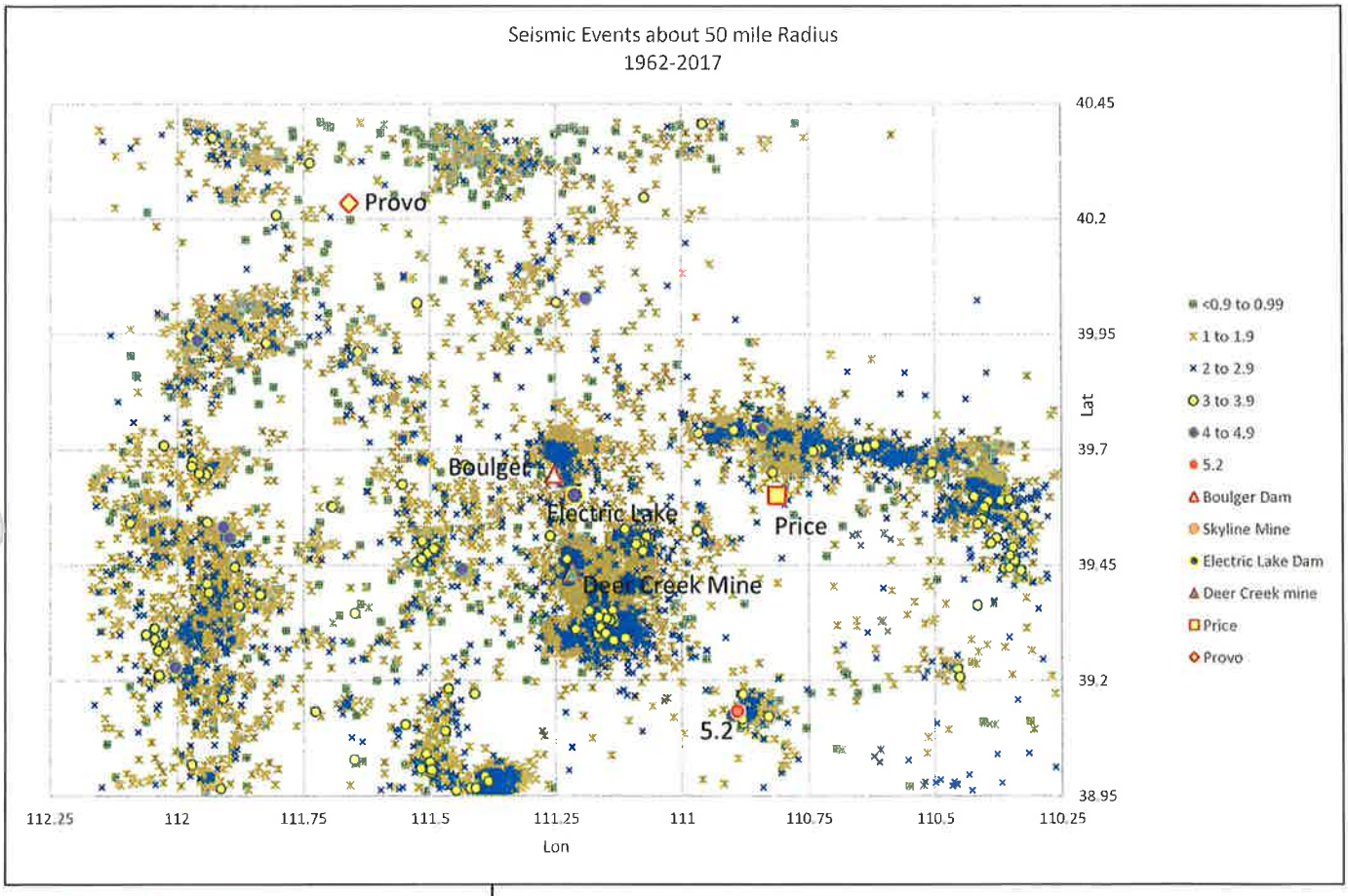

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Figure 6 Magnitude and Locations of Seismic Events within approx. 50 Miles of Electric Lake and Boulger Dam - 1962 to Sept 2017
Skyline Flat Canyon Lease Mining Induced Seismicity

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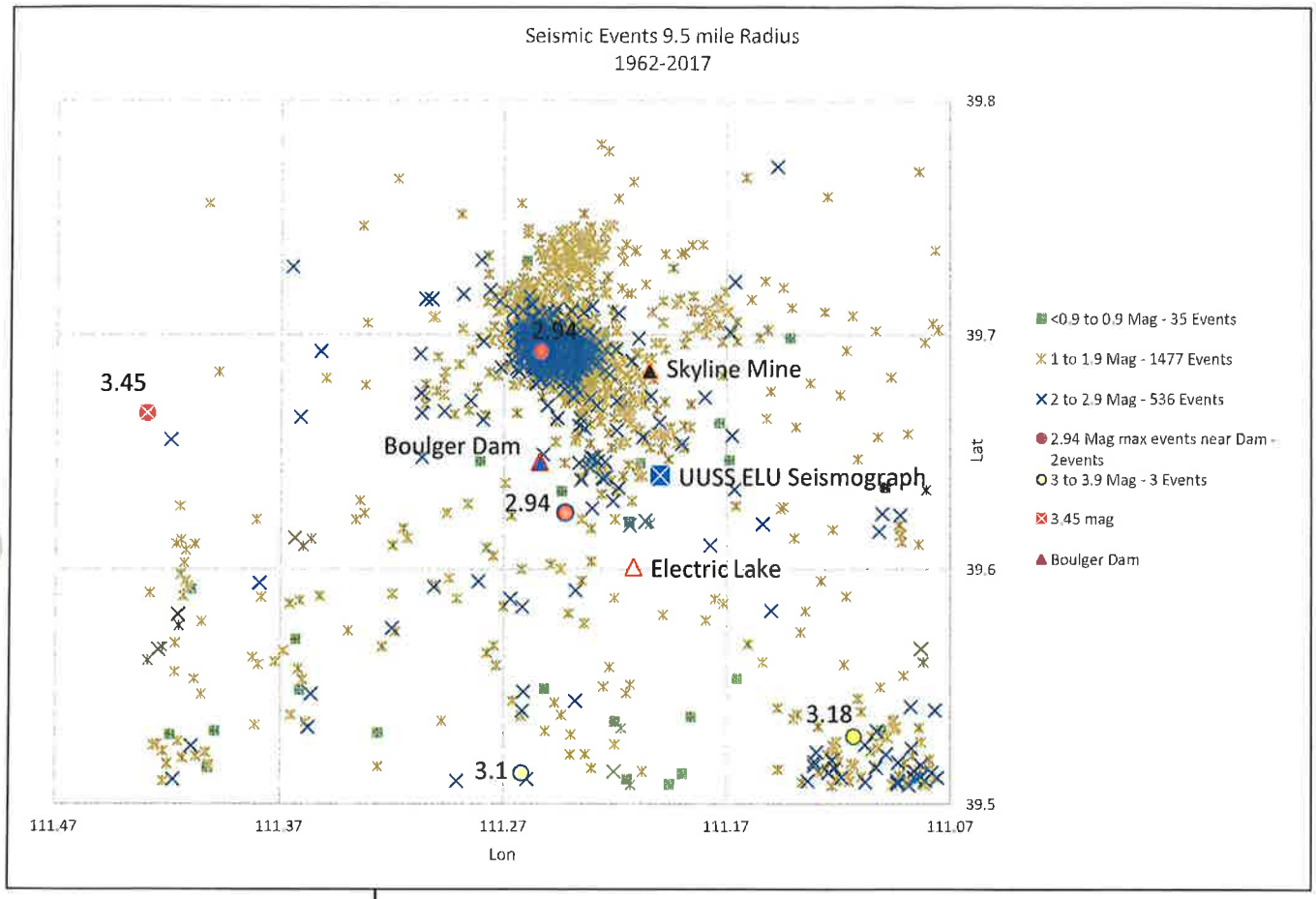

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Figure 7 **Magnitude and Locations of Seismic Events within 9.5 Miles of Boulger Dam 1962 to Sept 2017**
Skyline Flat Canyon Lease Mining Induced Seismicity

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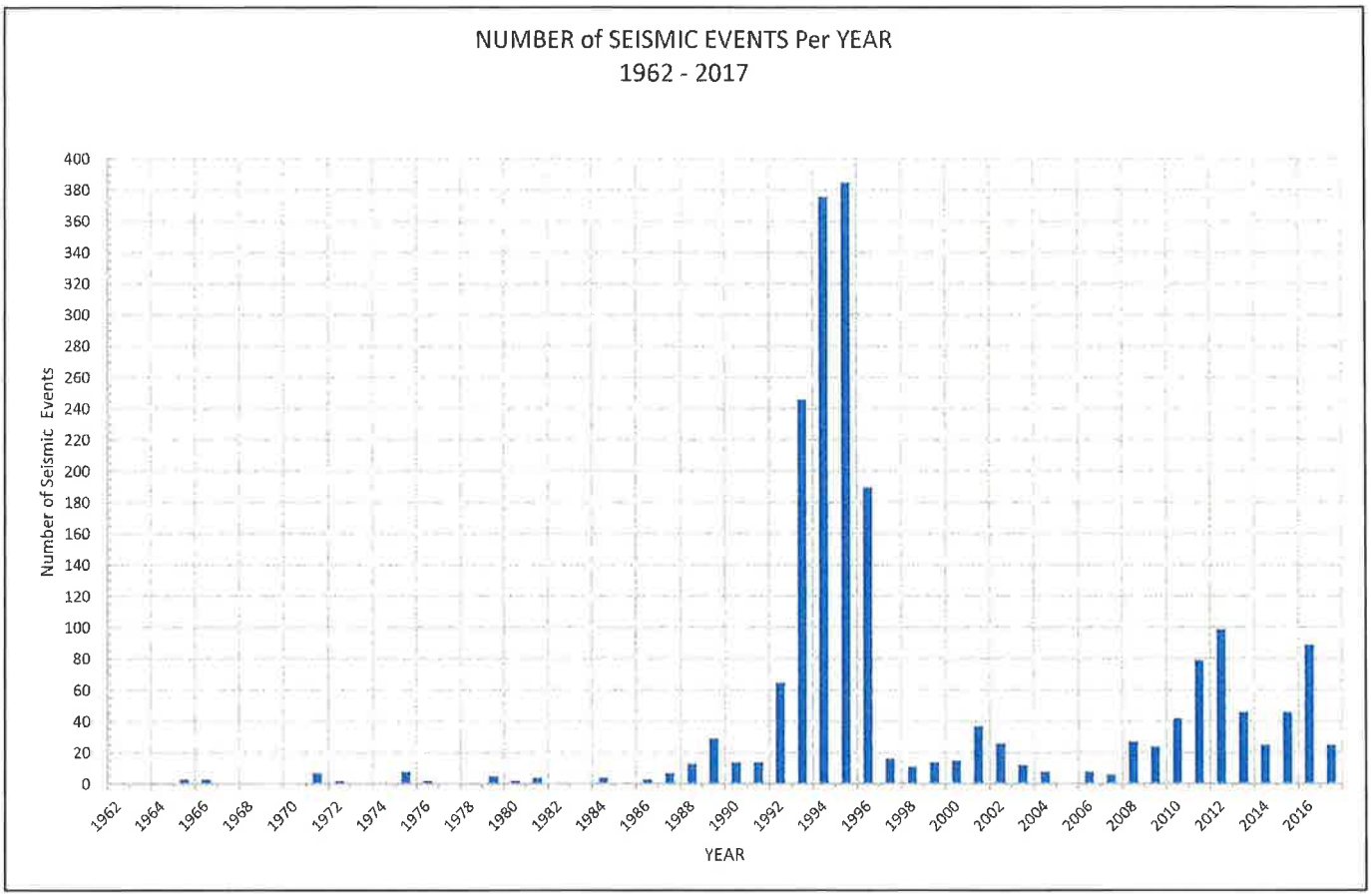

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Figure 8

Seismic Events per Year
1962 to Sept 2017
Skyline Flat Canyon Lease Mining Induced Seismicity

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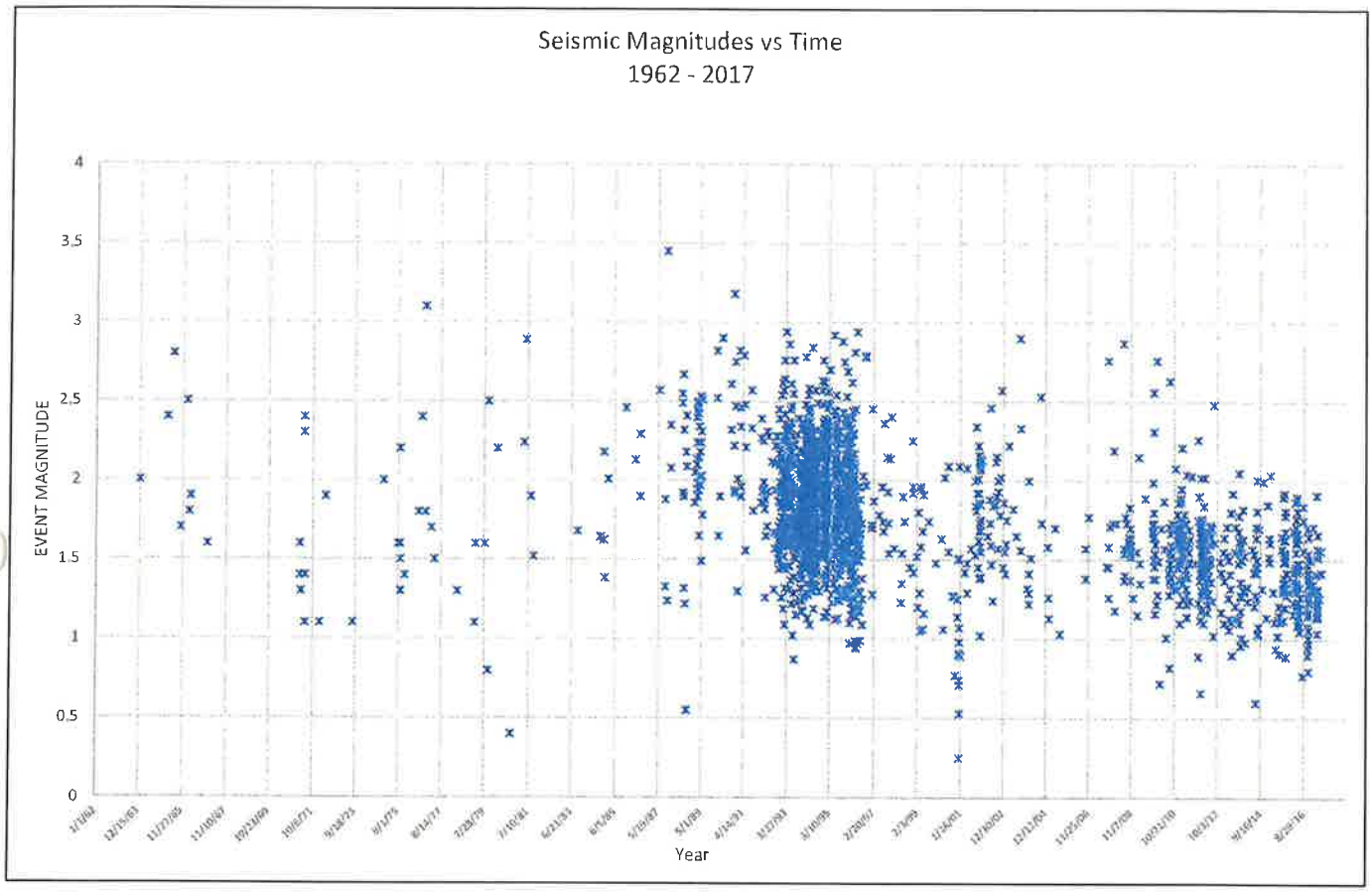

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Figure 9

Earthquake Magnitudes between 1962 to 2017
1962 to Sept 2017
Skyline Flat Canyon Lease Mining Induced Seismicity

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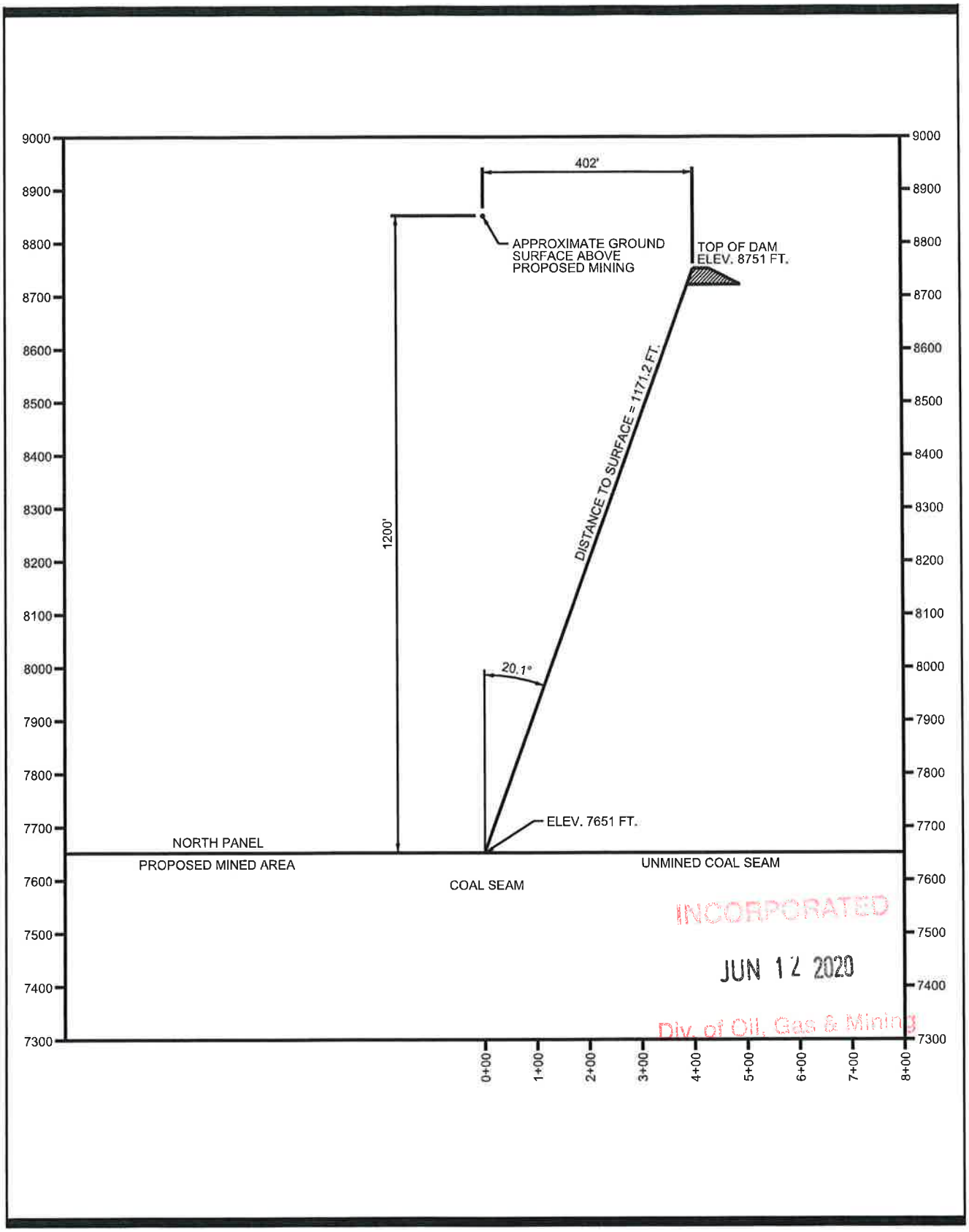

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Figure 10a HYPOCENTRAL DISTANCE - NORTH PANEL

Skyline Flat Canyon Mining Lease Mining-Induced Seismicity - Boulger Dam

Emery County, Utah

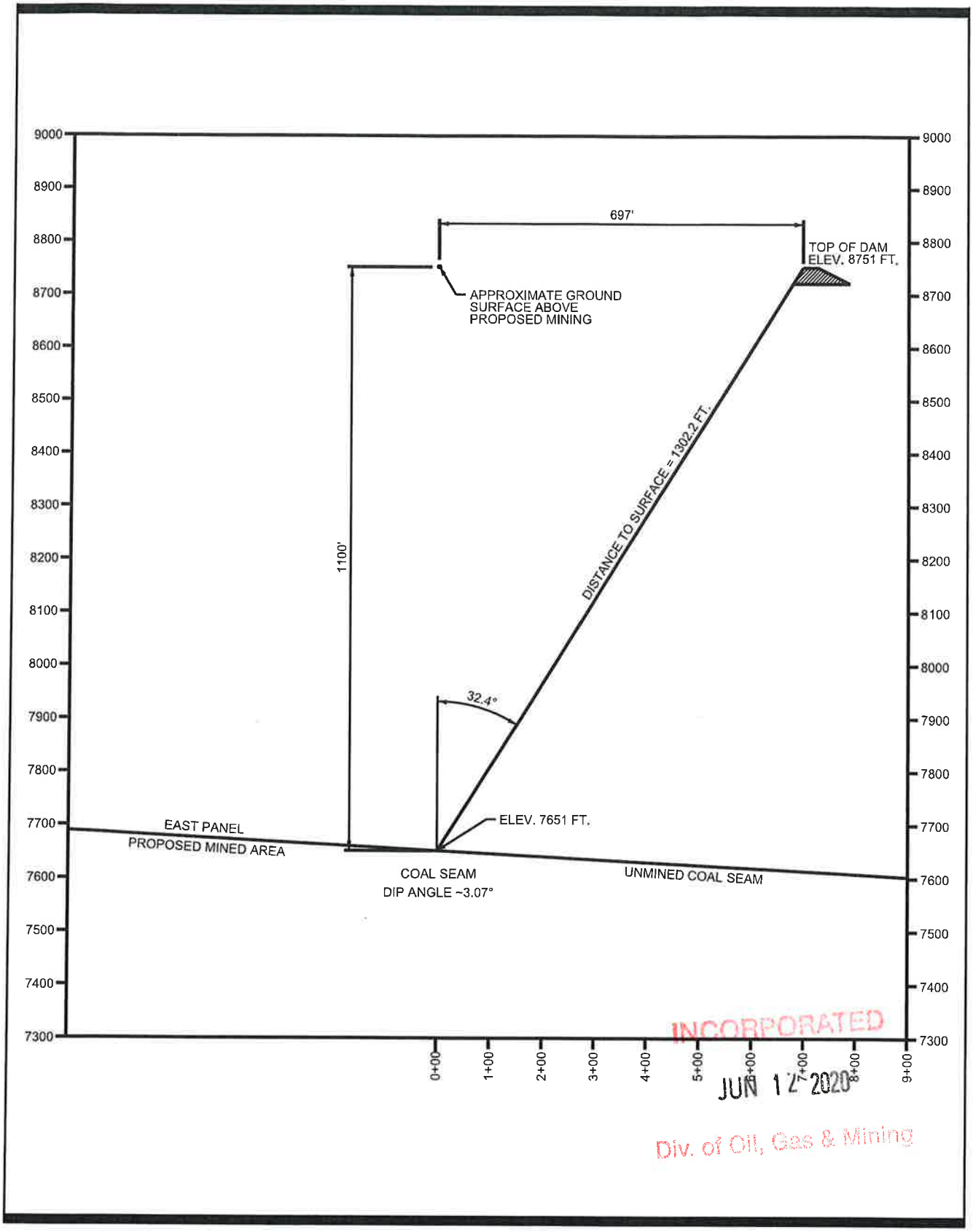

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Figure 10b HYPOCENTRAL DISTANCE - EAST PANEL

Skyline Flat Canyon Mining Lease Mining-Induced Seismicity - Boulger Dam

Emery County, Utah

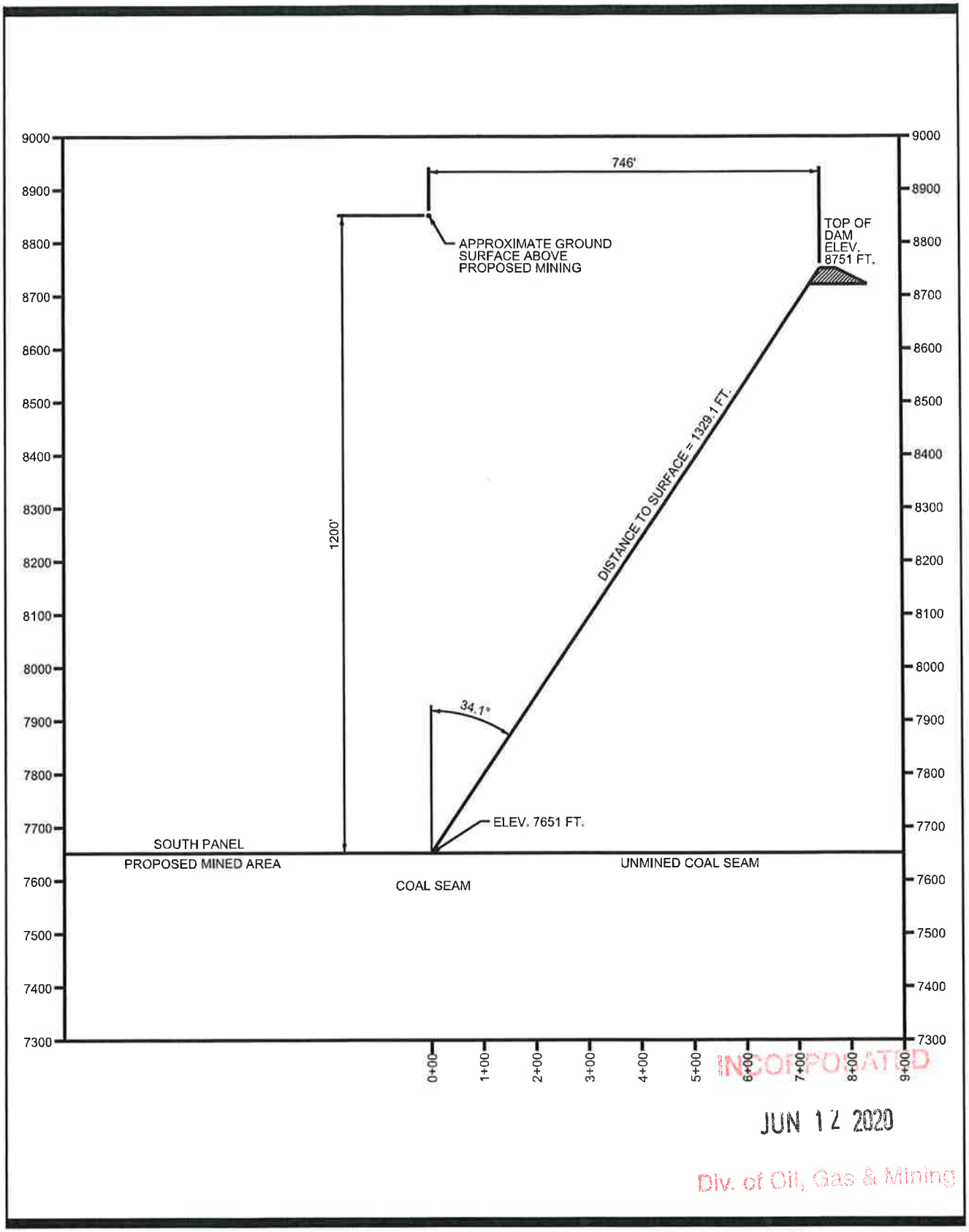

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Figure 10c HYPOCENTRAL DISTANCE - SOUTH PANEL

