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

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

April 15, 2015

C/007/0005
Received 4/20/15
Task ID #4883

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

RE: North of Graben (NOG) Bleeder Shaft, Canyon Fuel Company, LLC, Skyline Mine, C/007/0005,

Dear Daron:

Attached to this letter is pertinent information requesting approval to construct a ventilation shaft adjacent to Granger Ridge road, within lands managed by the Manti LaSal National Forest. The vent shaft, known as the NOG Bleeder Shaft, is necessary due to geologic conditions encountered underground that required turning two (2) separate mining districts into one, which modified the ventilation conditions. A field visit with Skyline, DOGM, and USFS personnel in 2014 proposed using a site on top of Granger Ridge and immediately adjacent to the existing road. Unfortunately, again due to geologic conditions, a prominent fault eliminated using the site that was initially proposed. However, the proposed design utilizes the area adjacent to the existing road and minimizes the associated disturbance to 1.7 acres.

The need for the shaft was unexpected, and will likely need to be in service by Fall 2016, with the shaft construction starting as early in 2016 as possible. Skyline personnel are hopeful the application can be approved by Fall 2015 with the pad being constructed before winter. The life of the installation will likely be approximately two (2) years; providing sufficient time to compete mining in the North Lease and remove equipment.

Attached to this cover letter are completed C1 and C2 (two pages) forms. In addition, a total of fourteen (14) files have been uploaded to the Division Google Drive (Amendment041515) containing redline/strikeout text of the M&RP modified information, numerous plates and independent reports providing support for the proposed permit amendment.

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

Sincerely:

Gregg A. Galecki

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

APPLICATION FOR COAL PERMIT PROCESSING

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

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine **Permit Number:** C/007/005
Title: NOG Bleeder Shaft
Description, Include reason for application and timing required to implement:
Installation of new bleeder shaft to ventilate the North Lease reserves.

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: 3.0 Disturbed Area: 0.40 ☒ increase ☐ decrease.
☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO# _____
☐ Yes ☒ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☐ Yes ☒ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☒ Yes ☐ No 6. Does the application require or include public notice publication?
☐ Yes ☒ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☒ Yes ☐ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV # _____
☒ Yes ☐ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain: _____
☐ Yes ☒ No 11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes ☒ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☒ Yes ☐ No 13. Does the application require or include collection and reporting of any baseline information?
☒ Yes ☐ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☒ Yes ☐ No 15. Does the application require or include soil removal, storage or placement?
☒ Yes ☐ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☒ Yes ☐ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☒ Yes ☐ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☒ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
☐ Yes ☒ No 20. Does the application require or include subsidence control or monitoring?
☒ Yes ☐ No 21. Have reclamation costs for bonding been provided?
☐ Yes ☒ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☐ Yes ☒ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

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

Carl W. Winters — Carl W. Winters 4-15-15
Print Name — Sign Name, General Manager, Date

Subscribed and sworn to before me this 15th day of April, 2015
Kathleen Atwood
Notary Public
My commission Expires: 12-02, 2015
Attest: State of Utah } } ss:
County of Carbon

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

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

Form DOGM- C1 (Revised March 12, 2002)

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: NOG Bleeder Shaft - Page 1 of 2

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

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Chapter 1 Legal, Financial Compliance Information pages 1-37, 1-38
☒ Add	☐ Replace	☐ Remove	Chapter 1, Appendix 118-A -Public Notice
☐ Add	☒ Replace	☐ Remove	Chapter 1, Plates 1.6-3
☒ Add	☐ Replace	☐ Remove	Chapter 2, Section 2.1 General Environmental Resources Summary: 2-4c2, 2-4e
☐ Add	☒ Replace	☐ Remove	Chapter 2, Section 2.2 Geology and Geotechnical: page 2-21(b)
☐ Add	☒ Replace	☐ Remove	Chapter 2, Section 2.7 Vegetation: pages 2-63a
☐ Add	☒ Replace	☐ Remove	Chapter 2, Section 2.9 Terrestrial Wildlife: page 2-104k (tables 2.9-4 and 2.9-5, Figure 2.9.3-A, and Figure 2.9.3 E(sage grouse) are being updated as part of the Flat Canyon Lease submittal)
☐ Add	☒ Replace	☐ Remove	Chapter 2, Section 2.10 Raptors: page 2-111b
☐ Add	☒ Replace	☐ Remove	Chapter 2, Section 2.11 Soils: page 2-120(L)
☐ Add	☒ Replace	☐ Remove	Chapter 2, Section 2.12 Soils: page 2-128, 2-131
☐ Add	☒ Replace	☐ Remove	Chapter 3, Section 3.2 Components of Operation: pages 3-31(b) and 3-72(c)
☒ Add	☐ Replace	☐ Remove	Chapter 3, Plates 3.2.4-5A through 3.2.4-5D
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.1 Reclamation Plan; page4-3(a)
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.2 Reclamation Timetable: page 4-6 Table4.2-1
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.3 Reclamation Bond; Reclamation Cost Estimate Summary Table, Demolition summaryTable, Earthwork Summary Table, Revegetation Summary Table
☒ Add	☐ Replace	☐ Remove	Chapter 4, Section 4.3 Reclamation Bond; NOG Bleeder Shaft Demolition sheet, NOG Bleeder Shaft Earthwork sheet
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.4 Backfill, Soil Stabilization, Compaction, Contouring, Grading; page 4-28
☒ Add	☐ Replace	☐ Remove	Chapter 4, Section 4.4 Backfill, Soil Stabilization, Compaction, Contouring, Grading; Plates 4.4.2-5A and 4.4.2-5B
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.6 Topsoil/Subsoil Handling Plan: Page 4-34(b), Page 4-38 (d) - Table 4.6-4, page 4-41(e)
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.7 Revegetation Plan: Page 4-50 (a)
☒ Add	☐ Replace	☐ Remove	Chapter 4, Section 4.7 Revegetation Plan: Table 4.7-10A pg 4-58(e), Table 4.7-10B pg 4-58(f)
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.9 Opening and Sealing Plan: Page 4-62(a)
☒ Add	☐ Replace	☐ Remove	Chapter 4, Section 4.9 Opening and Sealing Plan: Figure 4.9-D
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.11 Protection of Hydrological Balance: Page 4-72
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.12 Postmning Land Uses: Table 4.12-1 pg 4-75, Page 4-75(a), 4-81
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.18 Fish and Wildlife Plan: Page 4-103B
☐ Add	☒ Replace	☐ Remove	Chapter 4, Section 4.20 Transportation Facilities: Page 4-114(a)
☒ Add	☐ Replace	☐ Remove	Chapter 4, Plates 4.4.2-5A and 4.4.2-5B

Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	**Received by Oil, Gas & Mining**
Information was submitted electronically. Two (2) paper copies of the information will be submitted at final approval.	

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: NOG Bleeder Shaft 2 of 2

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

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☒ Add	☐ Replace	☐ Remove	Appendix A-2, Volume 2: Vegetation of the NOG Ventilation Site, 2014 Skyline Mine, Carbon County, Utah. Mt Nebo Scientific, Inc. (file name: Canyon15.Skyline14.NOG.rpt.final.pdf)
☒ Add	☐ Replace	☐ Remove	Appendix A-2 Volume 2: Order 2 Soil Survey for NOG Bleeder Shaft - Skyline, January 2015; Long Resources Consultants, Inc., (file name:NOG Soil Survey Report Jan 21 2015.pdf)
☒ Add	☐ Replace	☐ Remove	Appendix A-2, Volume 2: 2014 Wildlife Survey Report - NOG Graben Bleeder Shaft, Alpine Ecological, 3.28.15 (file name: 2014 Graben Survey Report.pdf)
☒ Add	☐ Replace	☐ Remove	Appendix A-4, Volume 2: CONFIDENTIAL FILE - A Cultural Resources Inventory for the Skyline Mine Expansion and Transmission Line Construction Project, Carbon and Emery Counties, Utah; Environment Planning Group, LLC., October 7, 2014 (file name: Bowie-Skyline Expansion Report_EPG.pdf)
☒ Add	☐ Replace	☐ Remove	Appendix A-5 Engineering Calculations, Section 25: North of Graben (NOG) Bleeder Shaft Area Hydrology Design Report; Earthfax Engineering Group, LLC., March 2015 (file name: NOG Bleeder Shaft Hydrology Design Report_Full.pdf)
☒ Add	☐ Replace	☐ Remove	Appendix A-5 Engineering Calculations, Section 25, North of Graben (NOG) Bleeder Shaft Area Slope Stablility Analysis; Earthfax Engineering Group, LLC., March 2015 (file name: Geotech Report-Full.pdf)
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	**Received by Oil, Gas & Mining**
Information has been submitted electronically. Two (2) paper copies of the information will be submitted at final approval.	

Ch. 1

of Mine Workings Workings (Life of Mine)	Surface to 1,500' max	Surface to 2,300' max	Surface to 1,500' max

The anticipated number of total surface land acres to be affected (life of mines) is less than the combined total of the affected acreages for each of the three mines due to the overlapping of mining operations which is inherent to this multi-seam mining operation. The total surface acreage to be disturbed by surface facilities associated with underground mining is 122.31 acres.