Skyline Flat Canyon Mining Lease Mining-Induced Seismicity - Boulger Dam

Sanpete County, Utah

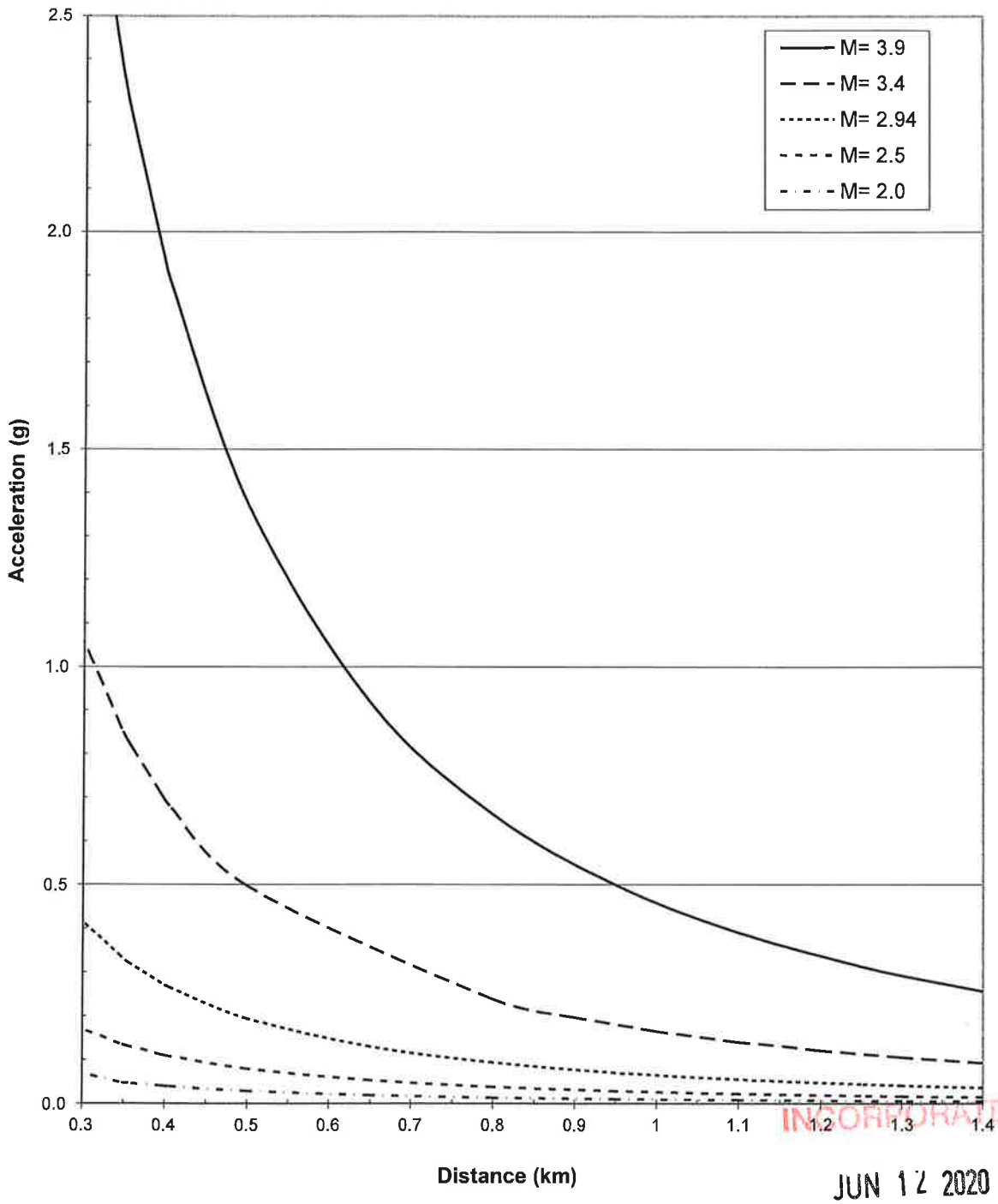

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Figure 11 Predicted MIS PGA Values at Boulger Dam
Based on McGarr & Fletcher (2005) with s = 0.337
Skyline Flat Canyon Lease Mining-Induced Seismicity

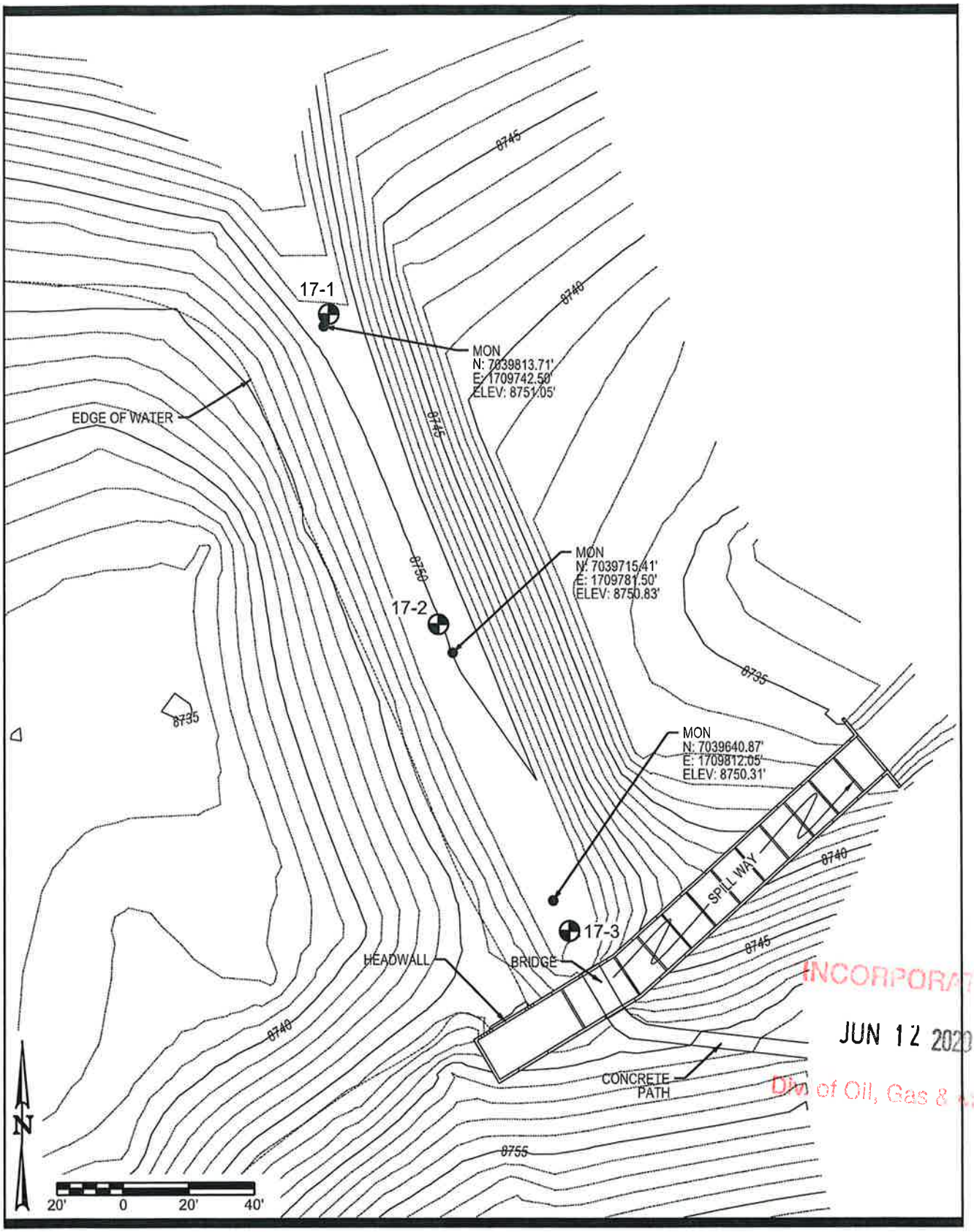

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Figure 12 SITE PLAN & TEST HOLE LOCATIONS

Skyline Flat Canyon Mining Lease Mining-Induced Seismicity - Boulger Dam

Sanpete County, Utah

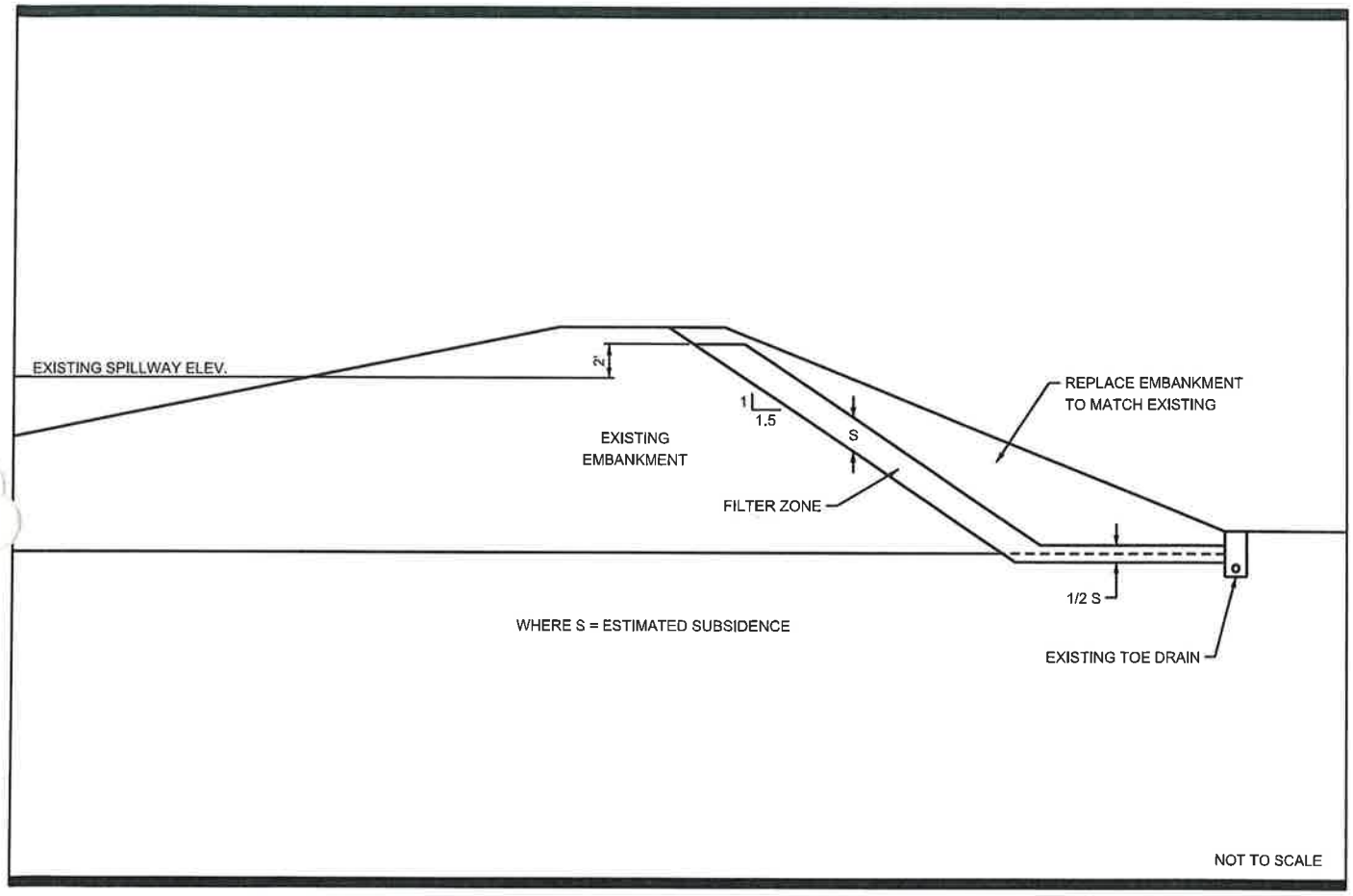

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Figure 13 TYPICAL CROSS SECTION

Skyline Flat Canyon Mining Lease Mining - Induced Seismicity - Boulger Dam

Emery County, Utah

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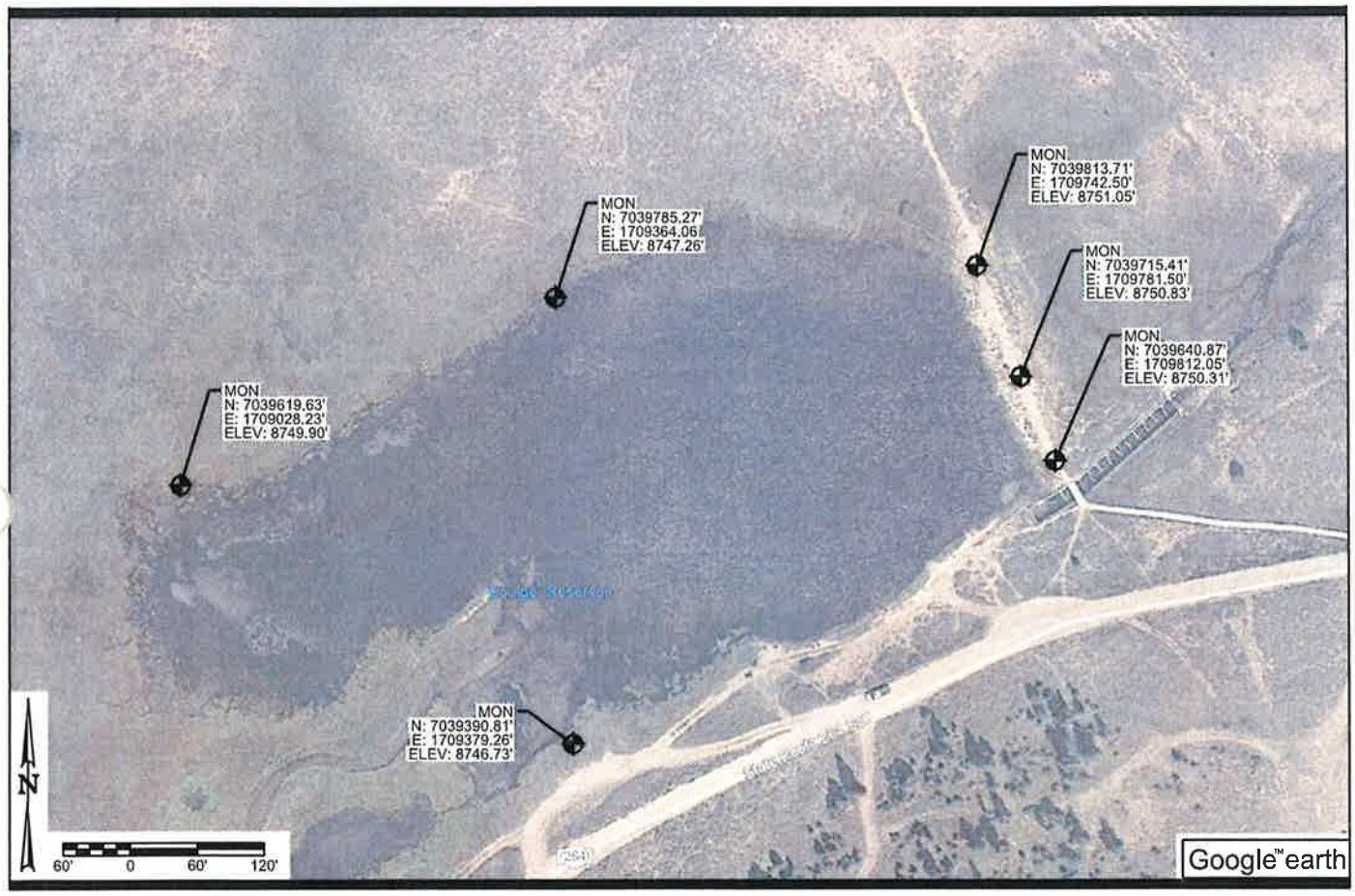

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Figure 14 SURVEY CONTROL

Skyline Flat Canyon Mining Lease Mining - Induced Seismicity - Boulger Dam

Emery County, Utah

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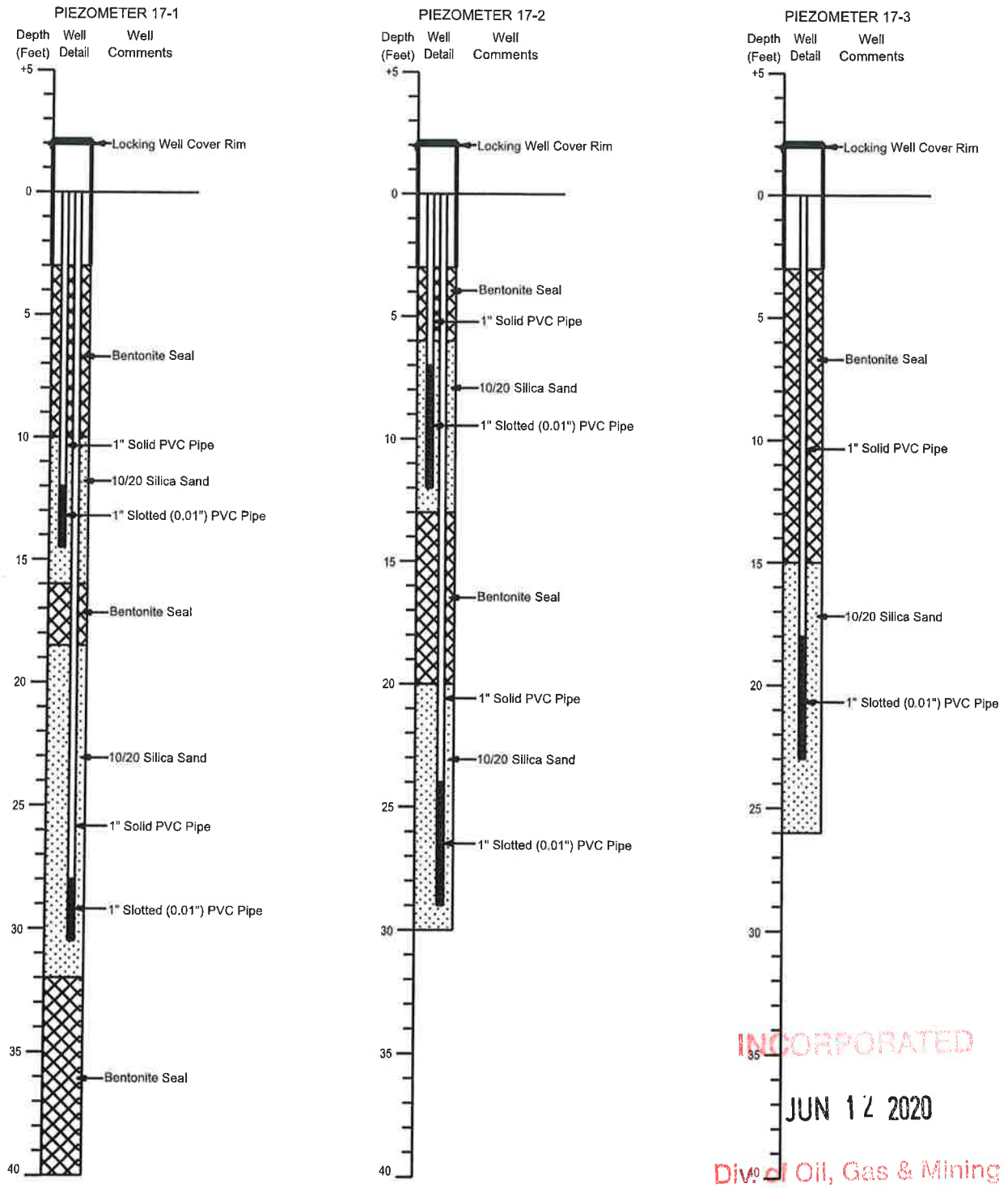

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Figure 15 PIEZOMETER INSTALLATION LOGS

Skyline Flat Canyon Mining Lease Mining - Induced Seismicity - Boulger Dam
Emery County, Utah

APPENDIX

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DRILL HOLE LOG

BORING NO. 17-1

PROJECT: SKYLINE FLAT CANYON MINING LEASE MINING INDUCED SEISMICITY - BOULGER DAM — SHEET 1 OF 1

CLIENT: CANYON FUEL COMPANY LLC — **PROJECT NUMBER:** 201701.022

LOCATION: LEFT ABUTMENT — **DATE STARTED:** 10/5/17

DRILLING METHOD: 08-CME-55 / HOLLOW STEM AUGER — **DATE COMPLETED:** 10/5/17

DRILLER: T. KERN — **GROUND ELEVATION:** ~8752.5'

DEPTH TO WATER - INITIAL: ▽ N.M. — **AFTER 24 HOURS:** ▼ 17.3' 10/14/17 — **LOGGED BY:** M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Rec. (in)	See Legend	USCS (AASHTO)	Material Description		Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				16	4,7,7,(30)	SM	brown, sl. moist, med. dense	SILTY SAND trace gravels (fill)								
8750				17	16,17,18,(74)	SM	brown, moist, very dense			6.1		NP	18	50	32	
	5			18	6,12,17,(58)	SM	gray-brown, moist & very moist, very dense	SILTY SAND W/GRAVEL (fill)								
8745				16	6,5,8,(22)	SM	mottled brown, gray & black, wet, med. dense			22.9		NP	13	52	35	
	10			17	4,6,9,(22)	SM	gray-brown, wet, med. dense	SILTY SAND organics, trace gravels, silt seams								
8740				1	33,37,25,(83)	GP	gray, very moist, very dense	GRAVEL possible cobbles, poor sample								
	15			12	11,13,25,(48)	GM	gray-brown, very moist to wet, med. dense	SILTY GRAVEL W/SAND silty sand layers, possible cobbles								
8735				2	60/2"	GC-GM	brown, moist, very dense	SILTY CLAYEY GRAVEL W/SAND possible cobbles, poor sample								
	20			16	6,11,14,(29) PP 3.0	SM	gray, moist & very moist, med. dense	SILTY SAND W/GRAVEL plastic		11.4	17	3	16	41	43	
8730				3	8,11,14,(27)	SM	yellow-brown, very moist, med. dense	SILTY SAND W/GRAVEL cut & crushed gravels								
	25			12	9,9,10,(20) PP 2.7	SC-SM	brown, moist to very moist, med. dense	SILTY CLAYEY SAND W/GRAVEL		10.0	18	5	25	39	36	
8725				17	7,10,11,(21) PP 2.5	SM	brown, very moist	SILTY SAND								
	30					SC	brown, moist, med. dense	CLAYEY SAND trace gravels	120.6	11.2						UC 2,781 psf
8720								BOH								
8715																
8710																

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DH LOG V8-2014-1 SKYLINE_BOULGER_DAM.GPJ US EVAL.GDT 5/4/18

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon

Split Spoon Sample: 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; T 0.45 ← Torvane (tsf); PP 2.0 ← Pocket Penetrometer (tsf); With Liners

Thin-Walled Tube Sample: Pushed; T 0.45 ← Torvane (tsf); PP 2.0 ← Pocket Penetrometer (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride
Hyd. = Hydrometer

DRILL HOLE LOG

BORING NO. 17-2

PROJECT: SKYLINE FLAT CANYON MINING LEASE MINING INDUCED SEISMICITY - BOULGER DAM

SHEET 1 OF 1

CLIENT: CANYON FUEL COMPANY LLC

PROJECT NUMBER: 201701.022

LOCATION: MAXIMUM SECTION

DATE STARTED: 10/4/17

DRILLING METHOD: 08-CME-55 / HOLLOW STEM AUGER

DATE COMPLETED: 10/5/17

DRILLER: T. KERN

GROUND ELEVATION: ~8751.2'

DEPTH TO WATER - INITIAL: ▽ 16.9'

AFTER 24 HOURS: ▼ 16.6' 10/14/17

LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description		Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
8750				10	5,11,17,(60)	GM	brown, sl. moist, dense	SILTY GRAVEL W/SAND (fill)								
	5			12	11,11,25,(77)	SC-SM	brown, moist, very dense	SILTY CLAYEY SAND trace gravels (fill)		10.0	20	5	14	43	43	
8745				17	9,13,14,(54) *PP 3.5*	SM	brown, moist, very dense	SILTY SAND W/GRAVEL plastic (fill)	133.4	9.4	19	3	17	42	41	DS
	10			18	8,12,12,(40)	SM	brown, moist, dense	SILTY SAND W/GRAVEL (fill)	123.5	12.5		NP	31	38	31	DS
8740				12	15,16,13,(43) *PP 3.8*	SC-SM	dk. gray-brown, moist, dense	SILTY CLAYEY SAND W/GRAVEL (fill?)								
	15			16	6,12,14,(35) *PP 3.0*	SC-SM	dk. gray-brown, moist, dense		114.6	12.9						UC 3,195 psf
8735 ▽▼				13	6,3,4,(9)	SC-SM	brown, moist to very moist, loose	SILTY CLAYEY SAND trace gravels		12.3	20	5	9	45	46	
	20															
8730				18	0,1,3,(5) *PP 0.2*	SC	green-gray, wet, loose	CLAYEY SAND trace gravels	114.3	19.4	25	11	13	43	44	DS
						GM	gray-brown, wet	SILTY GRAVEL W/SAND								
	25			16	5,9,14,(27)	SM	gray-brown, wet, med. dense									
8725				18	21,22,23,(51)	SM	gray-brown, wet, very dense	SILTY SAND trace gravels		18.5		NP	11	61	28	
	30			18	14,21,23,(48)	SM	gray-brown, wet, dense									
8720								BOH								

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DH LOG V8-2014-1 SKYLINE BOULGER DAM.GPJ US EVAL.GDT 5/4/18

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon

Split Spoon Sample: 2,3,2,(6) — Blow Count per 6"; $(N_1)_{60}$ Value; *T 0.45* — Torvane (tsf); *PP 2.0* — Pocket Penetrometer (tsf); With Liners

Thin-Walled Tube Sample: Pushed; *T 0.45* — Torvane (tsf); *PP 2.0* — Pocket Penetrometer (tsf)

OTHER TESTS

UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride
Hyd. = Hydrometer

DRILL HOLE LOG

BORING NO. 17-3

SHEET 1 OF 1

PROJECT: SKYLINE FLAT CANYON MINING LEASE MINING INDUCED SEISMICITY - BOULGER DAM
CLIENT: CANYON FUEL COMPANY LLC
LOCATION: RIGHT ABUTMENT
DRILLING METHOD: 08-CME-55 / HOLLOW STEM AUGER
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ 10.2' 10/14/17

PROJECT NUMBER: 201701.022
DATE STARTED: 10/4/17
DATE COMPLETED: 10/4/17
GROUND ELEVATION: ~8750.2'
LOGGED BY: M. HANSEN, J. BOONE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description		Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
8750				12	3,3,9,(26)	SM	brown, sl. moist, med. dense	SILTY SAND W/GRAVEL (fill)								
				15	11,14,21,(74)	SC-SM	brown, moist, very dense	SILTY CLAYEY SAND W/GRAVEL possible cobbles (fill)								
8745	5			13	6,5,9,(28)	SC-SM	brown, moist, med. dense	SILTY CLAYEY SAND W/GRAVEL silty sand lenses & layers (fill?)		8.5	21	5	19	43	38	
8740	▼10			13	5,4,6,(17) T 0.60 PP 0.6	SC	brown, very moist, med. dense	CLAYEY SAND	110.3	15.0						UU 1,813 psf
				14	4,17,30,(69)	SM	brown, moist to very moist, very dense	SILTY SAND W/GRAVEL sandy clay & gravel layers		10.6		NP	29	42	29	
8735	15			14	22,21,11,(43)	GM	brown, wet, med. dense	SILTY GRAVEL W/SAND possible cobbles								
				14	16,12,43,(71)	GM	brown, wet, dense			12.8		NP	42	38	20	
8730	20			9	5,7,9,(20) T 0.51 PP 1.0	SC	gray-brown, very moist, med. dense									
8725	25			17	4,6,16,(26) T 0.59 PP 1.0	SC	gray-brown, very moist, med. dense	CLAYEY SAND W/GRAVEL	131.8	12.3	21	8	20	33	47	UU 2,293 psf
				14	4,5,12,(20) T 0.54 PP 1.0	SC	gray-brown, very moist, med. dense		132.1	13.2						UC 2,659 psf
								BOH								

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DH LOG V8-2014-1 SKYLINE_BOULGER_DAM.GPJ US EVAL.GDT 5/4/18

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon
- Split Spoon Sample
- Thin-Walled Tube Sample

2,3,2,(6) ← $(N_1)_{60}$ Value
T 0.45 ← Torvane (tsf)
PP 2.0 ← Pocket Penetrometer (tsf)
With Liners
Blow Count per 6"

Pushed
T 0.45 ← Torvane (tsf)
PP 2.0 ← Pocket Penetrometer (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride
Hyd. = Hydrometer

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Table 1

SUMMARY OF TEST DATA

PROJECT LOCATION: Skyline Mine Seismic Monitering - Boulger Dam; Sanpete & Emery Counties, Utah

PROJECT NO.: 201701-022

FEATURE: Foundations

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	IN-PLACE		UNCONFINED OR UU TRIAXIAL COMPRESSIVE STRENGTH (psf)	ATTERBERG LIMITS			MECHANICAL ANALYSIS			PERCENT FINER THAN 0.005 mm	UNIFIED SOIL CLASSIFICATION SYSTEM
		DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY		
17-1	3-4.5		6.1				NP	18	50	32		SM
	9-10.5		22.9				NP	13	52	35		SM
	25-26.5		11.4		17	14	3	16	41	43		SM
	35-36.5		10.0		18	13	5	25	39	36		SC-SM
	40-41.5	120.6	11.2	UC 2,781								
17-2	3-4.5		10.0		20	15	5	14	43	43		SC-SM
	6-7.5	133.4	9.4		19	16	3	17	42	41		SM
	9-10.5	123.5	12.5				NP	31	38	31		SM
	15-16.5	114.6	12.9	UC 3,195								
	18-19.5		12.3		20	15	5	9	45	46		SC-SM
	21-22.5	114.3	19.4		25	14	11	13	43	44		SC
	27-28.5		18.5				NP	11	61	28		SM
17-3	6-7.5		8.5		21	16	5	19	43	38		SC-SM
	9-10.5	110.3	15.0	UU 1,813								
	12-13.5		10.6				NP	29	42	29		SM
	18-19.5		12.8				NP	42	38	20		GM
	24-25.5	131.8	12.3	UU 2,293	21	13	8	20	33	47		SC
	26-27.5	132.1	13.2	UC 2,659								

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NP=Non-Plastic

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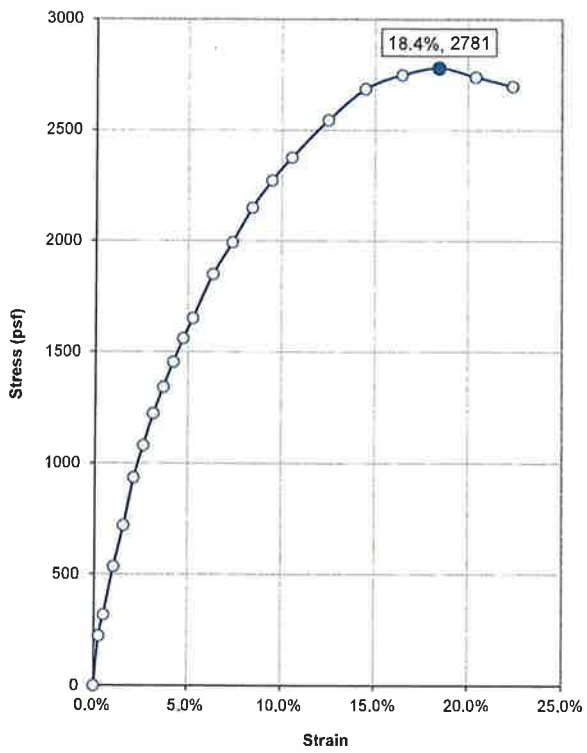
UNCONFINED COMPRESSION TEST ON COHESIVE SOILS

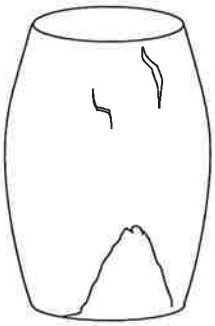
Project	Skyline Mine Seismic Monitering - Boulger Dam	**Boring No.**	17-1
Project No.	201701-022	**Sample**	1
Location	See Site Plan	**Depth / Elev. (ft)**	40-41.5'
Date	Tuesday, October 10, 2017	**Sample Description**	Clayey Sand SC
Tested By	S Neil	**Sample Type**	Spoon Sample

Apparatus No.	UC - 1	Proving Ring No.	5552



Total Strain	Stress (psf)
0.0%	0
0.3%	223
0.5%	318
1.1%	535
1.6%	719
2.1%	935
2.6%	1080
3.2%	1224
3.7%	1343
4.2%	1455
4.7%	1562
5.3%	1653
6.3%	1851
7.4%	1995
8.4%	2151
9.5%	2274
10.5%	2377
12.5%	2546
14.5%	2686
16.4%	2750
18.4%	2781
20.4%	2740
22.4%	2698

Sketch of Specimen After Failure



Initial Sample Data

Initial height of specimen	L_o	3.8	(in)	**Liquid limit**	LL	nt
Initial diameter of specimen	D_o	1.9	(in)	**Plastic index**	PI	nt
Height-to-diameter ratio	L_o / D_o	2.00		**Moisture content***	w	11.2%
Dry unit weight	γ_d	120.6	(pcf)			

Test Results

Unconfined compressive strength	q_u	2781	(psf)
Shear strength	τ_f	1390	(psf)
Average strain rate to failure		1%	
Strain at failure		18.4%	

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Remarks _____

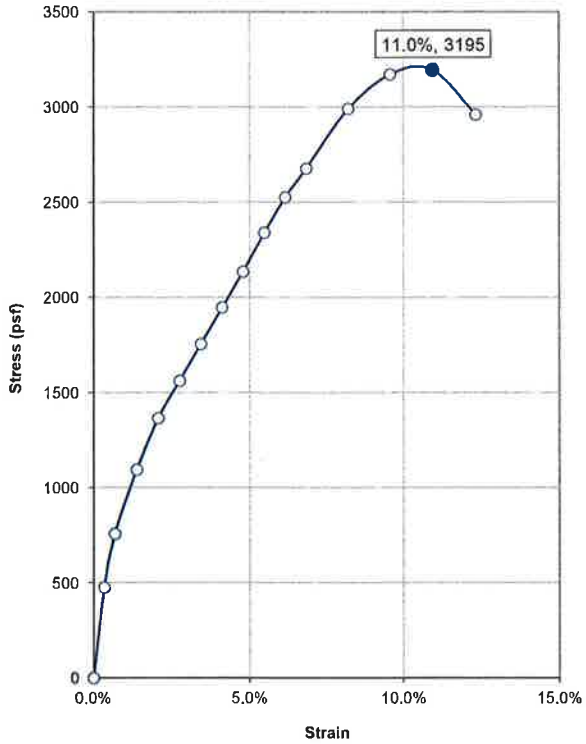
*Moisture content obtained from cuttings and or excess material

RB&G ENGINEERING, INC.

UNCONFINED COMPRESSION TEST ON COHESIVE SOILS

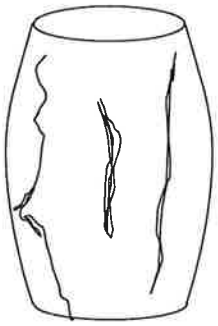
Project	Skyline Mine Seismic Monitering - Boulger Dam	**Boring No.**	17-2
Project No.	201701-022	**Sample**	1
Location	See Site Plan	**Depth / Elev. (ft)**	15-16.5'
Date	Tuesday, October 10, 2017	**Sample Description**	Clayey Sand w/ Gravel SC
Tested By	S Neil	**Sample Type**	Spoon Sample

Apparatus No.	UC - 1	Proving Ring No.	5552



Total Strain	Stress (psf)
0.0%	0
0.3%	476
0.7%	758
1.4%	1094
2.1%	1365
2.7%	1561
3.4%	1754
4.1%	1946
4.8%	2135
5.5%	2340
6.2%	2526
6.8%	2676
8.2%	2990
9.6%	3171
11.0%	3195
12.3%	2959

Sketch of Specimen After Failure



Initial Sample Data

Initial height of specimen	L_o	2.92	(in)	**Liquid limit**	LL	nt
Initial diameter of specimen	D_o	1.9	(in)	**Plastic index**	PI	nt
Height-to-diameter ratio	L_o / D_o	1.54		**Moisture content***	w	12.9%
Dry unit weight	γ_d	114.6	(pcf)			

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Test Results

Unconfined compressive strength	q_u	3195	(psf)
Shear strength	τ_f	1598	(psf)
Average strain rate to failure		1%	
Strain at failure		11.0%	

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Remarks _____

*Moisture content obtained from cuttings and or excess material

H:\2017\022_Skyline Mine Seismic Monitoring Network\Lab Testing\17-2 @ 15-16.5' UC

ASTM D 2166

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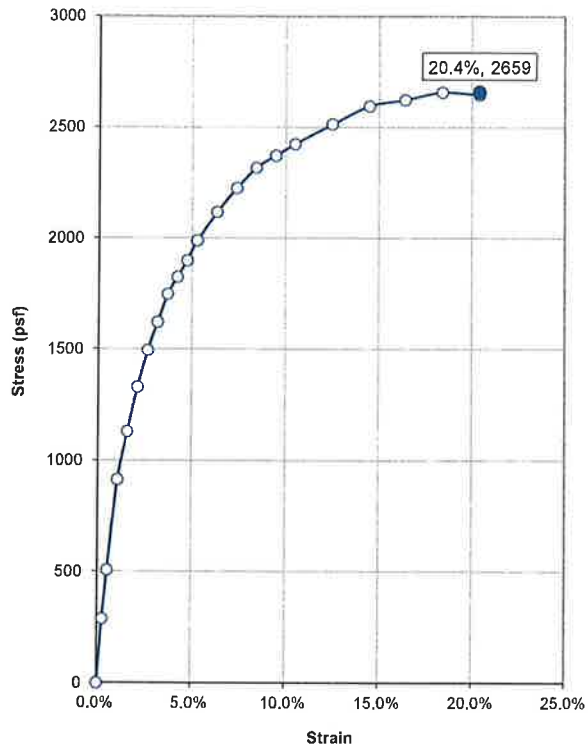
UNCONFINED COMPRESSION TEST ON COHESIVE SOILS

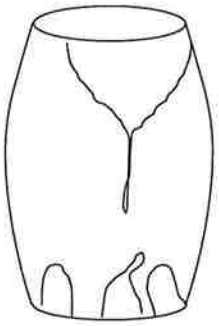
Project	Skyline Mine Seismic Monitering - Boulger Dam	**Boring No.**	17-3
Project No.	201701-022	**Sample**	1
Location	See Site Plan	**Depth / Elev. (ft)**	26-27.5'
Date	Tuesday, October 10, 2017	**Sample Description**	Clayey Sand w/ Gravel SC
Tested By	S Neil	**Sample Type**	Spoon Sample

Apparatus No.	UC - 1	Proving Ring No.	5552



Total Strain	Stress (psf)
0.0%	0
0.3%	287
0.5%	506
1.1%	913
1.6%	1130
2.1%	1330
2.6%	1495
3.2%	1621
3.7%	1749
4.2%	1824
4.7%	1899
5.3%	1990
6.3%	2117
7.4%	2225
8.4%	2317
9.5%	2372
10.5%	2424
12.5%	2514
14.5%	2595
16.4%	2624
18.4%	2657
20.4%	2647
20.4%	2659

Sketch of Specimen After Failure



Initial Sample Data

Initial height of specimen	L_o	3.8	(in)	**Liquid limit**	LL	nt
Initial diameter of specimen	D_o	1.9	(in)	**Plastic index**	PI	nt
Height-to-diameter ratio	L_o / D_o	2.00		**Moisture content***	w	13.2%
Dry unit weight	γ_d	132.1	(pcf)			

Test Results

Unconfined compressive strength	q_u	2659	(psf)
Shear strength	τ_f	1330	(psf)
Average strain rate to failure		1%	
Strain at failure		20.4%	

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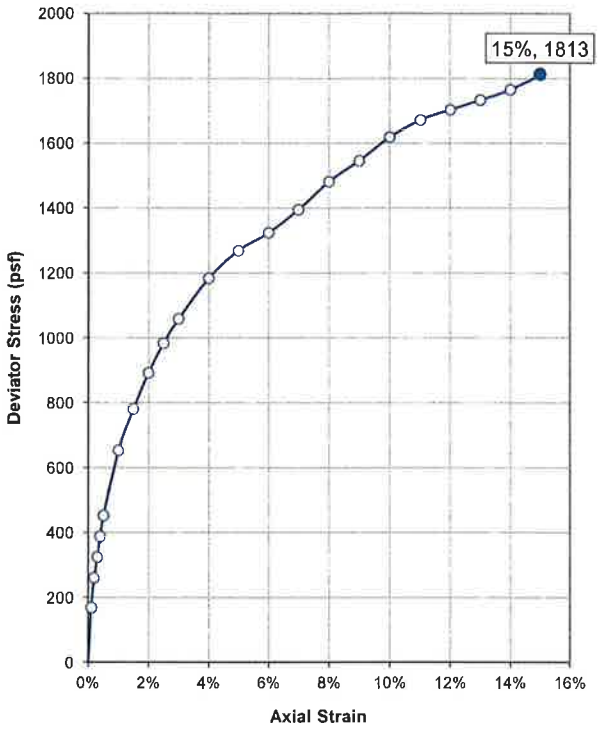
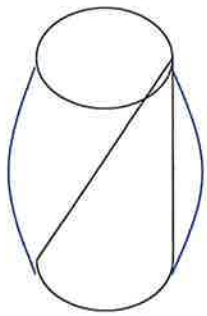
Remarks _____

*Moisture content obtained from cuttings and or excess material

UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS

Project	Skyline Mine Boulger	**Boring No.**	17-3
Project No.	201701-022	**Sample**	1
Location	see site plan	**Depth / Elev. (ft)**	9-10.5'
Date	Wednesday, October 18, 2017	**Sample Description**	Silty Sand SM
Tested By	J. B.	**Sample Type**	Spoon Sample



Axial Strain	σ_d (psf)	σ_d / 2 (psf)	Sketch of Specimen After Failure
0.0%	-3	-2	
0.1%	169	85	
0.2%	261	130	
0.3%	325	162	
0.4%	389	194	
0.5%	453	226	
1.0%	654	327	
1.5%	782	391	
2.0%	892	446	
2.5%	984	492	
3.0%	1059	529	
4.0%	1184	592	
5.0%	1269	635	
6.0%	1324	662	
7.0%	1395	698	
8.0%	1482	741	
9.0%	1546	773	
10.0%	1619	809	
11.0%	1672	836	
12.0%	1703	852	
13.0%	1733	867	
14.0%	1765	883	
15.0%	1810	905	

Initial Sample Data

Initial height of specimen	L_o	2.66	(in)	**Moisture content***	w	15.0%	
Initial diameter of specimen	D_o	1.91	(in)	**Dry unit weight**	γ_d	110.3	(pcf)
Height-to-diameter ratio	L_o / D_o	1.39		**Specific gravity of soil solids**	G_s	2.68	*[Estimated value]*
Liquid limit	LL	NP		**Initial void ratio**	e_o	0.517	
Plastic index	PI	NP		**Saturation**	S	78%	

Test Results

Deviator stress at failure**	$\sigma_{d,f}$	1813	(psf)	**Major principal stress at failure****	σ_1	2964	(psf)
Shear stress at failure**	c_u	907	(psf)	**Minor principal stress at failure****	σ_3	1151	(psf)
Average strain rate to failure		1%	/ min				
Strain at failure		15%					

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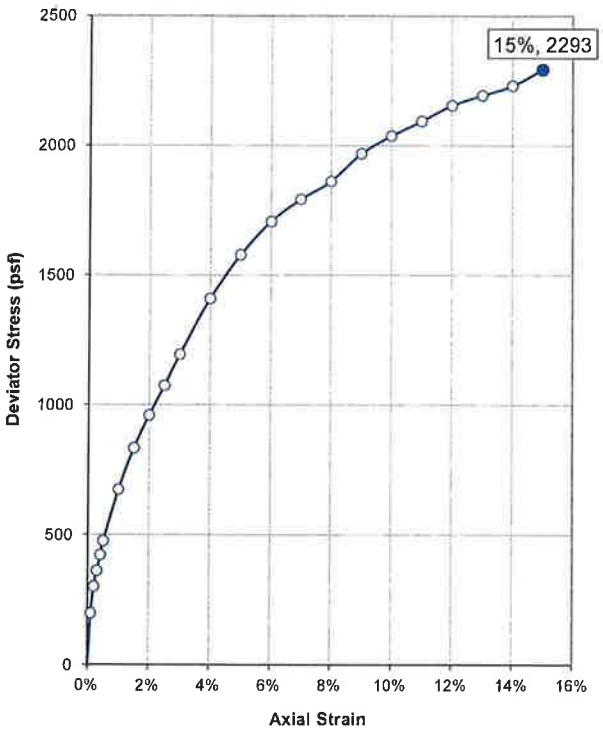
Remarks Confining Pressure 8 psi

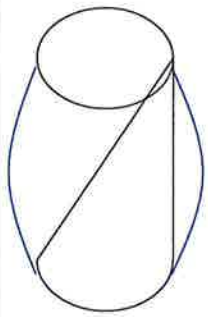
*Moisture content obtained from cuttings and or excess material
**Values corrected for membrane effects

ASTM D 2850

UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS

Project	Skyline Mine Boulger	Boring No.	17-3
Project No.	201701-022	Sample	1
Location	see site plan	Depth / Elev. (ft)	24-25.5'
Date	Wednesday, October 18, 2017	Sample Description	Clayey Sand w/ Gravel SC
Tested By	J. B.	Sample Type	Spoon Sampl



Axial Strain	σ_d (psf)	$\sigma_d / 2$ (psf)	Sketch of Specimen After Failure
0.0%	-6	-3	
0.1%	199	99	
0.2%	302	151	
0.3%	362	181	
0.4%	422	211	
0.5%	476	238	
1.0%	674	337	
1.5%	834	417	
2.0%	960	480	
2.5%	1074	537	
3.0%	1195	597	
4.0%	1409	705	
5.0%	1579	789	
6.0%	1707	853	
7.0%	1793	897	
8.0%	1862	931	
9.0%	1969	984	
10.0%	2037	1019	
11.0%	2093	1047	
12.0%	2154	1077	
13.0%	2193	1097	
14.0%	2230	1115	
15.0%	2293	1147	

Initial Sample Data

Initial height of specimen	L_o	3.63	(in)	Moisture content*	w	12.3%	
Initial diameter of specimen	D_o	1.90	(in)	Dry unit weight	γ_d	131.8	(pcf)
Height-to-diameter ratio	L_o / D_o	1.91		Specific gravity of soil solids	G_s	2.68	*[Estimated value]*
Liquid limit	LL	21		Initial void ratio	e_o	0.268	
Plastic index	PI	8		Saturation	S	100%	

Test Results

Deviator stress at failure**	$\sigma_{d,f}$	2293	(psf)	Major principal stress at failure**	σ_1	5170	(psf)
Shear stress at failure**	c_u	1147	(psf)	Minor principal stress at failure**	σ_3	2877	(psf)
Average strain rate to failure		1%	/ min				
Strain at failure		15%					

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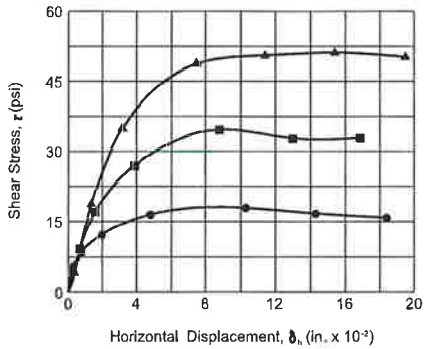
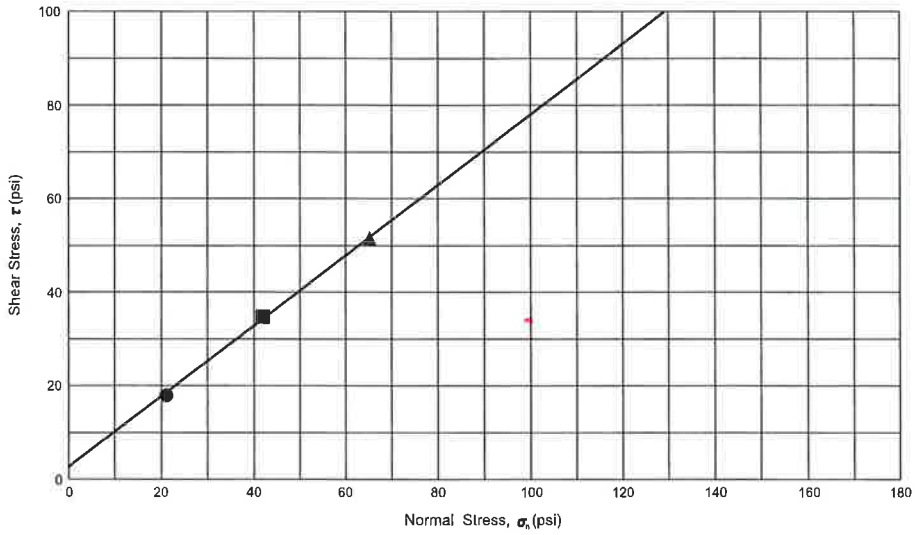
Remarks Confining Pressure 20 psi

*Moisture content obtained from cuttings and or excess material
**Values corrected for membrane effects

ASTM D 2850





Test No. or Symbol	Sample Size (inches)	Sample Data		Degree of Saturation (%)	Normal Stress σ_n (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/ minute)	Shear Strength Parameters	
		Dry Density (pcf)	Moisture Content (%)					Friction Angle (degrees)	Cohesion (psi)
●	2.37	133.1	9.4	~100	21.1	18.0	0.0006	37.0	3
■	2.37	132.8	9.3	~100	41.9	34.8	0.0006		
▲	2.37	131.1	9.4	~100	65.2	51.2	0.0006		

MATERIAL: SILTY SAND W/GRAVEL (PLASTIC) (SM) (REMOLDED)

RB&G ENGINEERING, INC.

DIRECT SHEAR TEST

Project: *Skyline Mine Seismic Monitoring - Boulger Dam*
Scofield, Carbon County, Utah

HOLE NO.: 17-2

DEPTH: 6'-7.5'

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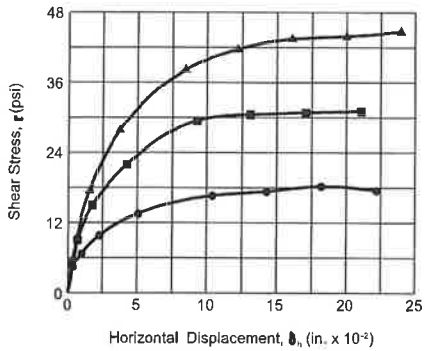

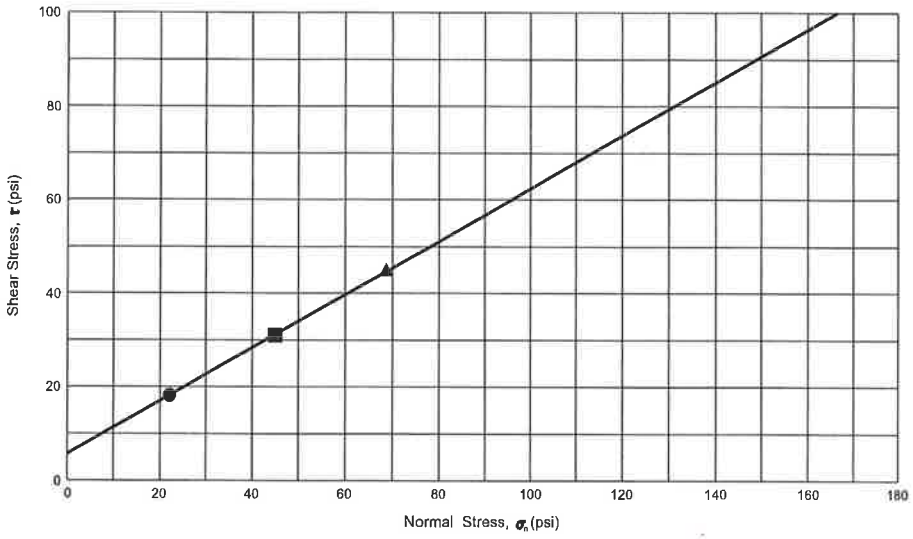

Test No. or Symbol	Sample Size (inches)	Sample Data		Degree of Saturation (%)	Normal Stress σ_n (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/ minute)	Shear Strength Parameters	
		Dry Density (pcf)	Moisture Content (%)					Friction Angle (degrees)	Cohesion (psi)
●	2.37	114.4	18.5	~100	22.1	18.3	0.0006	29.5	6
■	2.37	113.9	19.1	~100	45.0	31.1	0.0006		
▲	2.37	114.1	18.5	~100	68.7	44.7	0.0006		

MATERIAL: CLAYEY SAND (SC) (REMOLDED)

RB&G ENGINEERING, INC.

DIRECT SHEAR TEST

Project: *Skyline Mine Seismic Monitoring - Boulger Dam Scofield, Carbon County, Utah*

HOLE NO.: 17-2

DEPTH: 21'-22.5'

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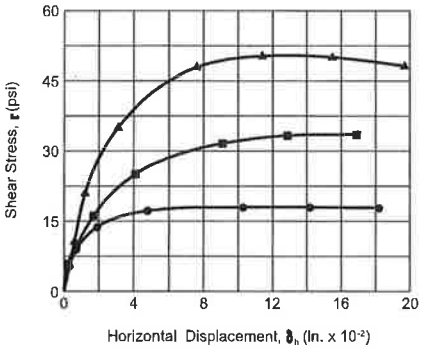

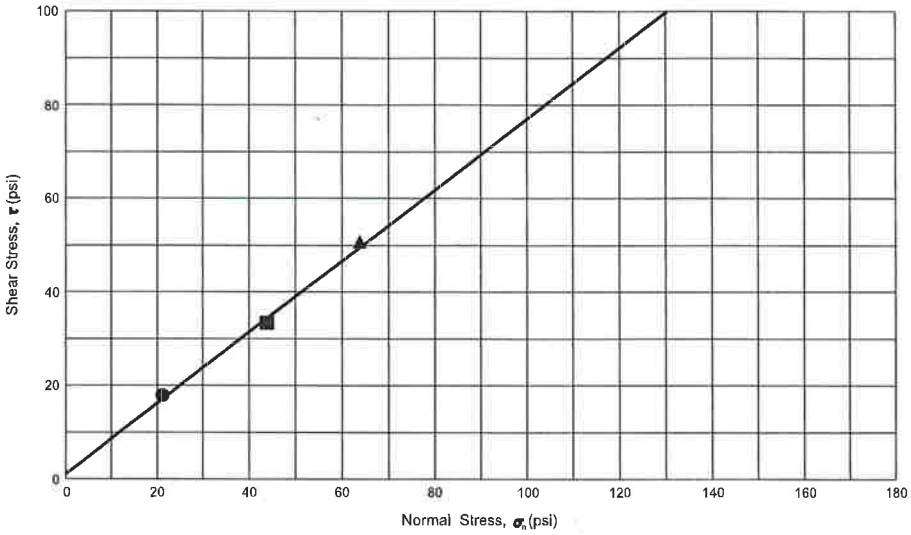

Test No. or Symbol	Sample Size (inches)	Sample Data		Degree of Saturation (%)	Normal Stress σ_n (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/ minute)	Shear Strength Parameters	
		Dry Density (pcf)	Moisture Content (%)					Friction Angle (degrees)	Cohesion (psi)
●	2.37	122.7	12.3	~100	21.1	18.0	0.0009	37.2	1
■	2.37	123.2	12.2	~100	43.9	33.5	0.0009		
▲	2.37	122.7	12.3	~100	63.8	50.4	0.0009		

MATERIAL: SILTY SAND W/GRAVEL (SM) (REMOLDED)

RB&G ENGINEERING, INC.

DIRECT SHEAR TEST

Project: *Skyline Mine Seismic Monitoring - Boulger Dam*
Scofield, Carbon County, Utah

HOLE NO.: 17-2

DEPTH: 9'-10.5'

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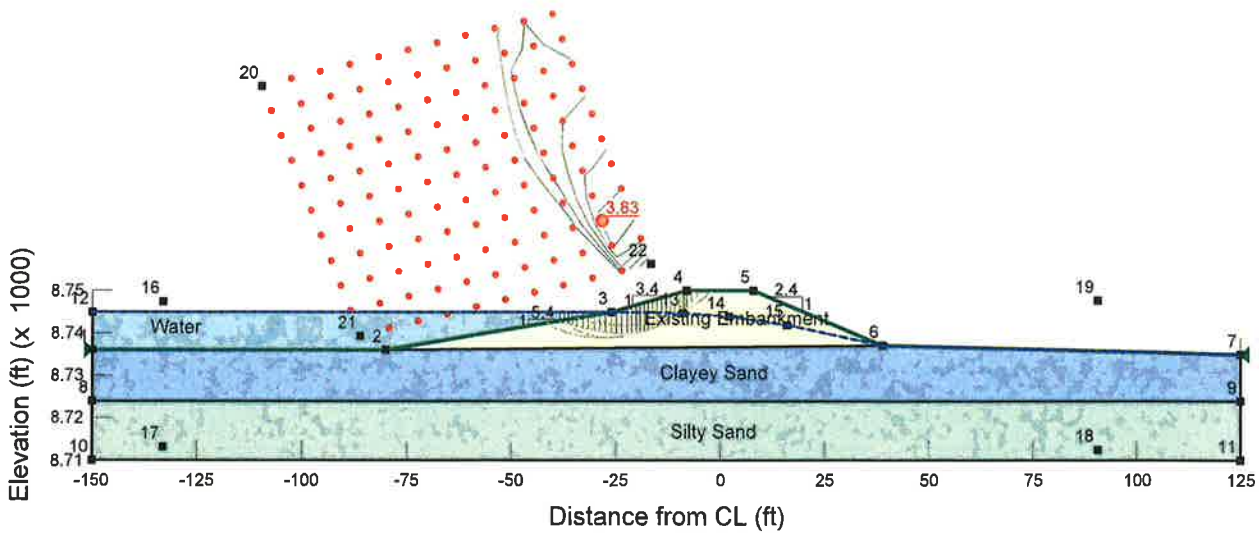
Boulger Dam
Upstream Slope
Steady State Condition

Description: Existing Embankment Wt: 135 Cohesion: 100 Phi: 35
Description: Clayey Sand Wt: 130 Cohesion: 200 Phi: 28
Description: Silty Sand Wt: 130 Cohesion: 0 Phi: 34
Description: Water Wt: 62.4



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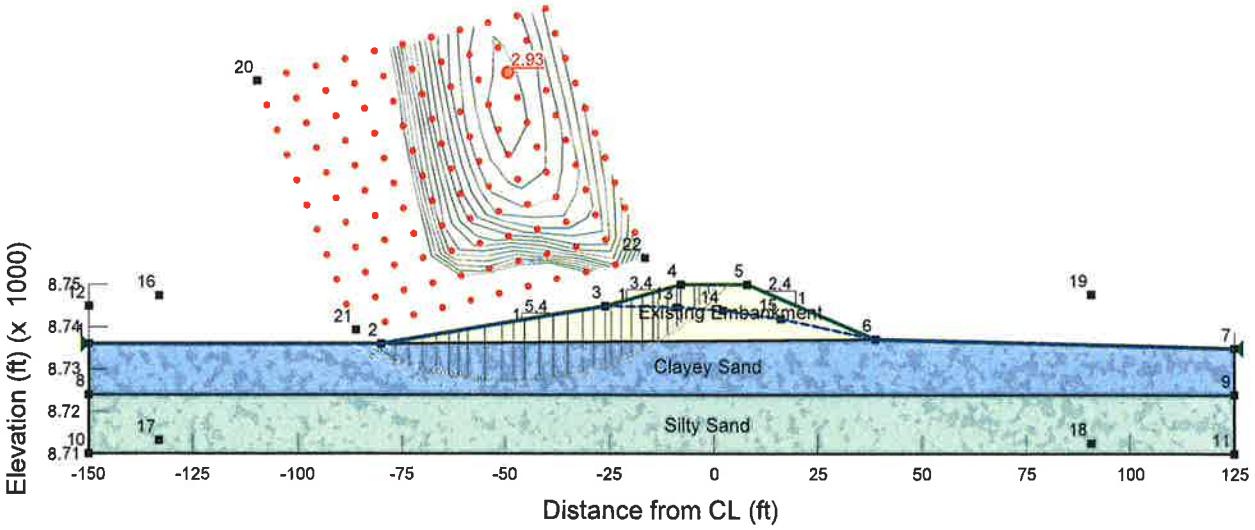
Boulger Dam
Upstream Slope
Instantaneous Draw Down Condition

Description: Existing Embankment Wt: 135 Cohesion: 100 Phi: 35
Description: Clayey Sand Wt: 130 Cohesion: 200 Phi: 28
Description: Silty Sand Wt: 130 Cohesion: 0 Phi: 34
Description: Water Wt: 62.4



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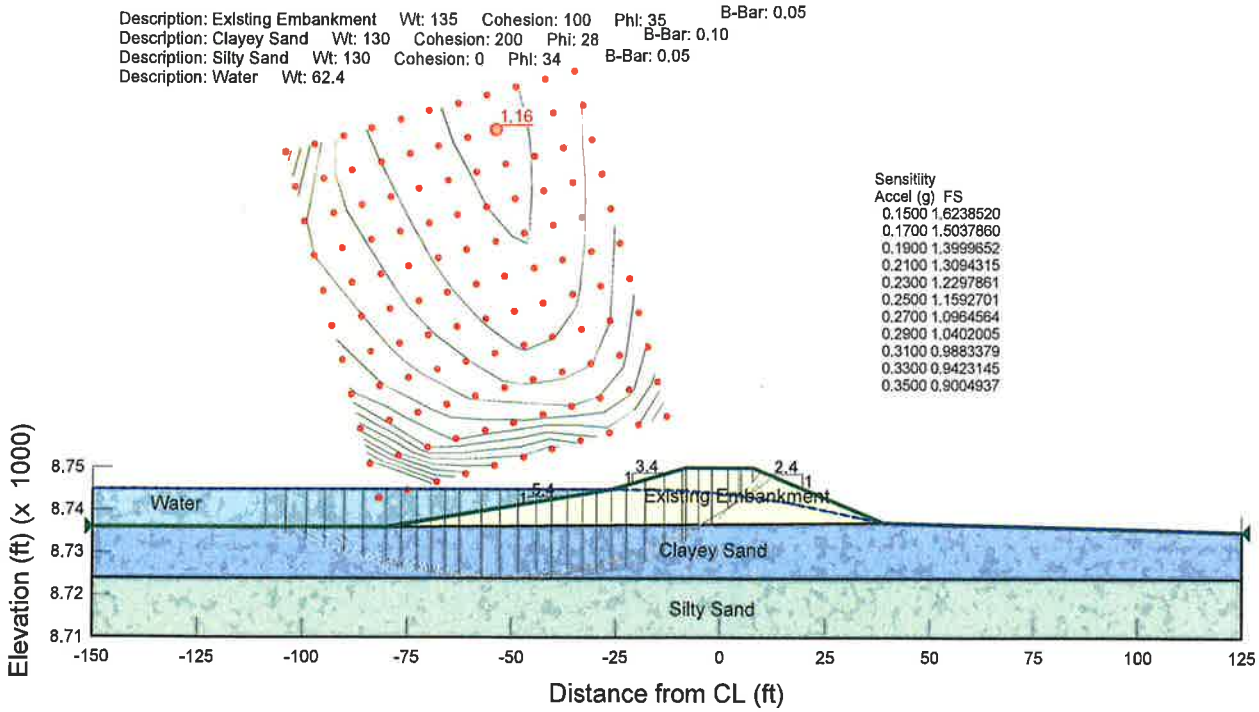
Boulger Dam
Upstream Slope
Seismic Yield Acceleration



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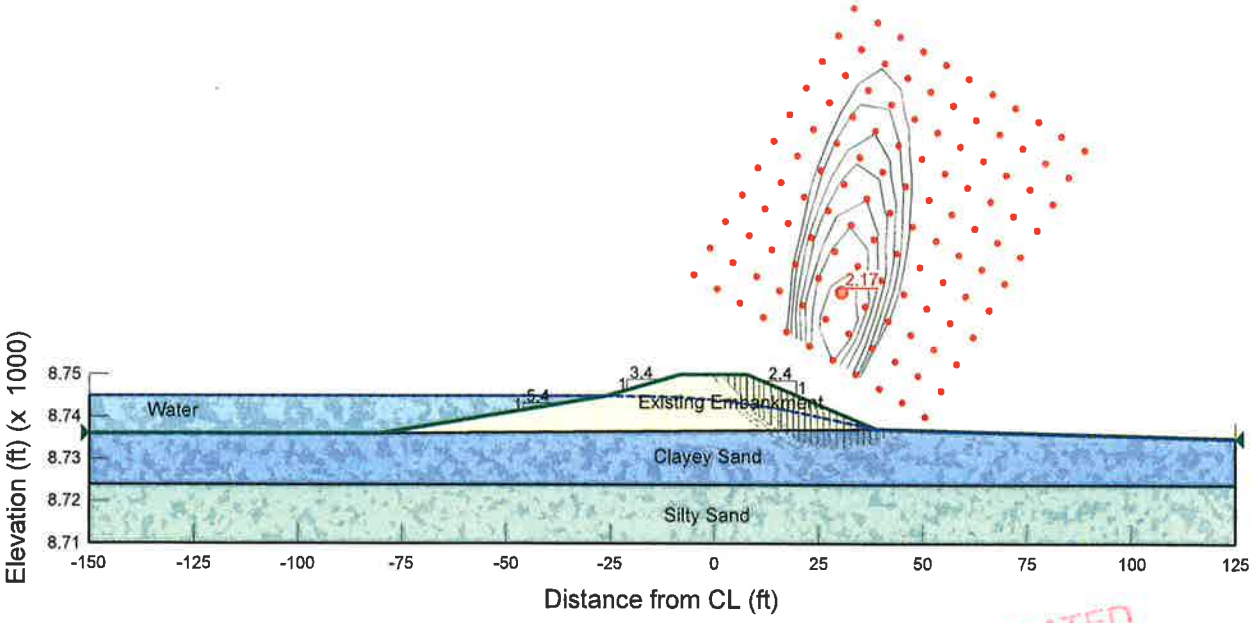
Boulger Dam
Downstream Slope
Steady State Condition

Description: Existing Embankment Wt: 135 Cohesion: 100 Phi: 35
Description: Clayey Sand Wt: 130 Cohesion: 200 Phi: 28
Description: Silty Sand Wt: 130 Cohesion: 0 Phi: 34
Description: Water Wt: 62.4



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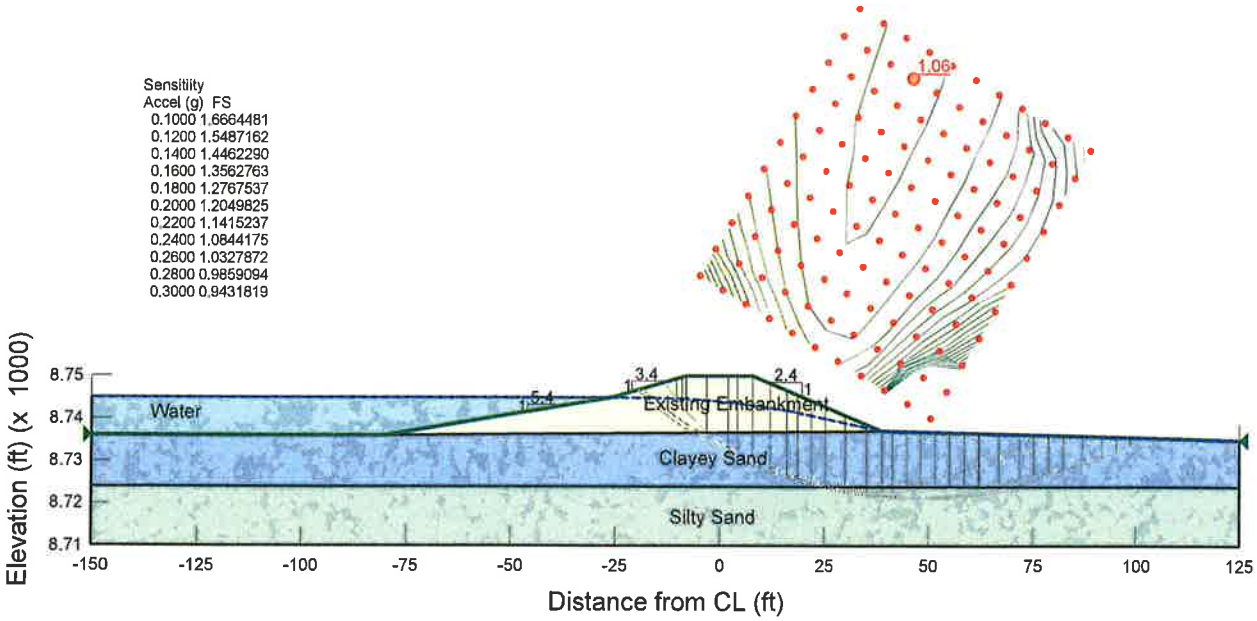
Boulger Dam
Downstream Slope
Seismic Yield Acceleration

Description: Existing Embankment Wt: 135 Cohesion: 100 Phi: 35 B-Bar: 0.05
Description: Clayey Sand Wt: 130 Cohesion: 200 Phi: 28 B-Bar: 0.10
Description: Silty Sand Wt: 130 Cohesion: 0 Phi: 34 B-Bar: 0.05
Description: Water Wt: 62.4

Sensitiity

Accel (g)	FS
0.1000	1.6664481
0.1200	1.5487162
0.1400	1.4462290
0.1600	1.3562763
0.1800	1.2767537
0.2000	1.2049825
0.2200	1.1415237
0.2400	1.0844175
0.2600	1.0327872
0.2800	0.9859094
0.3000	0.9431819



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Seismic Deformation Estimate - Newmark Sliding Block Method

Project: **Boulger Dam**

Date: 5/1/2018

By: bdh

Yield Accelerations:

beginning of earthquake

upstream:	0.30 g
downstream:	0.27 g

end of earthquake

upstream:	0.30 g
downstream:	0.27 g

Input Earthquake Record:

Event:	Mar 11, 2006 at Grassy Trail Dam
PGA:	0.348 g
Modifications:	Input motion scaled to PGA = 2.27g

Seismic Deformation:

positive record downstream	
top:	0.04 ft
middle:	0.01 ft
bottom:	0.00 ft
AVERAGE:	*0.02 ft*

negative record downstream	
top:	0.04 ft
middle:	0.02 ft
bottom:	0.01 ft
AVERAGE:	*0.02 ft*

negative record upstream	
top:	0.04 ft
middle:	0.02 ft
bottom:	0.00 ft
AVERAGE:	*0.02 ft*

positive record upstream	
top:	0.03 ft
middle:	0.02 ft
bottom:	0.00 ft
AVERAGE:	*0.02 ft*

Acceleration Time Histories obtained using 2D equivalent-linear modeling in Quake/W (Geo-Slope Intl.)

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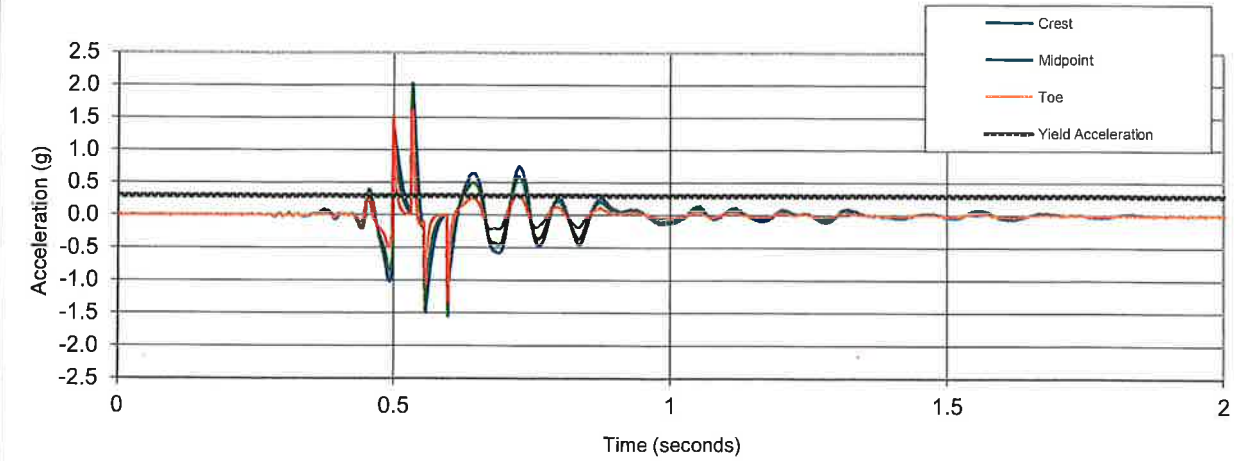

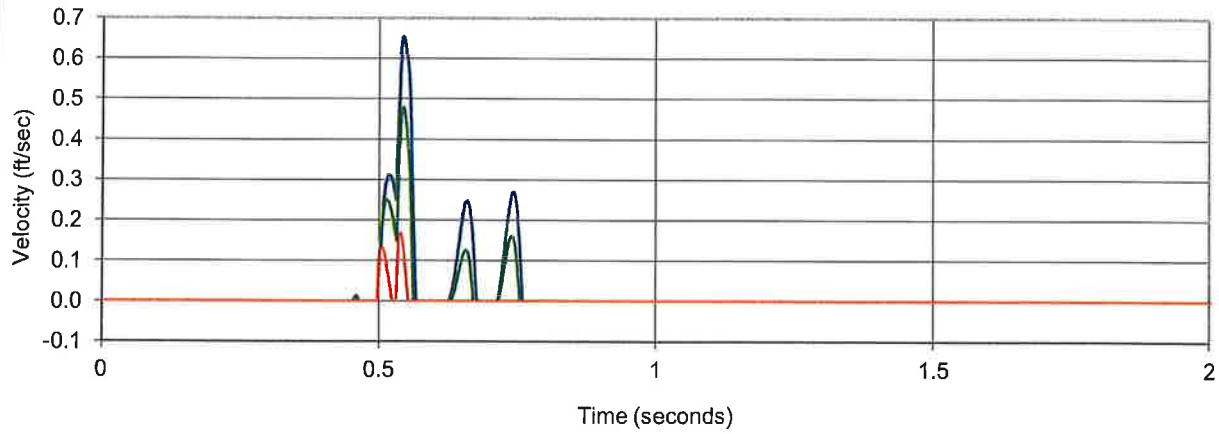

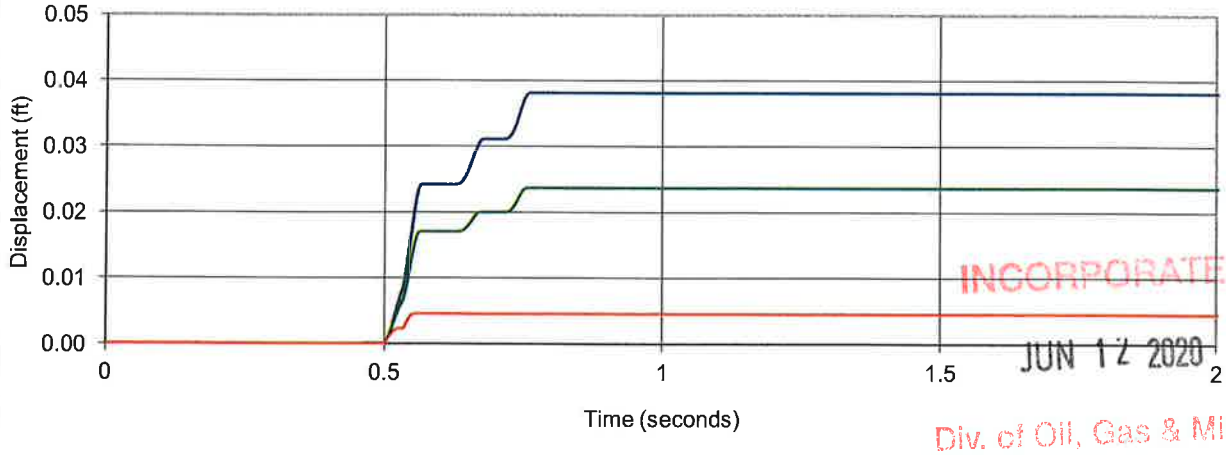

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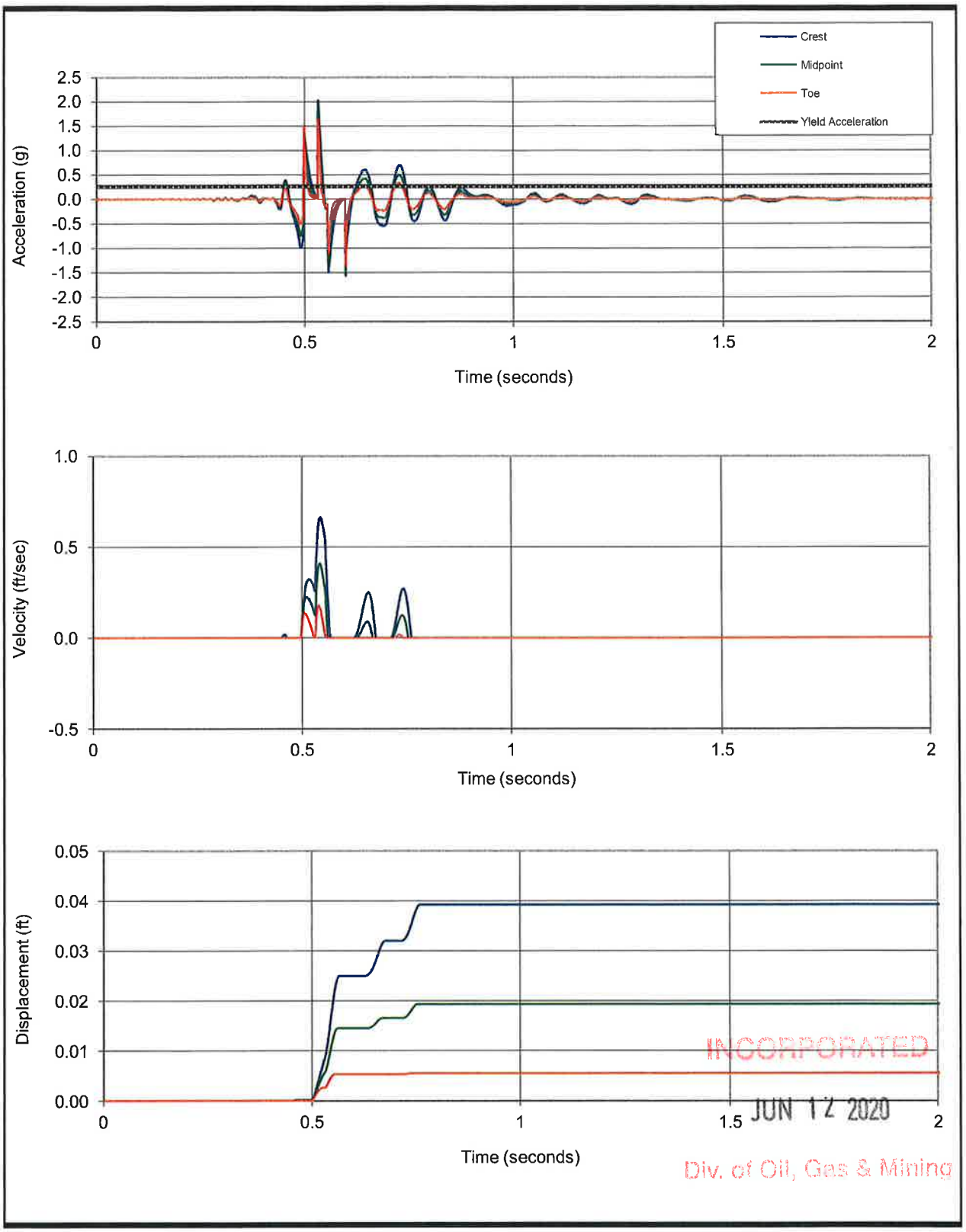
RB&G ENGINEERING INC.

Provo, Utah

Embankment Deformation
Upstream Slope, Negative Acceleration

Boulger Dam



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RB&G ENGINEERING INC.

Provo, Utah

Embankment Deformation - Grassy Trail 3/11/06
Downstream Slope, Negative Acceleration

Boulger Dam

Canyon Fuel Company, LLC.
A Subsidiary of Wolverine Fuels, LLC

SKYLINE MINE MEMORANDUM
Jason D. Layton
Engineering Manager, P.E.

Date: **May 7, 2019**

To: **Dave Marble, P.E., Utah Division of Water Rights - Dam Safety**

From: **Jason D. Layton, Engineering Manager, P.E.**

Subject: **Boulger Dam Reservoir – Mining-Induced Seismicity (MIS) Monitoring**

The following outlines the safety precautions Canyon Fuel Company, LLC, Skyline Mine personnel (Skyline) are taking to insure the safety of the public as underground mining approaches Boulger Reservoir in the Bureau of Land Management (BLM) federal lease UTU-77114 (Figure 1). These measures will be incorporated into the Division of Oil, Gas, and Mining (DOGM) Mining and Reclamation Plan (M&RP) for the Skyline Mine.

Mining Background: Skyline Mine opened in 1981 and in the past 38 years has mined more than 106 million tons of coal over an area covering in excess of 20 square miles. Within the 20 square miles, a total of only 139acres have been disturbed for the construction of surface facilities. Federal lease UTU-77114 represents approximately 12 years of additional mining from when the lease was acquired in 2015. Skyline employs two types of mining methods: development mining where pillars and roof support are employed to insure the area being mined does not collapse; and full extraction mining where a longwall system is used to extract a majority of the coal seam and the area being mined is designed to collapse as the longwall shear advances. This collapsing of the overlying bedrock generates both a small, short-duration seismic signature, and a lowering of the topographic surface above the area being mined. The collapsing of the bedrock propagating to the surface is termed subsidence. The amount and expression of subsidence are based on the geology of the area, the thickness of coal being mined, and the amount of overburden (depth beneath the surface). The anticipated subsidence of the Boulger Reservoir area would be approximately 2feet, to almost 4feet if the reservoir was undermined using full extraction mining techniques (Figure 2). The coal seam in the Boulger Reservoir area is approximately 10-12 feet thick and is located approximately 1200 feet below the reservoir. The interburden between the reservoir and coal seam consists of the Blackhawk Formation and approximately 30 to 60 feet of glacial-deposited sediments at the surface. The Blackhawk Formation is comprised of interbedded siltstones, mudstones, and shales while the glacial sediments tend to be unconsolidated clays, sands, gravels and cobbles. Both the Blackhawk Formation and glacial sediments tend to react plastically to subsidence, therefore making it highly unlikely that any noticeable or long-term cracking will be observed at the surface in the valley bottoms. Minor cracking at the surface along ridgetops areas where the Castlegate Sandstone is near the surface can occur (Figure 3). No Castlegate Sandstone is present in the valley bottoms of the Boulger Reservoir.

Boulger Reservoir Background: Based on Utah Division of Water Rights – Dam Safety (Dam Safety) records, Boulger Dam was originally construct in 1937 as an earthen dam with a reservoir storage capacity of 30 acre-feet at the spillway crest. The dam/reservoir has a Low Hazard Rating. Based on a 2017 licensed-survey, the reservoir contains approximately 19.4 acre-feet (Figure 4), which is likely due to sediment buildup over the last 80+ years, and possibly the elevation of the fish ladder/spillway that was installed in approximately 2001. The current storage capacity being less than 20 acre-feet is significant because Utah Code 73-5a-101 – Power of State Engineer to regulate dams states: "(3) The state engineer may by rule exempt from this chapter any dam that: (a) impounds less than 20 acre-feet of water and does not constitute a threat to human life if it fails; or (b) does not constitute a threat to human life and would result in only minor damage to property of the owner if it fails." A stipulation of the BLM federal lease UTU-77114 requires Boulger Reservoir be taken out of service or develop a mitigation plan when the dam is subjected to mining-induced acceleration of 0.1g and greater. The following monitoring program fulfills the requirements of the stipulation.

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Monitoring Program: Skyline has partnered with National Institute of Occupational Safety and Health (NIOSH) and contracted with RB&G Engineering, Inc. (RB&G), to design a program to monitor the mining-induced seismic (MIS) affects to Boulger dam as mining approaches. Specific monitoring devices for the dam and reservoir have been installed by RB&G, with ground-movement devices being installed by NIOSH and Skyline. Collection of the data will be done primarily by Skyline with technical expertise provided by both RB&G and NIOSH in their respective disciplines. Data will be supplied to Dam Safety on a regular basis.

Seismicity Monitoring: Skyline, in conjunction with NIOSH, has installed a six (6) station seismic vault network (Figure 5) to monitor the MIS acceleration as mining approaches the dam. Two (2) of the seismic monitoring locations are located at the Boulger dam, with one located in the approximate center and crest of the dam, and the other located on the abutment. These two (2) sites were installed in 2017 with data currently being collected and downloaded manually. Three (3) sites located north of the dam that surround existing and advancing mining were installed in 2018, with the last site located almost due-east of the reservoir and maintained by the University of Utah Seismic Stations (site name - ELU) (Figure 6). At this point, only the U of U site is collecting and sending data to the Mine. Later in 2019, data from all sites will be sent directly to the Skyline personnel for regular monitoring using a telemetry system that uploads information directly to Mine computers. Full extraction mining, which would cause seismicity, will be within a one-mile radius of the dam in approximately November 2019. Based on preliminary seismic data collected from temporary stations located immediately above full-extraction mining at the Skyline Mine, the largest seismic activity has been in the 1.0 to 1.5 magnitude range. Seismicity data will be uploaded directly to NIOSH and Skyline personnel computers for monitoring the regular activity. Both NIOSH and Skyline personnel will be notified via email if acceleration thresholds are exceeded.

Dam/Reservoir Monitoring: Skyline has contracted with RB&G Engineering, Inc. to provide a geotechnical assessment of the integrity of the dam, determine the amount of seismicity the dam can safely absorb, quantify the potential impacts to the dam due to mining activity, and to provide mitigation measures to maintain the reservoir while mining in the area (Report Attached). The *Mining-Induced Seismicity, RB&G, June 2018* report addresses impacts to the dam based both on the currently-approved DOGM mine plan where the reservoir is not undermined, and also a complete undermining of the reservoir (Skyline's anticipated future plan). Figure 2 from the RB&B report (attached as Figure 7) illustrates that the current mine plan does not undermine the reservoir, and full extraction mining can be conducted adjacent to the reservoir. An evaluation of full-extraction mining under the reservoir was also conducted by RB&G since undermining the reservoir was anticipated by the BLM at the time of lease issuance. To acquire both a baseline assessment and determine future monitoring needs, RB&G worked with Skyline to install a network of survey monuments and piezometers in the dam and around the reservoir that will provide comprehensive monitoring of both (Figure 8). A total of six (6) survey monuments have been installed: three (3) located on the crest of the dam and three surrounding the reservoir. In addition, a total of six (6) piezometers have been installed to monitor changes in the saturation of the dam; five (5) installed on the crest of the dam (2-double nested wells), and one (1) installed at the toe of the dam (Figure 9). Piezometer 17-4, located at the toe of the dam, was installed by a Skyline drilling contractor using a small direct-push drill rig due to wetland issues. The piezometers completed in the dam provided empirical data for the recommended mitigation measures outlined (Figure 10, 10a).

The following are mitigation/monitoring recommendations are quotes from the RB&G assessment report based on the currently-approved mine plan (Figure 3) that does not include undermining of the reservoir (*items in italics are Skyline recommendations*):

- When (full extraction) mining is within one mile of reservoir - Monthly site reconnaissance to observe any change of conditions in the embankment crest or slopes. Particular attention should be given to cracking, seepage and or deformation. Electronic photographs at predetermined designated viewpoints. *Excluding 1st quarter due to snow conditions*

- When (full extraction) mining is within one mile of reservoir - Monthly measurement of reservoir

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level and piezometers. *Excluding 1st quarter due to snow conditions (Reservoir measurements will be collected from the spillway / fish ladder as it leaves the reservoir.)*

- When (full extraction) mining is within one mile of a ground motion monitoring device (accelerometer) - The recorded data should be downloaded and reviewed weekly. It is recommended that an accelerometer be installed above a panel of active mining where similar hypocentral distances will exist, compared to when panel (full extraction) mining approaches the reservoir *(Will be using the NIOSH accelerometer located on the dam embankment)*

- If seepage areas exist or develop (*when extraction mining is within one mile of the reservoir)* which do not have measurement devices, flow measurements of the seepage will be collected on a monthly basis. *Excluding 1st quarter due to snow conditions*

- Annual survey of the dam and reservoir control points (elevation and horizontal).

- Daily monitoring of the UUSS list of recent seismic events whenever (*full extraction)* mining is within one mile of Boulger Dam or Reservoir. A daily record should be maintained of the recorded events within 5 miles of the site. The UUSS information can be obtained from: http://quake.utah.edu/earthquake-center/quake-map

- When an event greater than 3.0 occurs within 5 miles of the site, a site reconnaissance of the embankment crest, slopes and basin should be performed within 24 hours, including a review of the ground motion recordings. If recorded ground acceleration exceeds 0.1g on the dam, instrumentation (*visual observations, control point and piezometer*) readings should be performed. *(Skyline suggests if no effects to the dam are observed through initial ground accelerations greater than 0.1g, in the event 0.1g measurements are recorded regularly that instrumentation readings will be conducted weekly, then increased to monthly after one-month. Excluding 1st quarter due to snow conditions.)*

- Site reconnaissance and instrumentation reports should be forwarded to RB&G Engineering and the Utah State Dam Safety Engineer within 24 hours (*for events > 3.0 within 5 miles of the site)*, and the daily monitoring records should be submitted on a monthly basis.

The following are additional mitigation measures recommended by RB&G in the event Skyline acquires approval to undermine the reservoir (as permitted under the BLM lease):

- Boulger Reservoir should be drained while mining closer to the dam than illustrated in Figure 2 (Figure 7 of this report) until subsidence is complete. Alternatively, prior to mining activity closer to the dam than illustrated in Figure 2, the reservoir should be drawn down below the crest of the dam a distance twice the estimated subsidence, and the filter zone described in Section 6.4 should be installed (Figure 11).

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- An evaluation of the dam site should be made after mining and subsidence to determine the need for remedial action. The evaluation should be submitted to Utah State Dam Safety for review and acceptance.

Skyline Mine Proposed Mitigation Plan: The monitoring measures outlined above are comprehensive and conservatively monitor MIS effects to Boulger dam. The RB&G report indicates Boulger dam could safely withstand MIS event magnitude of 3.9, which may result in a Potential Ground Acceleration (PGA) of approximately 2.29, with no additional mitigation measures necessary. In addition, the report indicates, "MIS events with magnitudes no greater than 3.0 would not be expected to produce ground accelerations greater than 0.36g assuming an s value of 0.337"(pg. 11 RB&G report). As indicated in the preliminary NIOSH data, the MIS magnitude directly above full extraction mining in the area has been only in the 1.0 – 1.5 range. RB&G personnel indicate that there is little concern with this range of

magnitude or associated acceleration having a significant impact on the dam due to the short duration of the MIS activity. The mitigation measures of lowering the water levels and installing a filter zone are recommended due to concerns of potential cracking of the earthen dam when the area is subsiding if full extraction mining is conducted beneath the dam.

Skyline Mine personnel propose to follow the mitigation measures listed above while approaching Boulger Reservoir to detect any adverse effects to the dam as soon as they are encountered. Based on the combination of 1) a low-hazard rating; 2) containing less than 20 acre-ft of water; 3) being less than 8-feet of total water (Figure 4); and 4) the malleability of the geology overlying the coal seam that is not prone to cracking, Skyline will likely plan to mine beneath the reservoir. The potential mining sequence will include full extraction mining of the North Panel (as illustrated on Figure 7), with concurrent development mining (non-subsidence) beneath the reservoir in the East Panel without impacting the integrity of dam (Figure 12). The reservoir will then be completely drained prior to full extraction mining rather than implementing the mitigation measure suggested by the RB&G report. The recommended mitigation measure of drawing down the water level and installing a filter-zone will not be implemented because the reservoir would no longer be functional at the lower depth. The drawdown would leave only approximately 4-ft of water in the reservoir and would likely be too shallow to provide sustainable fish habitat and would likely be unsafe public access. In conjunction with the drawdown, a bypass pipe will be installed on upper Boulger Creek at the inlet of the reservoir to minimize inflow into the reservoir.

Based on the currently proposed mine plan (Figure 12) draining would commence in the Fall of 2021. Full extraction mining beneath the reservoir would be conducted in the Spring of 2022, with integrity assessment and any necessary repairs being conducted in the late Fall of 2023. Based on the empirical MIS and subsidence data collected from mining up to the reservoir, Skyline personnel anticipate the reservoir will be able to start refilling at the completion of any repairs, while mining continues to the south. Monitoring of the dam will continue through a thorough evaluation period recommended by RB&G and Dam Safety personnel. The implementation of the draining of Boulger Reservoir will be through consultation of Dam Safety, US Forest, and Utah Division of Wildlife personnel, with any necessary mitigation measures being addressed.

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GARY R. HERBERT
Governor
SPENCER J. COX
Lieutenant Governor

State of Utah
DEPARTMENT OF NATURAL RESOURCES
Division of Water Rights

BRIAN C. STEED
Executive Director

KENT L. JONES
State Engineer/Division Director

July 22, 2019

Jason D. Layton, P.E.
Canyon Fuel Company, LLC
HC 35, Box 380
Helper, Utah 84526

RE: Boulger Dam / UT00695
Skyline Mining-Induced Seismicity - Monitoring and Mitigation Plan

Dear Mr. Layton:

We have received the following documents:

1. "Boulger Dam Reservoir – Mining-Induced Seismicity (MIS) Monitoring" *memorandum*, prepared by Canyon Fuel Company, LLC, dated May 7, 2019.
2. "Mining-Induced Seismicity, Skyline Flat Canyon Mining Lease, Boulger and Electric Lake Dams & Reservoirs, Sanpete and Emery County, Utah," prepared by RB&G, dated June 26, 2018.

We have reviewed the above listed documents and find the recommended monitoring and mitigation plan for the Boulger Dam acceptable to Dam Safety. Provide to us a copy of the U.S. Forest (Owner) letter that acknowledges and accepts the proposed plan.

Please keep the Utah State Engineer's office informed as to the progress of the mining within 1-mile of the Boulger Dam and Reservoir, the draining of the Boulger Reservoir and the follow up integrity assessment report with any repair recommendations. Prior to any repairs, submit proposed repair plans for review and approval to the State Engineer's office.

If you have any questions or need to discuss these issues in further detail, please contact me at (801) 538-7376.

Sincerely,

David K. Marble, P.E.
Assistant State Engineer/Dam Safety

DKM/tg

pc: Marc Stilson - Regional Engineer
Bob Sengle - U.S. Forest Service Manti-La Sal
Steve Christensen - DOGM, stevechristensen@utah.gov
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Seismic Activity Summary January 1, 2017 through February 11, 2019
Shawn Boltz, Derrick Chambers, Dave Hanson

EXECUTIVE SUMMARY

This report provides a summary of seismic activity that has been detected in the vicinity of the mine between January 1, 2017, and February 11, 2019, on the University of Utah Seismograph Station's (UUSS) regional seismic network. It also provides a summary of current processing of data from the three temporary deployments that NIOSH has conducted at the mine.

A total of 54 events have been detected in the vicinity of the mine during the indicated time period, 34 of which are most likely associated with mining activity. The mining events are clearly divided into two time windows: January 2017 to July 2017 and August 2018 to present, likely corresponding to the mining of 15L and the mining of R2/R3, respectively. The number of events detected by UUSS during the two time windows is comparable.

Several events occurring since August 2018 were observable underground. Examining continuous records for the closest UUSS station, ELU, for the time windows surrounding these events allowed NIOSH researchers to identify these events and several others in those time windows.

Three temporary seismic deployments have been conducted by NIOSH researchers at the mine between September 2017 and August 2018, over panels 7L, R1 and R2. The data from the 7L panel has been manually processed while the processing of R1 and R2 is ongoing due to the number of detected events. There is a clear difference in the amount of activity between the 7L and R1 and R2 panels. The difference is partially attributable to differences in the station configurations between the deployments, as stations more densely spaced in the R1/R2 deployments, allowing the detection of smaller events. However, a statistical analysis reveals that the increase in activity for the R1, and likely R2, deployments is significant.

INTRODUCTION

This report provides a summary of seismic activity that has been detected in the vicinity of the mine. This report primarily focuses on data collected from the University of Utah Seismograph Station's (UUSS) regional seismic sensors from the time period of January 1, 2017, to February 11, 2019. It also summarizes the data collected from several NIOSH temporary seismic deployments during the same time window. Four permanent NIOSH seismic sensors are also deployed above the mine, but due to a lack of telemetry it is not feasible to collect the data until spring.

UUSS DATA

UUSS has four stations located within 45 km (28 mi) of the active mine workings, shown on Figure 1. One of these stations, ELU, is located 6 km (3.7 mi) from the R2 panel. Because of the large separation between these stations, UUSS's threshold for detecting events in this area is approximately a magnitude of 1.0, with the magnitude above which they are able to detect all events that occur likely being higher, around 1.8. As a result, it is important to note that UUSS was only be able to detect a small percentage of the events that actually occurred in this area. Additionally, the authors are not aware of any changes in the configuration of the UUSS network or event reporting procedures that would have a significant impact on the number or size of events reported during the specified time frame.

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Figure 1. Locations of UUSS regional sensors (green triangles) in relation to the mine. The point labeled R2 denotes the location of the R2 panel.

A catalog of events that occurred in the vicinity of the mine from January 1, 2017, to February 11, 2019, was obtained from the UUSS. Due to the uncertainty in the locations of regional events compared to the scale of the mine, a search region defined by the following rectangle was used: Latitude 39.587° – 39.767° N, Longitude 111.130° – 111.363° W.

The UUSS catalog contains 54 events, plotted in Figure 2. Events were classified as either mining-induced or tectonic after Stein [2015]. The events can be divided into five groups:

- events that are likely associated with the current panel district (yellow, listed in Table 1);
- events that may be associated with 15L (red, listed in Table 2);
- events that may be associated with older mine workings or some non-mining source (light blue, listed in Table 3);
- events that are most likely tectonic (purple, listed in Table 4); and
- events of an unknown, but possibly tectonic, origin (green, listed in Table 5).

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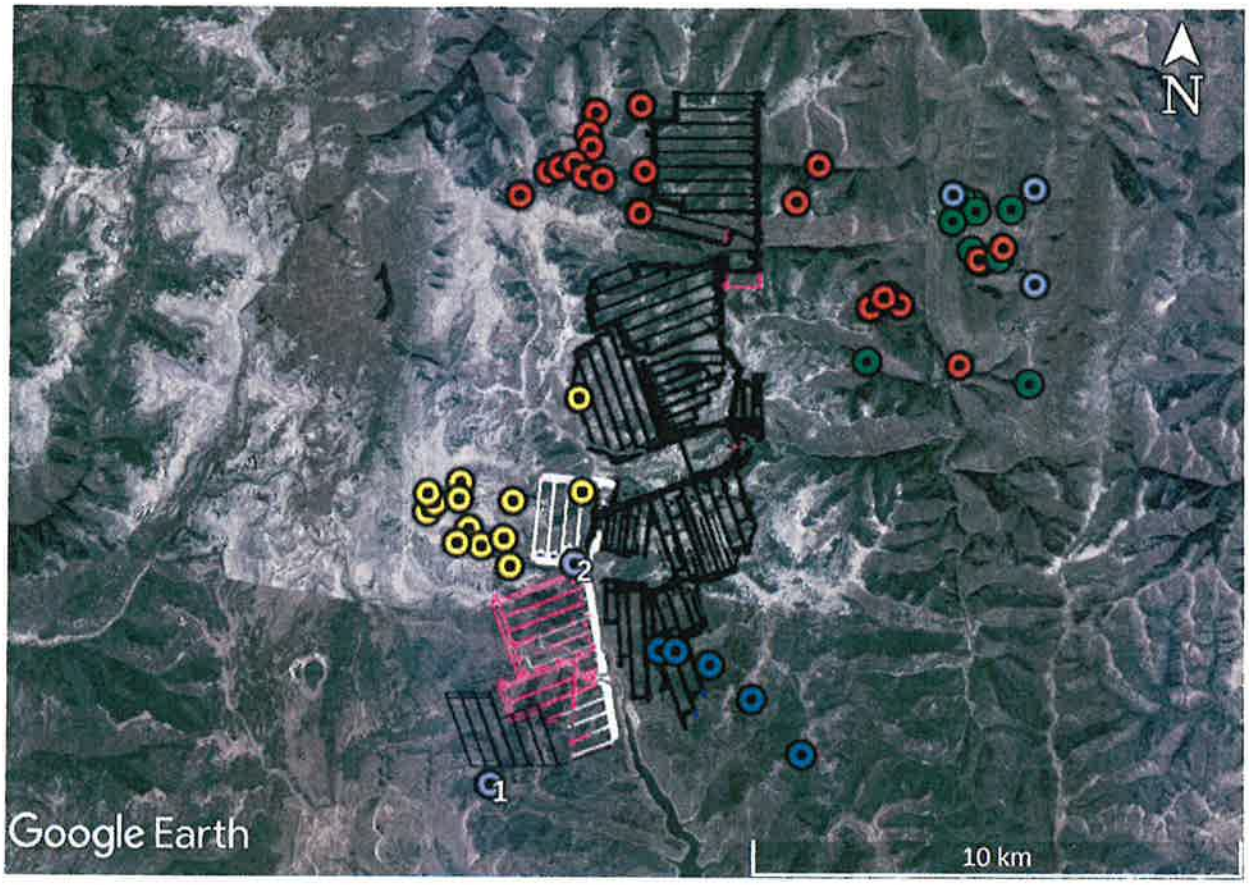

Figure 2. Locations of events reported in the UUSS catalog. Events are colored by cluster and labeled as in Tables 1-5.

Table 1. Events associated with the current panel district (yellow)

Origin Time (UTC)	Origin Time (Local)	Latitude	Longitude	Depth	Magnitude
2018-08-15T00:11:13.240Z	2018-08-14T19:11:13.240Z	39.67567	-111.245	-1.14	1.07
2018-08-21T10:30:22.960Z	2018-08-21T04:30:22.960Z	39.66633	-111.275	-2.01	1.38
2019-01-07T00:03:55.010Z	2019-01-06T17:03:55.010Z	39.66583	-111.269	-1.59	1.63
2019-01-07T08:59:37.250Z	2019-01-07T01:59:37.250Z	39.674	-111.261	-1.72	1.35
2019-01-21T07:50:29.400Z	2019-01-21T00:50:29.400Z	39.67367	-111.28	-3.48	1.35
2019-01-23T11:51:41.540Z	2019-01-23T04:51:41.540Z	39.67533	-111.282	-3.4	1.41
2019-02-01T00:35:57.560Z	2019-01-31T17:35:57.560Z	39.67733	-111.274	-3.43	1.58
2019-02-01T09:33:11.100Z	2019-02-01T02:33:11.100Z	39.67433	-111.274	-3.41	1.35
2019-02-03T00:00:54.460Z	2019-02-02T17:00:54.460Z	39.672	-111.282	-3.39	1.49
2019-02-05T14:31:57.600Z	2019-02-05T07:31:57.600Z	39.669	-111.272	-2.72	1.48
2019-02-08T09:41:58.800Z	2019-02-08T02:41:58.800Z	39.69267	-111.246	-3.45	1.03
2019-02-10T19:41:06.100Z	2019-02-10T12:41:06.100Z	39.66717	-111.264	-1.56	1.34
2019-02-10T07:19:04.190Z	2019-02-10T00:19:04.190Z	39.66217	-111.262	-1.82	1.43

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Table 2. Events associated with 15L (red)

Origin Time (UTC)	Origin Time (Local)	Latitude	Longitude	Depth	Magnitude
2017-02-14T21:22:37.050Z	2017-02-14T14:22:37.050Z	39.70933	-111.176	-1.53	1.32
2017-04-06T14:08:50.040Z	2017-04-06T08:08:50.040Z	39.70983	-111.169	-1.41	1.32
2017-04-14T17:38:40.170Z	2017-04-14T11:38:40.170Z	39.71117	-111.173	-1.59	1.21
2017-04-14T19:41:15.070Z	2017-04-14T13:41:15.070Z	39.71133	-111.172	-3.4	1.19
2017-04-18T15:37:59.760Z	2017-04-18T09:37:59.760Z	39.69883	-111.155	-1.31	1.19
2017-06-23T03:51:52.870Z	2017-06-22T21:51:52.870Z	39.72017	-111.144	6.69	1.42
2018-12-18T20:41:35.120Z	2018-12-18T13:41:35.120Z	39.718	-111.15	1.64	1.15
2017-04-01T07:25:04.090Z	2017-04-01T01:25:04.090Z	39.746	-111.231	5.96	1.41
2017-04-06T23:10:46.590Z	2017-04-06T17:10:46.590Z	39.73467	-111.251	3.76	1.91
2017-04-07T03:02:18.870Z	2017-04-06T21:02:18.870Z	39.73833	-111.243	1.31	1.14
2017-04-11T08:59:20.380Z	2017-04-11T02:59:20.380Z	39.73317	-111.245	4.33	1.26
2017-04-14T02:43:41.260Z	2017-04-13T20:43:41.260Z	39.72633	-111.231	1.56	1.15
2017-04-15T16:06:35.410Z	2017-04-15T10:06:35.410Z	39.73517	-111.189	1.66	1.04
2017-04-15T23:01:41.730Z	2017-04-15T17:01:41.730Z	39.73383	-111.253	-0.39	1.21
2017-04-20T11:55:08.080Z	2017-04-20T05:55:08.080Z	39.74467	-111.242	15.35	1.22
2017-04-20T21:39:43.710Z	2017-04-20T15:39:43.710Z	39.7325	-111.24	1.95	1.66
2017-04-21T21:39:28.510Z	2017-04-21T15:39:28.510Z	39.7295	-111.26	3.04	1.14
2017-04-21T22:50:50.970Z	2017-04-21T16:50:50.970Z	39.7285	-111.194	-3.43	1.52
2017-04-23T10:07:11.780Z	2017-04-23T04:07:11.780Z	39.74083	-111.244	6.01	1.27
2017-04-23T21:39:23.210Z	2017-04-23T15:39:23.210Z	39.73533	-111.247	1.13	1.31
2017-04-25T14:41:36.250Z	2017-04-25T08:41:36.250Z	39.734	-111.23	2.1	1.54

Table 3. Events associated with older mine workings or some non-mining source (light blue)

Origin Time (UTC)	Origin Time (Local)	Latitude	Longitude	Depth	Magnitude
2017-04-18T01:34:26.750Z	2017-04-17T19:34:26.750Z	39.64433	-111.214	5.42	1.16
2018-09-24T19:16:03.940Z	2018-09-24T13:16:03.940Z	39.63817	-111.204	-2.34	1.88
2019-01-06T18:17:14.320Z	2019-01-06T11:17:14.320Z	39.62817	-111.193	-1.98	1.35
2019-01-29T12:20:40.130Z	2019-01-29T05:20:40.130Z	39.64683	-111.222	-0.9	1.52
2019-02-01T00:45:55.340Z	2019-01-31T17:45:55.340Z	39.647	-111.226	-0.71	1.28

Table 4. Events that are most likely tectonic (purple)

Origin Time (UTC)	Origin Time (Local)	Latitude	Longitude	Depth	Magnitude
2017-02-04T14:16:32.700Z	2017-02-04T07:16:32.700Z	39.62267	-111.267	7.95	1.71
2017-02-11T12:01:25.210Z	2017-02-11T05:01:25.210Z	39.66267	-111.247	19.46	1.35
2018-12-26T02:41:08.240Z	2018-12-25T19:41:08.240Z	39.7135	-111.137	6.67	1.44
2018-12-26T02:42:37.500Z	2018-12-05T19:42:37.500Z	39.73083	-111.137	2.4	1.47
2019-02-08T18:38:39.310Z	2019-02-08T11:38:39.310Z	39.72983	-111.156	3.17	2.03

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Table 5. Events of unknown, possibly tectonic, origin (green)

Origin Time (UTC)	Origin Time (Local)	Latitude	Longitude	Depth	Magnitude
2019-02-08T18:19:20.770Z	2019-02-08T11:19:20.770Z	39.71967	-111.152	3.35	1.47
2019-02-08T19:17:52.790Z	2019-02-08T12:17:52.790Z	39.71833	-111.145	6.06	1.44
2019-02-08T19:22:12.680Z	2019-02-08T12:22:12.680Z	39.6955	-111.138	1.79	1.36
2019-02-08T20:08:49.000Z	2019-02-08T13:08:49.000Z	39.71767	-111.15	4.72	1.69
2019-02-08T18:20:28.560Z	2019-02-08T11:20:28.560Z	39.72683	-111.151	2.6	1.55
2019-02-08T18:28:32.480Z	2019-02-08T11:28:32.480Z	39.72717	-111.142	-1.7	1.15
2019-02-08T18:54:35.020Z	2019-02-08T11:54:35.020Z	39.6995	-111.177	-3.04	1.22
2019-02-08T19:07:22.300Z	2019-02-08T12:07:22.300Z	39.72817	-111.151	1.39	1.07
2019-02-08T19:18:43.700Z	2019-02-08T12:18:43.700Z	39.72883	-111.154	-0.17	1.66
2019-02-08T19:18:43.790Z	2019-02-08T12:18:43.790Z	39.725	-111.157	3.31	1.91

Event Rates

Figure 3 shows the cumulative number of events over time during the study period. Figure 4 shows the cumulative number of only the events that are highly likely to be mining related. The small number of detected events makes it difficult to draw conclusions about how seismically active the mine is; however, the amount of activity detected since January 2019 is comparable to the amount detected in early 2017, during mining of panel 15L. Another interesting observation is the apparent absence of events from July 2017 to August 2018, during the mining of the 7L, ???, and R1 panels, which were all single panels.

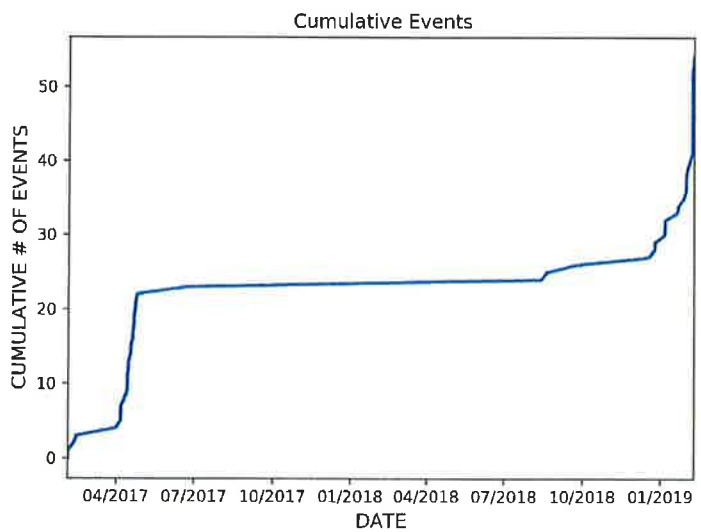

Figure 3. Cumulative number of events from January 1, 2017, to February 11, 2019

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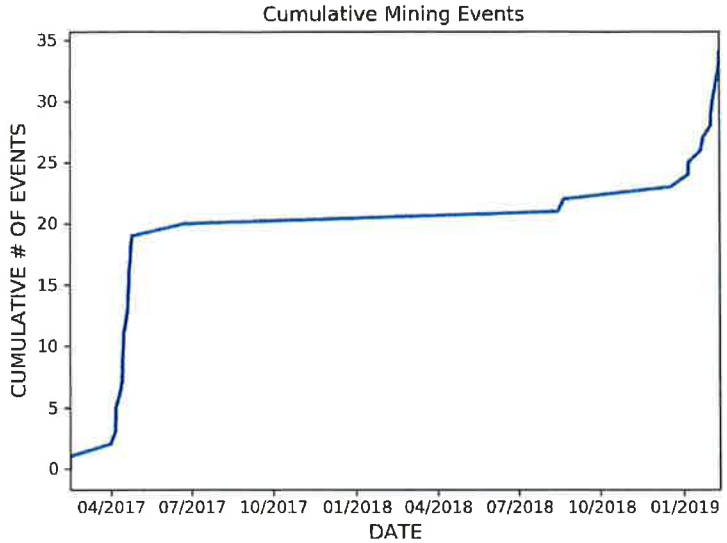

Figure 4. Cumulative number of mining-induced events from January 1, 2017, to February 11, 2019

Events Observed Underground

Four events were observed underground while mining R2 and R3:

- 2018-08-22T18:30 UTC (2018-08-22T12:30 MDT)
- 2018-09-15T17:10 UTC (2018-09-15T11:10 MDT)
- 2019-01-31T08:30 UTC (2019-01-31T01:30 MST)
- 2019-02-01 during graveyard shift

The continuous data for station ELU was examined during one-hour time windows surrounding the August, September, and January events and a six-hour time window during the early morning on the day of the February event. Events were identified during these time windows and magnitudes are approximated by assuming the events are located at point R2 in Figure 1. Station ELU is only a single component station and the events are too small to be picked up on the stations that are farther away; therefore, locations for these events cannot be determined at this time and we cannot confirm they are necessarily associated with the R2 and R3 panels. Additionally, the waveforms observed at ELU will not contain all of the necessary information for accurate magnitudes. As a result, caution should be applied when interpreting these results.

Tables 6-9 provide listings of the events and their magnitudes for each of the four events. The bolded event is the event that is thought to correspond to underground observations. The August and September events were clearly visible at station ELU, while it was much more difficult to identify the January event. Numerous events occurred during the time window examined for the February event and without additional information it is not possible to say with certainty which event was the one observed underground. However, there was one event that was large enough to be reported by UUSS during that time window.

Table 1. Events surrounding the 2018-08-22T18:30 UTC event

Origin Time (UTC)	Origin Time (Local)	Magnitude
2018-08-22T18:12:10	2018-08-22T12:12:10	0.9
2018-08-22T18:32:57	**2018-08-22T12:32:57**	**1.0**

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Table 2. Events surrounding the 2018-09-15T17:10 UTC event

Origin Time (UTC)	Origin Time (Local)	Magnitude
2018-09-15T16:30:29	2018-09-15T10:30:29	1.0
2018-09-15T16:34:13	2018-09-15T10:34:13	0.9
2018-09-15T16:37:46	2018-09-15T10:37:46	0.9
2018-09-15T16:51:18	2018-09-15T10:51:18	0.9
2018-09-15T16:52:07	2018-09-15T10:52:07	0.9
2018-09-15T16:54:32	2018-09-15T10:54:32	0.9
2018-09-15T17:03:58	2018-09-15T11:03:58	0.9
2018-09-15T17:08:29	2018-09-15T11:08:29	0.9
2018-09-15T17:11:04	**2018-09-15T11:11:04**	**0.9**
2018-09-15T17:17:02	2018-09-15T11:17:02	0.9
2018-09-15T17:41:15	2018-09-15T11:41:15	0.9

Table 3. Events surrounding the 2019-01-31T08:30 UTC event

Origin Time (UTC)	Origin Time (Local)	Magnitude
2019-01-31T08:00:58	2019-01-31T01:00:58	0.9
2019-01-31T08:05:48	2019-01-31T01:05:48	0.9
2019-01-31T08:09:01	2019-01-31T01:09:01	0.9
2019-01-31T08:12:20	2019-01-31T01:12:20	0.9
2019-01-31T08:14:39	2019-01-31T01:14:39	0.9
2019-01-31T08:23:48	2019-01-31T01:23:48	0.9
2019-01-31T08:25:05	2019-01-31T08:25:05	0.9
2019-01-31T08:29:47	**2019-01-31T01:29:47**	**0.9**
2019-01-31T08:35:50	2019-01-31T01:35:50	0.9
2019-01-31T08:47:45	2019-01-31T01:47:45	0.9
2019-01-31T08:48:05	2019-01-31T01:48:05	0.9
2019-01-31T08:48:34	2019-01-31T01:48:34	0.9

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Table 4. Events surrounding the 2019-02-01 event

Origin Time (UTC)	Origin Time (Local)	Magnitude
2019-02-01T06:10:52	2019-02-01T00:10:52	1.0
2019-02-01T06:14:20	2019-01-31T11:14:20	1.0
2019-02-01T06:16:05	2019-01-31T11:16:05	1.0
2019-02-01T06:22:03	2019-01-31T11:22:03	0.9
2019-02-01T06:22:41	2019-01-31T11:22:41	0.9
2019-02-01T06:22:59	2019-01-31T11:22:59	1.0
2019-02-01T06:25:43	2019-01-31T11:25:43	1.0
2019-02-01T06:27:09	2019-01-31T11:27:09	1.0
2019-02-01T06:29:28	2019-01-31T11:29:28	0.9
2019-02-01T06:30:53	2019-01-31T11:30:53	1.0
2019-02-01T06:33:33	2019-01-31T11:33:33	0.9
2019-02-01T06:34:06	2019-01-31T11:34:06	1.0
2019-02-01T06:35:45	2019-01-31T11:35:45	0.9
2019-02-01T06:36:26	2019-01-31T11:36:26	1.0
2019-02-01T06:42:37	2019-01-31T11:42:37	0.9
2019-02-01T06:44:06	2019-01-31T11:44:06	0.9
2019-02-01T06:49:35	2019-01-31T11:49:35	1.0
2019-02-01T06:56:36	2019-01-31T11:56:36	1.0
2019-02-01T07:43:48	2019-02-01T00:43:48	0.9
2019-02-01T08:34:08	2019-02-01T01:34:08	1.0
2019-02-01T08:36:22	2019-02-01T01:36:22	0.9
2019-02-01T08:54:28	2019-02-01T01:54:28	1.0
2019-02-01T09:33:11	**2019-02-01T02:33:11**	**1.5**
2019-02-01T10:08:40	2019-02-01T03:08:40	1.0
2019-02-01T10:27:22	2019-02-01T03:27:22	1.0
2019-02-01T10:51:02	2019-02-01T03:51:02	1.0
2019-02-01T10:51:30	2019-02-01T03:51:30	0.9
2019-02-01T11:15:15	2019-02-01T04:15:15	1.0
2019-02-01T11:25:16	2019-02-01T04:25:16	1.0
2019-02-01T11:33:45	2019-02-01T04:33:45	0.9
2019-02-01T11:57:39	2019-02-01T04:57:39	1.0

Since ELU is only a single-component station, the analysis that can be done at this time is extremely limited. However, it may be possible to identify additional events during the study period by using short-term average/long-term average triggering methods or using matched filters, which may have the additional advantage of providing some information about event location. It may be possible to provide locations and better magnitude estimates and determine with certainty which events originate from the mine with the inclusion of data from several permanent stations NIOSH installed in September 2018.

TEMPORARY NIOSH SEISMIC DEPLOYMENTS

NIOSH conducted three temporary seismic deployments during the time period of interest:

- September 25, 2017 – October 15, 2017, over the 7L panel
- May 18, 2018 – June 11, 2018, over the R1 panel

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- June 28, 2018 – August 6, 2018, over the R2 panel (sensors were out until August 14, 2018, but their batteries had died)

The data from the 7L deployment has been manually reviewed. An unanticipated volume of data was collected from the R1 and R2 deployments. As a result, NIOSH researchers are still in the process of manually reviewing it. Automatic locations and magnitudes have been determined from R1, with a smaller subset of events that have been manually processed and located, while R2 has only been automatically located at this time. NIOSH researchers are in the process of applying a convolutional neural network to aid in the processing of both datasets.

Event Locations

Figure 5 shows the event locations from the 7L deployment. The events are primarily located along the gateroads in previously mined areas and across the active face. These events are consistent with the yielding of pillars and caving during longwall operations. The events to the south of the panel are mislocated and likely located on the gateroad, as explained in Boltz et al. [2018]. Because the seismic sensors are located on the surface with a several-hundred meter spacing, it is not possible to determine reliable depths for the events.

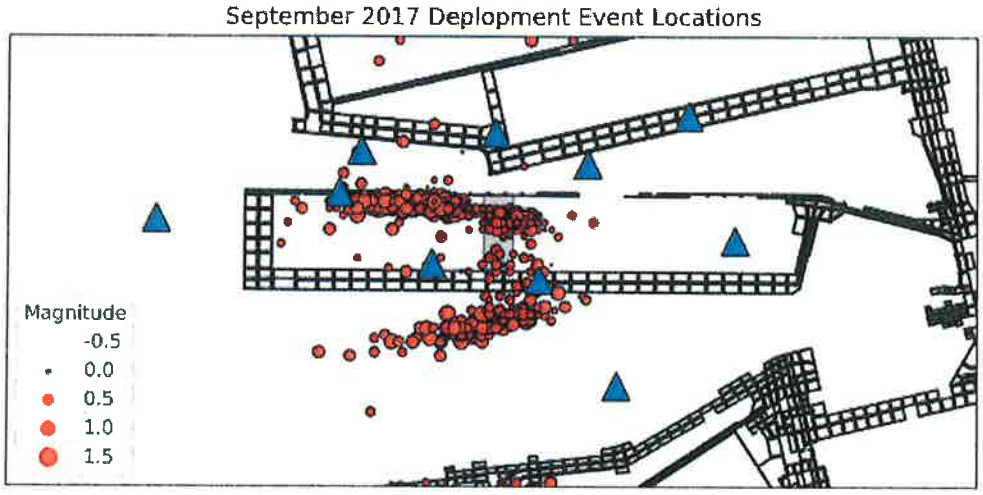

Figure 5. Plan-view locations of seismicity detected during the September 2017 temporary deployment. Red dots are locations of events, blue triangles are locations of sensors.

Figures 6 and 7 show the locations of the automatically located and manually reprocessed subset of events from R1 deployment. The automatic locations show the events occurring in a cloud above R1. There are also a significant number of events that occur in the pillar between R1 and the development for R2, though the decrease in events locating in this area after manually processing suggest that those locations may be an artifact of errors in the automatic processing. The manually processed events form a tight cluster above R1. Figure 8 shows the location of an event in three-dimensions with a cloud indicating the location uncertainty. For most of the events examined, the location uncertainty clearly indicates the events occur in the mine roof. This is consistent with expected gob formation processes.

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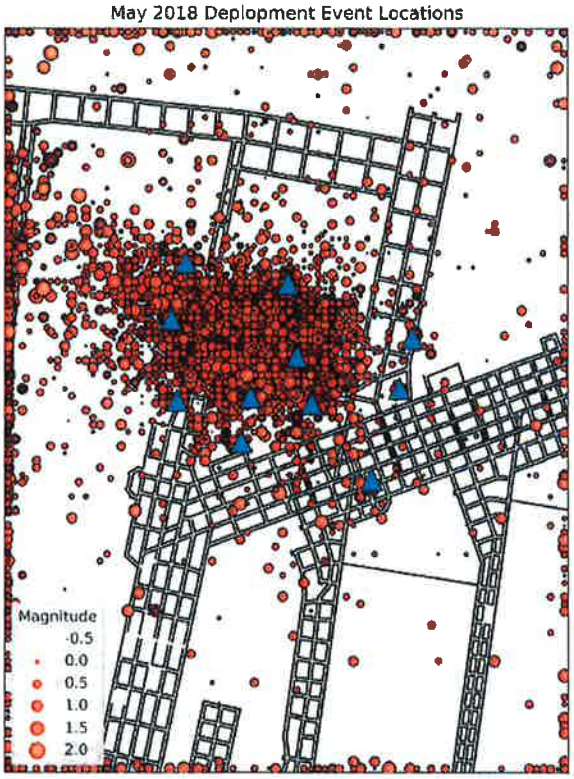

Figure 6. Automatically processed event locations for the May 2018 temporary deployment

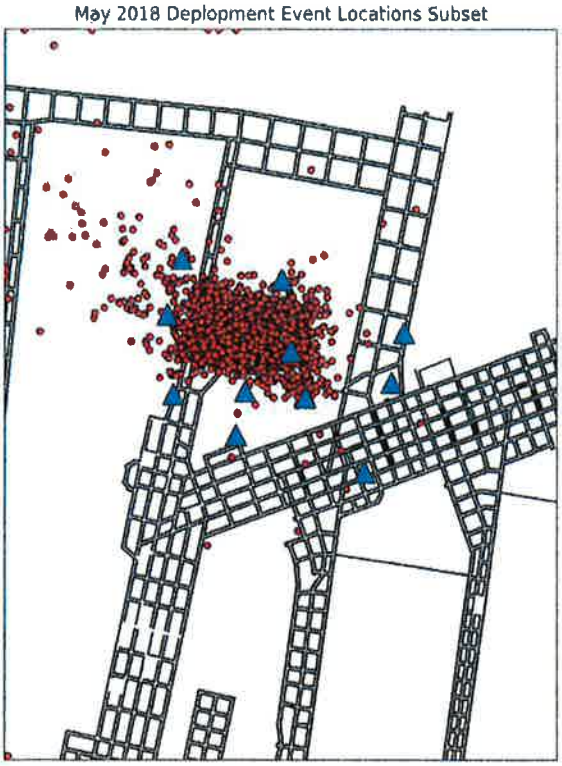

Figure 7. Manually processed event subset locations for the May 2018 temporary deployment

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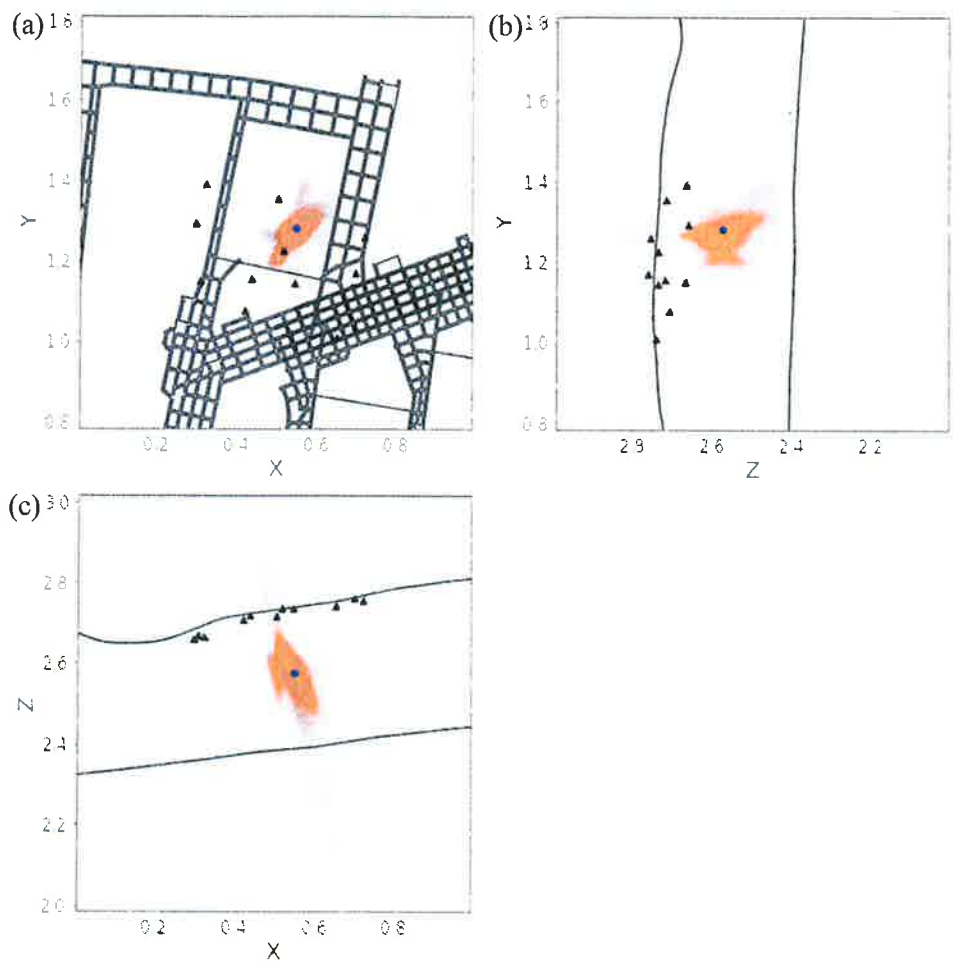

Figure 8. Probability density function for an event in the R1 deployment in (a) plan view, (b) South-North cross-section, and (c) West-East cross-section. Blue dot is the maximum probability event location. The warm colors indicate areas where the probability is high that the event could be located there.

Figure 9 shows the automatic locations from the R2 deployment. As with R1, the events form a cloud over the active panel. The events have not yet been examined in cross-section. The gridding in the event locations is an artifact of poor location quality.

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Figure 9. Automatically processed event locations for the June 2018 temporary deployment

Event Rates

Figures 10-12 show the number of events per day for each of the three temporary deployments. It is apparent that there are significantly more events during the R1 and R2 deployments compared to the 7L deployment. The number of events per day during the R2 deployment ramps up as time progresses because the deployment took place during the beginning of the panel. The increasing activity during that deployment represents the development of caving over the panel.

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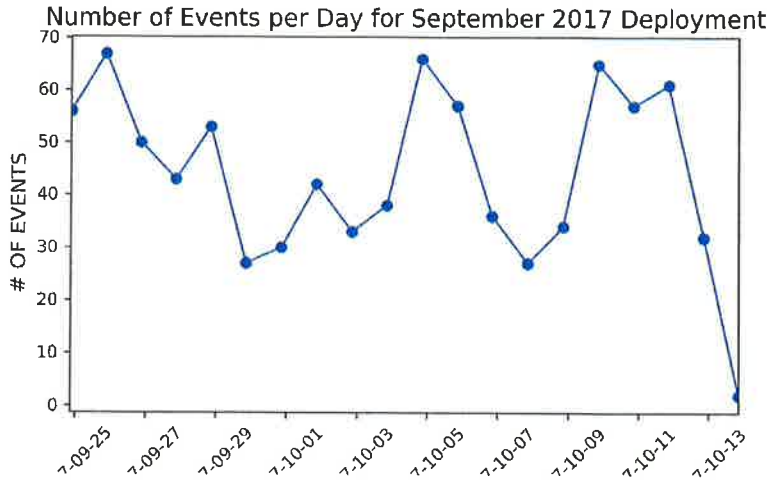

Figure 10. Number of events per day for the September 2017 temporary deployment

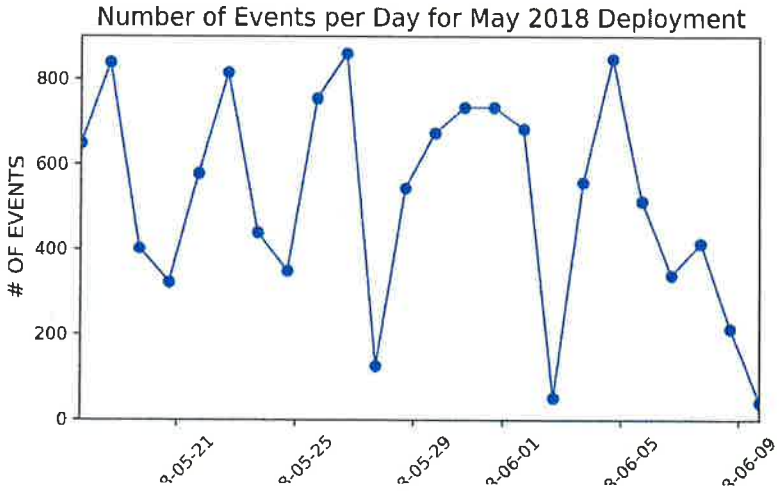

Figure 11. Number of events per day for the May 2018 temporary deployment

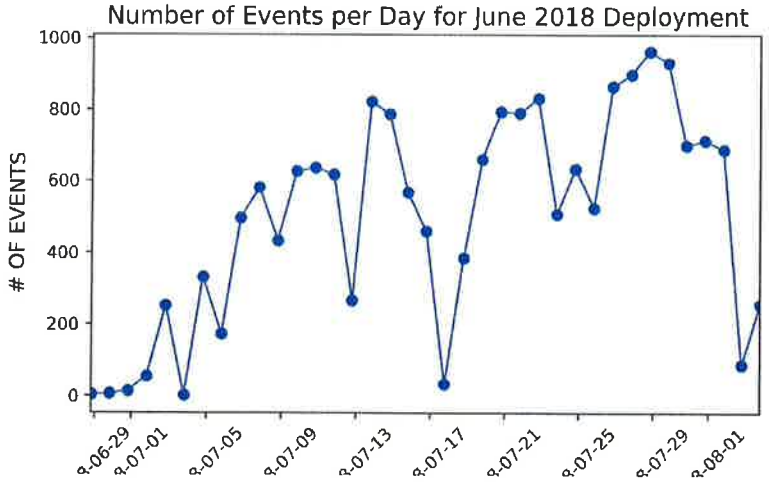

Figure 12. Number of events per day for the June 2018 temporary deployment

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The increase in seismicity could partially be an artifact of the different station configurations for the three deployments. There were fewer stations with larger spacing and poorer angular coverage for the 7L panel than the R1 and R2 panels. However, an analysis of the distributions of the magnitudes for the events suggest that there is a statistically significant increase in the amount of seismicity between the 7L and R1 deployments.

Figure 13a shows a histogram of event magnitudes for the 7L deployment and Figure 13b shows the magnitude histogram for the R1 deployment. The number of events have been normalized for the length of the deployments. In earthquake seismology, earthquake magnitudes are expected to follow a logarithmic relation where if there is a single magnitude 2 event, there should be approximately 10 magnitude 1 events, 100 magnitude 0 events, etc. [Gutenberg and Richter, 1956]. This relation can be used to estimate the approximate magnitude above which a network is able to detect all events. For the 7L and R1 deployments, this magnitude can be estimated as 0.5 and 0.25, respectively. A line can be fit to the magnitude-frequency distributions. The slope of this line, known as the b-value, provides a way to quantify the ratio of large events to small events, where values greater than 1 indicate there is an unusual number of smaller events while values less than 1 indicate an unusual number of larger events. The intercept, or a-value represents the total seismicity rate, where a larger a-value indicates more seismicity.

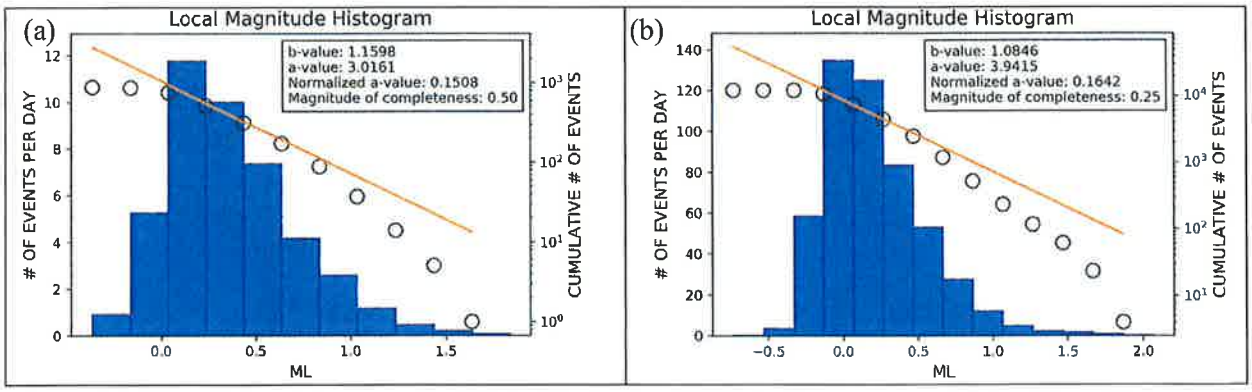

Figure 12. Magnitude histograms for (a) the September 2017 deployment and (b) the May 2018 deployment

For the 7L deployment the normalized a-value is 0.15 and b-value is 1.16. For the R1 deployment, the a-value is 0.16 and b-value is 1.08. This suggests that there is more seismicity and a greater number of larger events in the R1 deployment compared to the 7L deployment. The magnitudes for the R1 deployment may be overestimated due to errors in the event locations, but this is likely negligible and will improve as manually processing progresses.

Conclusions

54 events have occurred in the vicinity of the mine during the time period from January 1, 2017, to February 11, 2019, that were large enough to be reported by UUSS. Approximately half of these events are likely the result of mining activity. Events from the time period of January 1, 2017, to June 23, 2018 are likely the result of development and extraction of the 15L panel, followed by a lull in seismicity until August 2018 when events began occurring in the current panel district near panels R2 and R3. Event rates from regional UUSS data and from temporary seismic deployments by NIOSH suggest that the current panel district is more seismically active than previous areas of the mine. Four events were observed underground between August 2018 and February 1, 2019. Three of these events were large enough to be observed on the closest UUSS station, ELU, but small enough to not be

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reported by UUSS. The time of the fourth event is uncertain, but there is one event during the indicated shift that was large enough to be reported by UUSS and numerous other small events that occurred during that time window.

With a tenable increase in seismicity related to current mining, and a number of reported events, it should be a high priority to complete NIOSH's surface network and the associated telemetry infrastructure. Without data collected by NIOSH stations, the quality and value of seismic monitoring is very limited in addressing and understanding the changing conditions.

REFERENCES

Boltz MS, Chambers DJA, and Hanson DR [2018]. Evaluating seismicity at underground coal mines using temporary surface geophone deployments. In: Proceedings of the 52nd Rock Mechanics/Geomechanics Symposium, June 17–20. Seattle, WA: 9 pp.

Gutenburg B, Richter CF [1956]. Magnitude and Energy of Earthquakes. Annali di Geofisica. 9: 1–15.

Stein, J. [2015]. Seismic source discrimination in the Wasatch Plateau region of central Utah. MS Thesis, University of Utah, Department of Geology and Geophysics, Salt Lake City, UT, 64 pp.

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CHAPTER 6

GEOLOGY

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610 INTRODUCTION

This chapter presents a description of the geologic resources in the area of the Skyline Mine, and more specifically around the Boulger Reservoir and how the geology effects both seismicity and subsidence. Most of this chapter has been compiled from both Section 2.2 Geology and Geotechnical and Section 4.17 Subsidence Control Plan of the approved M&RP; Attachment 5-4 (Mining-induced Seismicity, by RB&G Engineering) of this Appendix.

611 General Requirements

The geologic resources in the Skyline Mine area are discussed in Section 2.2 of the M&RP. Information pertaining more specifically to subsidence associated with full extraction mining in the vicinity and beneath the Boulger Reservoir are addressed in this section.

612 Certification

No maps, plans or cross-sections have been submitted in this section that requires certification by a professional engineer.

620 ENVIRONMENTAL DESCRIPTION

This section presents a description of the geologic resources in the Skyline Mine and more specifically in the areas associated with the Boulger Subsidence monitoring equipment.

621 General Requirements

This section presents both the regional and site-specific geologic information for the Boulger Subsidence monitoring equipment.

622 Cross Sections, Maps and Plans

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Refer to Plate 2.2.1-1 (General Geologic Map of Permit Area) of the approved M&RP for the general geology associated with seismic station locations identified on Figure 1-1 of this appendix. Figure 6-1 provides a more detailed description of the Quaternary-age glacial moraine deposits in the vicinity of the Boulger Dam Reservoir which are consistent with the drill logs (RB&G report appendix) associated with the drilling of the piezometers. Plate 2.2.7-3 and 2.2.7-4 of the approved M&RP provide both the Lower O'Connor B Isopach and Lower O'Connor B Overburden, respectively, for the coal seam that will be mined in the vicinity of Boulger Reservoir.

623 Geologic Determinations

No acid or toxic forming materials will originate with both the installation and subsidence monitoring associated with Boulger Reservoir.

624 Geologic Information

624.100 Regional Setting

Refer to Section 2.2 of the approved M&RP.

624.200 Test Boring and Drill Hole Data (overburden removed)

No test boring or overburden was removed with the installation of the subsidence monitoring equipment

624.300 Test Boring and Drill Hole Data (overburden not removed)

No test boring or drill cores were conducted for the seismic equipment sites. The lithologic logs associated with the installation of the piezometers are available in the appendix of the RB&G report (Attachment 5-5).

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625 Additional Geologic Information

No geologic data was collected at the seismic equipment site which included only minor surface disturbance. The RB&G Mining-Induced Seismicity (MIS) Report (Attachment 5-4) provides extensive geotechnical information addressing the MIS effects to both Boulger Reservoir and Electric Lake dams. The RB&G report indicates Boulger dam could safely withstand an MIS event magnitude of 3.9, which may result in a Potential Ground Acceleration (PGA) of approximately 2.29, with no additional mitigation measures necessary. In addition, the report indicates, "MIS events with magnitudes no greater than 3.0 would not be expected to produce ground accelerations greater than 0.36g assuming an s-value of 0.337" (pg. 11 RB&G report). As indicated in preliminary NIOSH data, the MIS magnitude directly above full extraction mining in the area has only been in the 1.0 – 1.5 range. The RB&G personnel indicate there is little concern with this range of acceleration having a significant impact on the dam due to the short duration of the MIS activity.

.626 Sampling Waivers

A sampling waiver is not requested at this time for the seismic site.

627 Description of the Overburden Thickness and Lithology

Plate 2.2.7-4 – Overburden Isopach Lower O'connor B seam from the approved M&RP indicates the overburden is approximately 1,100 feet at the Boulger dam. The thickness of the Quaternary-age glacial deposits is unknown but fairly shallow, with the remainder of the 1,100 feet consisting of the Blackhawk Formation which consists of interbedded lenticular beds of fine-grained siltstones, sandstones, shale and coal.

630 OPERATION PLAN

631 Casing and Sealing of Exploration Holes

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The piezometers will be abandoned per State regulations at the completion of the study.

632 Subsidence Monitoring

Section 4.17 - Subsidence Control Plan of the approved M&RP provides a comprehensive review of the subsidence control plan for the entire area. The following subsidence discussion focuses on the monitoring involved with subsidence related to Boulger Reservoir. Attachment 5-5 is a Skyline memo outlining both the seismicity and subsidence monitoring proposed by Skyline that was approved by the Utah State Engineer, David Marble (Attachment 5-6).

As discussed in Section 4.17 the subsidence factor for the anticipated subsidence for the Boulger dam is 0.3, which is based on the combination of the mining height and overburden. With an overburden of approximately 1,100 feet and mining height of 10 feet, the conservative estimate of subsidence is approximately three feet. Plate 4.17.3-1A_rev.10 of the M&RP illustrates the anticipated subsidence of the Boulger dam area with the proposed future mine plan. The following outlines both the subsidence and seismic monitoring on the dam as outlined in Attachment 5-5:

- When full extraction mining is within one mile of the dam;
    - Monthly visual inspection of dam (excluding winter conditions)
    - Monthly reservoir and piezometer levels (excluding winter conditions)
    - Weekly review of dam accelerometer data
    - A daily record of UUSS seismic information
    - Seismic event greater than 3 within 5-miles, site reconnaissance of crest within 24-hours;
        - Acceleration data forwarded to qualified engineer and Utah State Dam Safety Engineer
    - Acceleration >0.1g on dam; piezometer, survey monument and observational data collected weekly (excluding winter conditions)
        - Data collection increased to monthly following initial month
- Annual survey of both regional and reservoir-specific subsidence survey monuments
- Lowering of water level in reservoir prior to undermining

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- Post-subsidence survey confirming maximum subsidence has occurred
- Post-subsidence dam inspection by qualifed engineer prior to refilling reservoir
    - Any necessary repairs prior to refilling

640 PERFORMANCE STANDARDS

641 Exploration and Drill Holes

The performance standards used in the casing and sealing of all exploration holes and drill holes are outlined in the approved M&RP.

642 Monuments and Surface Markers of Subsidence Monitoring Points

All monuments and surface markers used as subsidence monitoring points will be reclaimed according to State regulations unless USFS personnel request they remain in place around the reservoir.

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Attachment 5-6 Boulger Dam Reservoir – Mining-Induced Seismicity (MIS) Monitoring, memorandum, prepared by Canyon Fuel Company, LLC, May 7, 2019

Attachment 5-7 Boulger Dam (UT00695) Skyline Mining-Induced Seismicity Monitoring and Mitigation Plan, David K. Marble, Asst. State Engineer/Dam Safety, July 22, 2019

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710 INTRODUCTION

711 General Requirements

This chapter presents a description of the following as it pertains to the subsidence monitoring primarily associated with the Boulger reservoir and dam, although limited areas cover the minimal disturbance associated with the seismic stations:

- Proposed operations and the potential impacts to the hydrologic balance;
- Methods of compliance with design criteria; and
- Applicable hydrologic performance standards.

Attachment 5-6 (Boulger Dam Reservoir – Mining-Induced Seismicity (MIS) Monitoring memorandum) outlines the details of the monitoring involved with the dam and water as related with mining in the vicinity of Boulger reservoir. As outlined in Attachment 5-6, Skyline intends to employ full-extraction mining techniques throughout the Boulger reservoir area including beneath the reservoir. While surface- and groundwater monitoring for the entire mining area is discussed in Sections 2.3 and 2.4 of the M&RP, this section addresses monitoring specific to the Boulger reservoir and dam, respectively.

712 Certification

No maps or cross sections have been submitted in this section requiring certification by a qualified, registered professional engineer.

713 Inspection

Inspections are not required since no permanent impoundments exist at the seismic sites, and the dam is not regulated as described under R645-301-514.300. The inspection integrity of the Dam is conducted by the Utah State Engineer – Dam Safety. However, based on the MIS observed in the seismic data collected, Skyline mine will be making regular visual inspections of the dam as outlined in the mitigation plan (Attachment 5-6) as mining advances. The reservoir will be drained prior to full-extraction mining, and will be inspected by a qualified engineer following subsidence and prior to refilling.

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720 ENVIRONMENTAL DESCRIPTION

721 General Requirements

The application will include a description of the existing pre-mining hydrologic resources with the proposed permit and adjacent areas that may be affected or impacted by the proposed coal mining and reclamation operations.

722 Cross Sections and Maps

722.100 Location and Extent of Subsurface Water

Section 2.3 of the approved M&RP provides baseline groundwater conditions of the entire permit area.

722.200 Location of Surface Water Bodies

Section 2.4 of the approved M&RP provides baseline surface water conditions of the entire permit area. Plate 2.3.6-1 identifies the location of all surface water bodies, and Figure 1-2 provides a detailed view of Boulger Reservoir.

722.300 Locations of Monitoring Stations

Plate 2.3.6-1 in the approved M&RP shows the location of surface water and groundwater monitoring stations for the entire permit area. Figure 1-2 (Chapter 1 of this Appendix) illustrates the location of the both the piezometers monitoring the water saturation levels within and below the dam, and the locations and elevations of the survey monuments.

722.400 Locations and Depth of Water Wells

Refer to Sections 2.3 and 2.5 and Plate 2.3.6-1 of the approved M&RP for information pertaining to the groundwater monitoring wells for the entire area. Table 7-1 identifies the location, screen interval, and elevations of the piezometers located both within the dam, and the toe of the dam, respectively.

722.500 Surface Topography

Surface topography features at the subsidence monitoring sites and adjacent areas are shown on Figures 1-1 and 1-2.

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723 Sampling and Analysis

Refer to Section 2.3 of the approved M&RP for water quality and quantity analysis of the entire permit area. Only water depth within the piezometers and the shore line of the reservoir are being collected and analyzed in this amendment.

724 Baseline Information

Refer to Section 2.3 and 2.4 of the approved M&RP. Water level in piezometers located in the proximity of the dam have been monitored in the 2nd, 3rd, and 4th calendar quarters since installation in 2017. Table 7-2 provides the information.

724.100 Groundwater Information

Refer to Section 2.3 of the approved M&RP for the groundwater information of the entire permit area. Water level information from the piezometers located in the proximity of the dam will be submitted to the Division in the Annual Report.

724.200 Surface Water Information

Refer to Section 2.4 of the approved M&RP for surface water information of the entire permit area. Table 7-3 identifies the location and initial elevations of the survey monuments which serve as additional information on the shoreline of the reservoir. According to Utah Division of Water Rights – Dam Safety records, Boulger dam was originally constructed in 1937 as an earthen dam with a reservoir capacity of 30 acre-feet. A 2017 licensed survey indicated the reservoir currently contains approximately 19.4 acre-feet. The dam has a Low Hazard rating. Survey monument data will be submitted to the Division in the Annual Report.

724.300 Geologic Information

General geologic information related to the subsidence monitoring sites and adjacent areas in presented in Section 2.2 of the approved M&RP, with a more detailed discussion in Chapter 6 of this Appendix.

724.400 Climatological Information

Climatological data are summarized in Section 2.6 of the approved M&RP.

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724.500 Supplemental Information

Refer to Section 2.6 of the approved M&RP. No additional information is necessary due to the small scale of both the Boulger subsidence monitoring equipment and the draining of the 19.4 acre-foot reservoir. No adverse impacts to the hydrologic balance, nor are acid-forming or toxic-forming minerals present that will affect ground water or surface water.

724.600 Survey of Renewable Resource Lands

Refer to Section 2.14 – Prime Farmland Investigation of the approved M&RP.

724.700 Alluvial Valley Floor Requirements

Information regarding the presence or absence of alluvial valley floors subsidence monitoring sites and adjacent areas is presented in Chapter 4, Section 4.23 of the approved M&RP. Figure 6-1 (Chapter 6 of this Appendix) illustrates the dam rests on Holocene alluvial deposits and is flanked by glacial lateral moraine deposits.

725 Baseline Cumulative Impact Area Information

The CHIA currently in place for the Skyline Mine covers the Boulger Subsidence Monitoring area. The hydrologic and geologic information required for the Division to develop a Cumulative Hydrologic Impact Assessment (CHIA) is presented in the approved M&RP.

726 Modeling

No groundwater or surface water modeling was conducted in support of this submittal.

727 Alternative Water Source Information

Not applicable.

728 Probable Hydrologic Consequences

This section addresses the probable hydrologic consequences of construction and reclamation operations at the well sites. Mitigation measures are discussed generally in this section and in detail in Section 730 of the approved M&RP.

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728.100 Potential Impacts of Surface and Groundwater

Potential impacts of the Boulger Subsidence Monitoring in this area on the quality and quantity of surface and groundwater flow is minimal. The potential impact is addressed in Section 728.300 of this submittal and the approved M&RP.

728.200 Baseline Hydrologic and Geologic Information

Baseline geologic information is presented in Chapter 2, Section 2.2 of the approved M&RP. Baseline hydrologic information is presented in Chapter 2, Sections 2.3 and 2.4 of the approved M&RP.

728.300 PHC Determination

Potential Impacts to the Hydrologic Balance - Potential impacts of the Skyline Mine on the hydrologic balance of the Boulger subsidence monitoring equipment and adjacent areas are addressed in Section 2.5 and PHC Appendix Volumes 1 and 2 the approved M&RP. No water usage will be associated with the seismic station. The piezometers, survey monuments, and seismic stations are all monitoring devices intended to avert any unintended discharges from the reservoir. No impacts to the Hydrologic Balance are anticipated for the installation of the subsidence monitoring equipment since 1) the potential impacts are limited in area to the installation of the equipment; 2) no topsoil or vegetation removal will take place; and 3) the seismic stations are a significant distance from any water source. The proposed mitigation while conducting full-extraction mining beneath the reservoir will have no impacts to the hydrologic balance as outlined below.

Acid and Toxic Forming Materials – Not applicable.

Groundwater – No groundwater will be impacted with the installation of the subsidence monitoring equipment as the seismic stations are located on a dry ridge and the minimal disturbance will be within two feet of the surface. Similarly, the installation of the piezometers

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and survey monuments are either within two-feet of the surface (survey monuments), or the piezometers are within approximately 20-feet of the surface and completed within the dam, escarpment, or toe of the dam and will not impact the groundwater.

Surface Water - No surface water will be impacted as the installation of the subsidence monitoring equipment had no associated surface disturbance. As discussed with both USFS and Utah Division of Wildlife Resources (DWR) personnel, the impacts of draining the reservoir while full-extraction mining is conducted beneath the reservoir will be minimized through close coordination with agency personnel.

Under a future mine plan to be proposed, full-extraction mining beneath the Boulger Reservoir will occur in approximately March 2023. With the proposed mining, the DWR would minimize restocking of the reservoir in 2022 to minimize any loss of fish. Steps would then be taken in Fall 2022 to reduce the water elevation in the reservoir. With a capacity of 19.4 acre-feet and a total depth of 8-feet, Skyline is hoping to modify the elevation of the fish-ladder outfall to enable a passive bypass of the dam that will not require pumping or a bypass pipe while safely minimizing water on the dam.

Once the area has been fully subsided based on monument surveys, the dam will be inspected by a qualified engineer. Once any necessary repairs are conducted, the reservoir will be refilled and restocked with fish. Assuming a baseline flow approximately 740 gpm (Nov. 2019) in upper Boulger Creek, the reservoir will take approximately six days to refill.

Potential Hydrocarbon Contamination – No hydrocarbon products will be used or stored at the seismic sites. In the event pumping needs to take place at the reservoir during full extraction mining, standard Spill Prevention, Control, and Countermeasure (SPCC) precautions outlined in the Skyline SPCC plan will be implemented to minimize any potential for contamination.

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729 Cumulative Hydrologic Impact Assessment (CHIA)

The Cumulative Hydrologic Impact Assessment currently in place for the Skyline Mine includes the seismic site and adjacent areas.

730 OPERATION PLAN

731 General Requirements

731.100 Hydrologic - Balance Protection

Groundwater Protection – No protection of the groundwater at the seismic site is necessary. See section 2.3 and 2.4 of the M&RP for the overall protection of the groundwater in the area. Protection of the dam embankment is monitored by both the seismic array monitoring the acceleration encountered on the dam through Mining Induced Seismicity (MIS) and piezometers located in the vicinity of the embankment.

Surface Water Protection - To protect the hydrologic balance, construction, maintenance, and reclamation operations will be conducted to handle earth materials and runoff in a manner that prevents, to the extent possible, additional contributions of suspended solids to stream flow outside the permit area, and otherwise prevent water pollution. No additional protection of the surface-water at the seismic site is necessary. Sections 2.3 and 2.4 of the M&RP outline the surface water protection and monitoring for the reservoir and surrounding area.

731.200 Water Monitoring

No water monitoring will be conducted at the seismic station. Monitoring data from the piezometers located in the vicinity of the dam are collected on a quarterly basis and will increase to monthly (excluding winter months) once full extraction mining is within one mile of the reservoir. Streams and wells for the surrounding are monitored as outlined in Sections 2.3 and 2.4 of the approved M&RP. Piezometer information will be submitted with the annual report.

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731.300 Acid or Toxic Forming Materials

No acid or toxic forming materials are anticipated with the installation of the subsidence monitoring equipment or the undermining of the reservoir.

731.400 Transfer of Wells

Not applicable.

731.500 Discharge

Not applicable.

731.600 Stream Buffer Zones

Stream Channel Diversions - No stream channel diversions are associated with the seismic station installation. While undermining of the reservoir, it is anticipated the water level of the reservoir will be lowered to the extent where upper Boulger creek will pass directly through the area normally retaining water.

Buffer Zone Designation – No designation is necessary for any of the subsidence monitoring equipment.

731.700 Cross Section and Maps

Figure 1-2 in Chapter 1 of this Appendix illustrates the location of the piezometers and survey monuments. Figure 7-1 illustrate a cross section of the dam with the locations of the piezometers. Plate 4.17.3-1A from the approved M&RP illustrate the anticipated subsidence in the vicinity of the Boulger Reservoir that is discussed more thoroughly in Section 6 of the appendix.

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731.800 Water Rights and Replacement

Refer to Chapter 2, Sections 2.3.5.1 and 2.3.5.2 of the approved M&RP for surface water and ground water right information, respectively.

732 Sediment Control Measures

The only sediment control measures implemented at the subsidence monitoring equipment station installation will be to minimize the disturbance utilizing hand tools. Sediment will be controlled with existing vegetation.

732.100 Siltation Structures

Not applicable.

732.200 Sedimentation Pond

Not applicable.

732.300 Diversions

Not applicable.

732.400 Road Drainage

No new roads will be constructed with the installation of the seismic site.

733 Impoundments

733.100 General Plans

Not applicable.

733.200 Permanent and Temporary Impoundments

No permanent impoundments will exist with the installation of the subsidence monitoring equipment.

734 Discharge Structures

No discharge structure will be constructed with the addition of the subsidence monitoring equipment.

735 Disposal of Excess Spoil

There will be no excess spoil generated with the installation of the subsidence monitoring equipment.

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736 Coal Mine Waste

There will be no coal mine waste generated or stored with the installation of the subsidence monitoring equipment.

737 Non-Coal Mine Waste

There will be no non-coal mine waste disposed with the installation of the subsidence monitoring equipment.

738 Temporary Casing and Sealing of Wells

Not applicable with the installation of the subsidence monitoring equipment.

740 DESIGN CRITERIA AND PLANS

741 General Requirements

This submittal includes the installation of the subsidence monitoring equipment that incorporate design criteria for the control of drainage.

742 Sediment Control Measures

742.100 General Requirements

Design - Sediment control measures for the with the installation of the subsidence monitoring equipment were to minimize erosion to the extent possible, by disturbing as small of area as possible, roughen the ground, and reseeding.

Measures and Methods - Sediment control methods will include minimizing the disturbance, raking, and reseeding. Sediment is controlled with existing vegetation. The seismic sites are considered Alternate Sediment Control Areas (ASCA's) as they do not report to a sediment pond. Their existence has been noted in Chapter 3, Section 3.2.12 as ASCA AREA 42 of the existing M&RP. Section 3.2.12 refers to Figure 1-1 of Appendix 4.17-1 for locations.

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742.200 Siltation Structures

General Requirements - Additional contributions of suspended solids and sediment or runoff outside the installation of the subsidence monitoring equipment area will be prevented to the extent possible minimizing the disturbance, roughening the disturbed areas, and reseeding.

Design – No designs were necessary due to the limited disturbance.

742.300 Diversions

Not applicable.

742.400 Road Drainage

Not applicable.

743 Impoundments

No impoundments will exist with the installation of the subsidence monitoring equipment.

744 Discharge Structures

No discharge structures have been planned or designed.

745 Disposal of Excess Spoil

There will be no excess spoil generated with the installation of the subsidence monitoring equipment.

746 Coal Mine Waste

746.100 General Requirements

There will be no coal mine waste generated with the installation of the subsidence monitoring equipment.

746.200 Refuse Piles

There will be no refuse piles with the installation of the subsidence monitoring equipment.

746.300 Impounding Structures

No impounding structures will be implemented with the installation of the subsidence monitoring equipment.

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746.400 Return of Coal Processing Waste to Abandoned Underground Workings

No coal processing waste will be generated with the installation of the subsidence monitoring equipment.

747 Disposal of Non-Coal Mine Waste

All non-coal mine waste will be disposed of at an approved landfill.

748 Casing and Sealing Wells

Not applicable.

750 PERFORMANCE STANDARDS

751 Water Quality Standards and Effluent Limitations

Not applicable.

752 Sediment Control Measures

No sediment control structures or measures will be associated with the installation of the subsidence monitoring equipment.

752.100 Siltation Structures and Diversions

No siltation structures or diversions are necessary with the installation of the subsidence monitoring equipment.

752.200 Road Drainage

Not applicable.

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753 Impoundments and Discharge Structures

Not applicable.

754 Disposal of Excess Spoil, Coal Mine Waste and Non-Coal Mine Waste

There will be no excess spoil or coal mine waste generated with the installation of the subsidence monitoring equipment.

755 Casing and Sealing

Not applicable.

760 RECLAMATION

761 General Requirements

A detailed reclamation plan for the subsidence monitoring equipment is presented Chapter 5. No structures will exist with the installation of the subsidence monitoring equipment.

762 Roads

Not applicable.

762.100 Restoring the Natural Drainage Patterns

The natural drainage patterns will be maintained both after construction and reclamation.

762.200 Reshaping Cut and Fill Slopes

No cut and fill slopes will occur with the installation of the subsidence monitoring equipment.

763 Siltation Structures

763.100 Maintenance of Siltation Structures

No structures will be installed with the installation of the subsidence monitoring equipment.

763.200 Removal of Siltation Structures

Not applicable.

764 Structure Removal

A timetable for the reclamation of the subsidence monitoring equipment will be implemented once the NIOSH study is complete.

765 Permanent Casing and Sealing of Wells

Not applicable.

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Figure 7-1

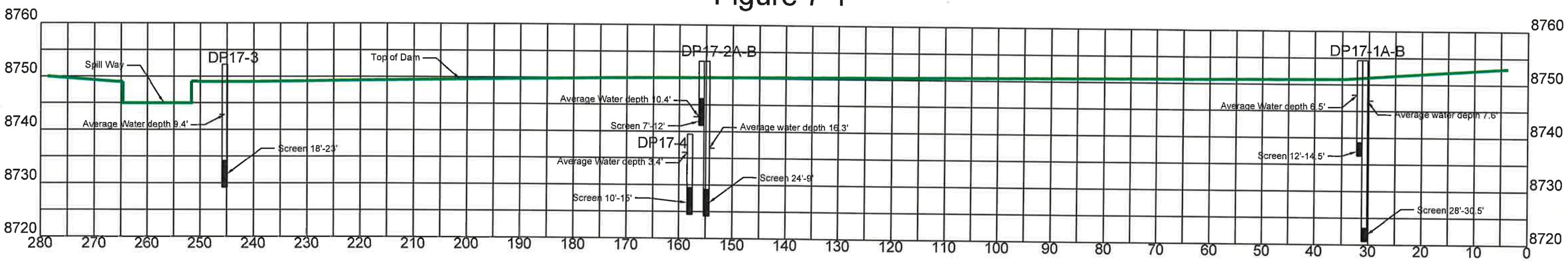

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Table 7-1

Boulger Dam Piezometers

Piezometer	Location	Screen Int.	Collar elev.
DP17-1A	N : 7039829.4294, E : 1709745.0029	12'-14.5'	8754.57
DP17-1B	N : 7039829.4294, E : 1709745.0029	28'-30.5'	8754.57
DP17-2A	N : 7039699.8028, E : 1709795.8893	7'-12'	8753.2
DP17-2B	N : 7039699.8028, E : 1709795.8893	24'-29'	8753.2
DP17-3	N : 7039632.6232, E : 1709824.7423	18'-23'	8752.21
DP17-4	N : 7039731.4990, E : 1709825.5731	10'-15'	8739.5

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Table 7-2

Piezometer	Date	Water Depth	Comment
DP 17-1A	10/24/2017	7.05	
DP 17-1A	6/6/2018	7.21	
DP 17-1A	10/17/2018	7.23	
DP 17-1A	6/16/2019	3.85	
DP 17-1A	9/28/2019	6.69	
DP 17-1A	10/23/2019	6.95	
DP 17-1B	10/24/2017	9.08	
DP 17-1B	6/6/2018	7.94	
DP 17-1B	10/17/2018	8.15	
DP 17-1B	6/16/2019	4.87	
DP 17-1B	9/28/2019	7.65	
DP 17-1B	10/23/2019	7.9	
DP 17-2A	10/24/2017	13.75	
DP 17-2A	6/6/2018	11.28	
DP 17-2A	10/17/2018	9.49	
DP 17-2A	6/16/2019	9.67	
DP 17-2A	9/28/2019	8.82	
DP 17-2A	10/23/2019	9.6	
DP 17-2B	10/24/2017	16.79	
DP 17-2B	6/6/2018	16.67	
DP 17-2B	10/17/2018	16.15	
DP 17-2B	6/16/2019	15.25	
DP 17-2B	9/28/2019	16.7	
DP 17-2B	10/23/2019	16.5	
DP 17-3	10/24/2017	10.32	
DP 17-3	6/6/2018	9.05	
DP 17-3	10/17/2018	9.7	
DP 17-3	6/16/2019	7.1	
DP 17-3	9/28/2019	9.9	
DP 17-3	10/23/2019	10.1	
DP 17-4	10/24/2017	3.57	
DP 17-4	6/6/2018	3.67	
DP 17-4	10/17/2018	2.9	
DP 17-4	6/16/2019		Buried in snow
DP 17-4	9/28/2019	3.6	
DP 17-4	10/23/2019	3.4	

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820 Performance Bond 4-1

ATTACHMENT 8-1 USFS concrete burial approval

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820 PERFORMANCE BOND

820 Performance Bond

The comprehensive cost estimate for the Performance Bond for the Skyline Mine is located in Chapter 4, Section 4.2 of the M&RP. The minimal cost of reclaiming the concrete associated with the vaults and pole/mast of the seismic station are covered under general concrete removal in the Demolition section Skyline Mine performance bond. Concrete associate with the seismic station will be crushed and buried on site with USFS personnel approval (See Attachment 8-1). The seismic equipment is owned and operated by NIOSH. As with previous studies by NIOSH, they will retrieve the equipment to be used at another study. Abandonment of the piezometers have been added to Section 4.2, Demolition Section, sheet 45– Well Abandonment as an hourly line-item.

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Gregg Galecki

From: Salow, Jeffrey - FS <jeffrey.salow@usda.gov>
Sent: Monday, November 18, 2019 8:18 AM
To: Gregg Galecki
Subject: FW: NIOSH Repeater site

**** STOP. THINK EXTERNAL EMAIL ****

Hi Gregg,

I think if you guys need to bury the concrete in-place, that should be fine with the forest.

Thanks,
jeff

From: Olsen, Darren G -FS
Sent: Friday, November 15, 2019 1:41 PM
To: Salow, Jeffrey - FS <jeffrey.salow@usda.gov>
Subject: RE: NIOSH Repeater site

I think this sounds reasonable. Not sure where this site is, but the further away from things the more this approach makes sense.

Darren Olsen
District Ranger
Forest Service
Manti-La Sal National Forest
p: 435-636-3586
c: 435-201-0865
f: 435-384-3296
darren.olsen@usda.gov
115 W Canyon Road; PO Box 310
Ferron, UT 84523
www.fs.fed.us
Caring for the land and serving people

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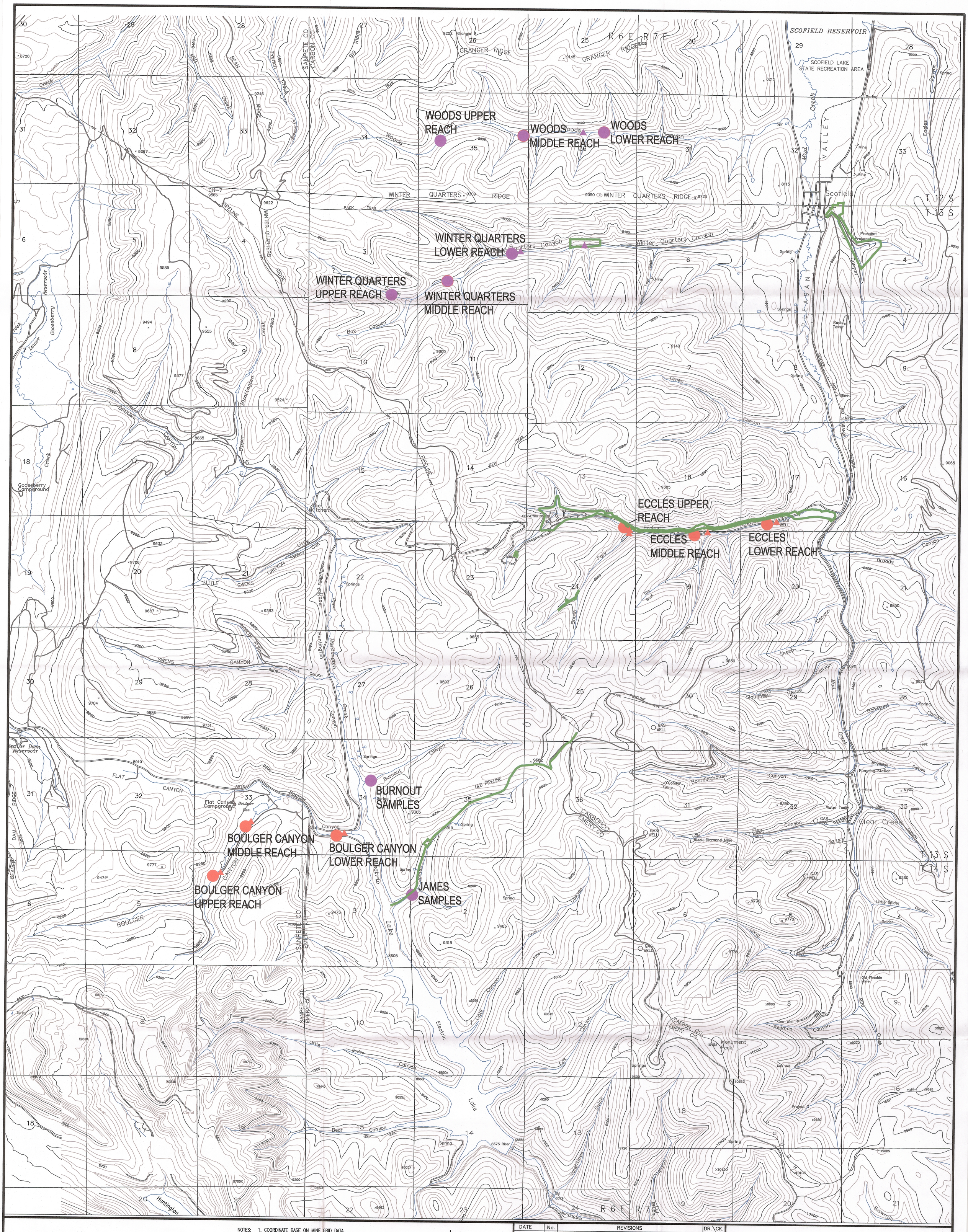
From: Salow, Jeffrey - FS <jeffrey.salow@usda.gov>
Sent: Thursday, November 14, 2019 10:16 AM
To: Olsen, Darren G -FS <darren.olsen@usda.gov>
Subject: FW: NIOSH Repeater site

Darren,

I was asked if a 2 foot diameter concrete footing(~4inches thick) installed 1-1.5 feet below the surface could be left in place on 4 NIOSH repeater sites, for the monitoring of induced seismicity for the Skyline Mine. The Mine would bury the concrete slabs in place and revegetate over the disturbed area. Does this sound acceptable or should the company



MACROINVERTABRATE SAMPLING LOCATIONS

FISH SAMPLING LOCATIONS

PERMIT BOUNDARY

MACROINVERTABRATE SAMPLING LOCATIONS - discontinued in 2015

FISH SAMPLING LOCATIONS - discontinued in 2015

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'

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

DATE	No.	REVISIONS	DR.\CK.
6-07			BR\GG
DEC 09	2	MODIFIED PERMIT BOUNDARY	AB\GG
Sept 10	3	ADDED MACROINVERTABRATE SITES TO WOODS CREEK AND FISH SITES TO ECCLES, WINTER QUARTERS AND WOODS CREEKS	AB\GG
Sept 15	4	Reduced macroinvertebrate and fish monitoring sites	GG/GG
DEC 19	5	Added Boulger canyon sites	TE/GG

MACROINVERTEBRATE SAMPLE SITE LOCATIONS

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

SCALE: 1" = 2000'	DATE: 5/5/05	CK.BY: G. GALECKI	REVISION: 5
DWG. NO.: 2.8.1-1		DR.BY: C. HANSEN	12-20-19
CAD FILE: 2.8.1-1REV4_9-11-15			

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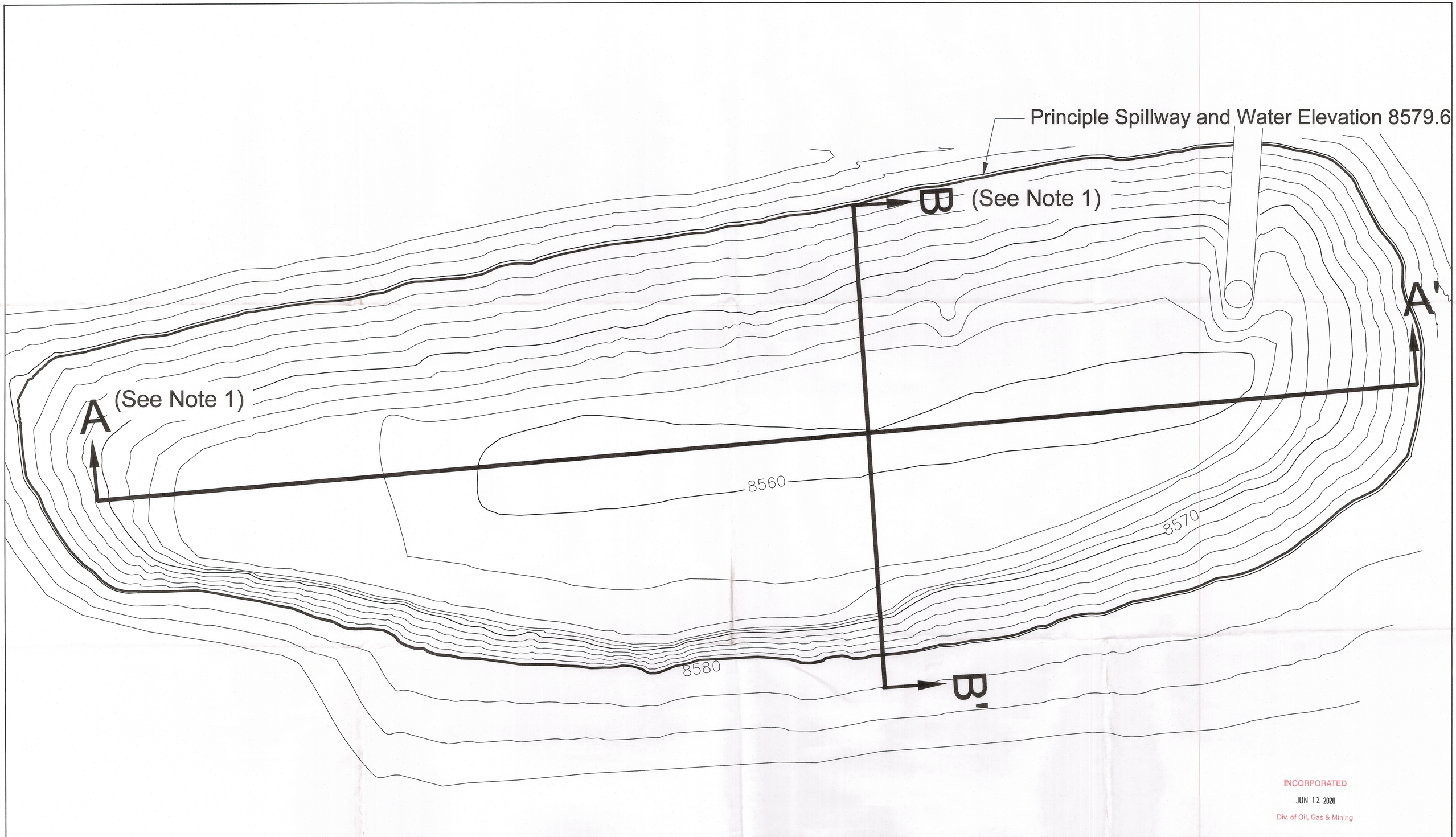

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Notes
1. Typical Cross section shown on map 3.2.1-2 (3-43)
2. Map re-created from original scanned image

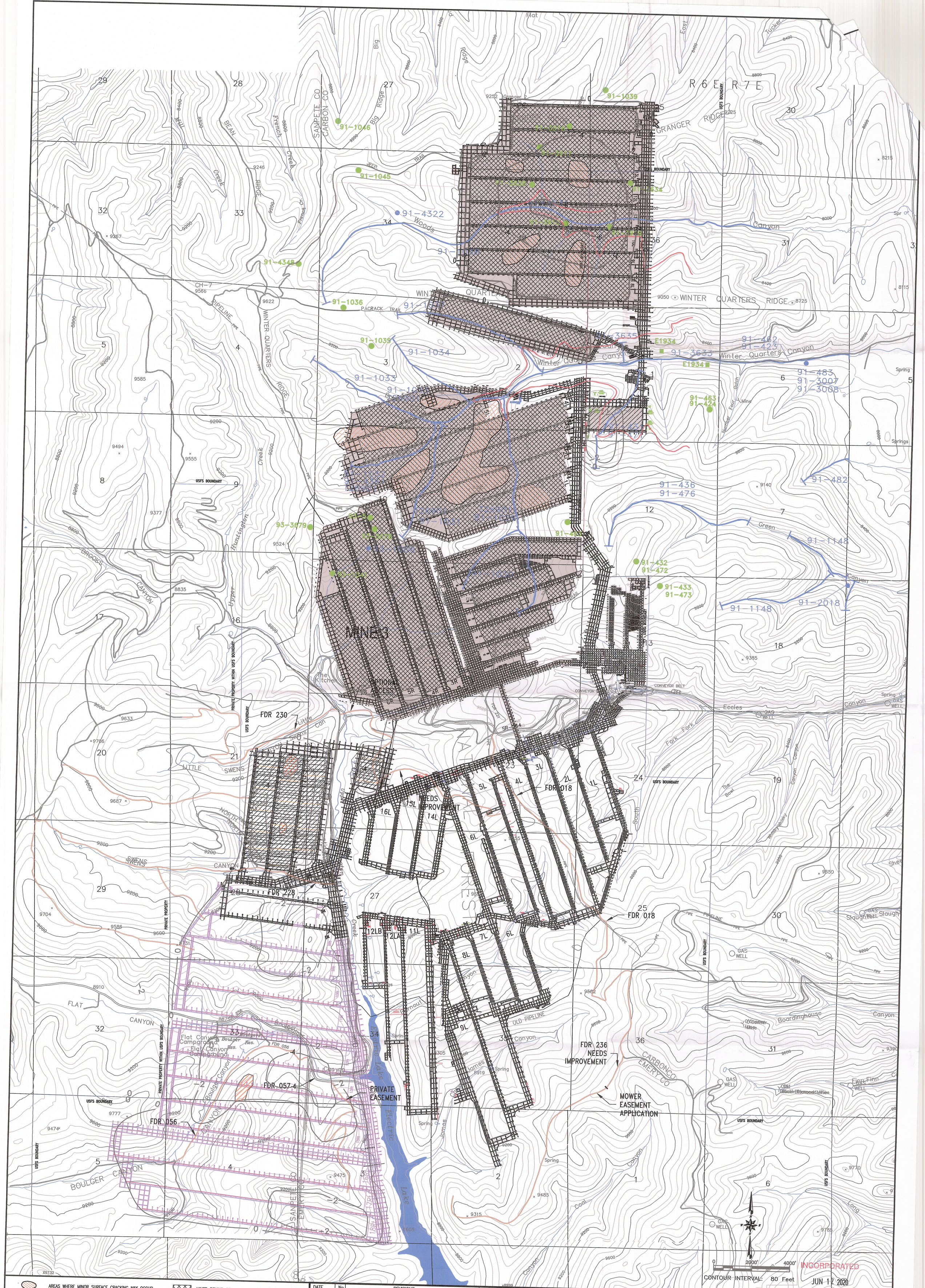
SEAL:

DATE	No.	REVISIONS	APPD. CHKD.	DES. DR.
10/8/1987	1	Zone C-4 Added words "emergency spillway"	BFG KWZ	
12/5/1991	2	Added emergency spillway		
12/20/2019	3	Changed scale and removed 12" Emergency spillway	GAG TWE	

Mine Portal
Sedimentation Pond
Asbuilt Contour Map

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526
435-448-2632
CAD FILE:
DATE: 12/20/19
SCALE: 1"=10'
CK.BY: GGalecki
DR.BY: TEarl
REVISION: 3
12/20/19
DWG. NO.: 3.2.1-2B



AREAS WHERE MINOR SURFACE CRACKING MAY OCCUR

-2- POTENTIAL SUBSIDENCE CONTOUR

700' FT. OF OVERBURDEN OVER LOWER O'CONNOR "A" SEAM

91-3638 GROUND WATER RIGHT LOCATION AND NUMBER

91-3635 SURFACE WATER RIGHT LOCATION AND NUMBER

93-1006 SURFACE WATER DIVERSION LOCATIONS

PROJECTED NORTH LEASE & FLAT CANYON WORKINGS

MINED BEHIND SEALS

MINED NOT SEALED

SEE PLATE 1.6-3 FOR PERMIT AND ADJACENT AREAS

DATE	No.	REVISIONS	DR.	CHKD.
05/05/05	1			CDH
08/29/05	2			CDH
10/19/05	3		JT	GG
06/14/07	4	MODIFIED PERMIT BOUNDARY (IBC) UPDATED PROJECTED MINE PLAN	BR	GG
Oct 09	5	Modified Permit Boundary	AB	GG
JULY 10	6	REMOVED PERMIT BOUNDARY, ADDED LOCATION NOTE	JH	GG
SEPT 10	7	MODIFIED PANEL ORIENTATION, SUBSIDENCE CONTOURS AND AREAS OF POSSIBLE SURFACE CRACKING	AB	GG
OCT 13	8	Updated mined areas, added panels 13 Left through 15 Left, modified 8 Left through 12 Left	GG	GG
DEC 16	9	Updated mined areas, added SWR panels.	JA	GG
12/31/19	10	UPDATED MAP	TWF	GAG

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

PRE-SUBSIDENCE SURVEY MAP

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

SCALE: 1" = 1500'	DATE: 11/04/02	CK.BY: C. HANSEN	REVISION: 10
DWG. NO.: 4.17.3-1A		DR.BY: C. HANSEN	12/20/19
CAD FILE: 4.17.3-1AREV9			