The following information was based on projection for the next five years (2012-2016).

	Mine No. 1	Mine No. 2	Mine No. 3
Extent of Horizontal Workings	240 acres	375 acres	1,400 acres
Extent of Vertical Workings	Surface to 1,250'	Surface to 2,250'	Surface to 2,125'

Permit Area

The construction/installation of surface facilities at the mine site, loading area, conveyor belt route, well houses, water tank pad, waste rock disposal site, and South Fork Breakout, and Winter Quarters Ventilation Facility comprise the Permit Area. The permit area acreage listed adequately accommodate areas of disturbance.

PERMIT AREAS TO BE RECLAIMED

AREA	ACREAGE
Loadout	13.86
Portal Yard	42.55
Water tanks, water lines, and Well pads (water lines not reclaimed	0.60
Conveyor Bench	14.18
Waste Rock Disposal Site and Road	32.48
South Fork Breakout	0.96
James Canyon Buried Power Line	0.30
James Canyon Buried Pipeline	1.60
James Canyon Water Wells and Road	2.95
Winter Quarters Ventilation Facility	7.93
Winter Quarters Road (not reclaimed)	4.90
North of Graben (NOG) Shaft	3.00
TOTAL	~~122.31~~125.31

Legal Description of Permit Area

Township 12 South, Range 6 East, SLBM

Section 26: Portions of SW1/4SW1/4
Section 34: Portions of NE1/4NE1/4

Township 12 South, Range 7 East, SLBM

Section 32: Portion SE1/4SE1/4

Township 13 South, Range 6 East, SLBM

Section 1: Portions of S1/2NW1/4, S1/2NE1/4
Section 13: Portions of S1/2S1/2
Section 23: Portions of SE1/4NE1/4
Section 24: Portions of NE1/4SW1/4
Section 25: Portions of S1/2S1/2
Section 35: Portions of NE1/4, S1/2
Section 36: Portions of N1/2NW1/4

Township 13 South, Range 7 East, SLBM

Section 4: Portions of SW1/4NW1/4, NW1/4SW1/4
Section 5: Portions of E1/2NE1/4
Section 6: Portions of S1/2N1/2
Section 17: Portions of S1/2S1/2
Section 18: Portions of S1/2S1/2
Section 19: Portions of N1/2N1/2

Township 14 South, Range 6 East, SLBM

Section 2: Portions of W1/2NW1/4
Section 3: Portions of SE1/4NE1/4

See Plate 1.6-3 for graphic illustration of Permit Area

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04/04/11
Division of Oil, Gas & Mining

Appendix
118-A

LEGAL NOTICE

Canyon Fuel Company, LLC, has filed a complete application with the Division of Oil, Gas and Mining for a revision of the existing Mining and Reclamation Plan, C/007/0005 for the Skyline Mine. Canyon Fuel Company, LLC operates the Skyline Mines with surface facilities located in Eccles Canyon which is approximately 4 miles southwest of the town of Scofield, Utah. The revision includes the addition of a ventilation shaft and associated pad adjacent to Granger Ridge road.

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

Proposed Additional Areas Authorized for Coal Mining and Reclamation Activities

Township 12 South, Range 6 East, SLBM

Section 26: Portions of SW1/4SW1/4
Section 34: Portions of the NE1/4NE1/4

Total acres within the affected area: 3.0 acres for the ventilation facility

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

After filing, copies of this permit application will be available for inspection at the following location: Utah Division of Oil, Gas and Mining, 1594 West North Temple, Suite 1210, Salt Lake City, Utah, and the Utah Division of Oil, Gas, and Mining website under the Coal Permit files.

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

Published in the Sun Advocate and the Emery County Progress on (four consecutive weeks in 2015 once approved).

Sec. 2.1

submitted a cultural resource survey identifying the WQVF pad site as being on the westernmost edge of the Winter Quarters mining district. In addition, Skyline submitted a second amended report that was necessary to identify changes to WQVF pad, which in turn modified the features to be impacted with the construction of the site. The pad site will potentially impact eleven (11) features which comprise of earthen and or stone foundation alignments. No standing structures exist in the area. Earlier cultural resource surveys indicate ''little new evidence is expected to be found in Winter Quarters Canyon'' (Cook 1981). No remnant standing structures are within 1/2-mile of the pad site. The Winter Quarters mining district is apparently eligible or qualifies for the National Historic Register, however landowners controlling the site have adamantly opposed being listed on the Registry when approached by SHPO on previous occasions.

The existing road through the Winter Quarters canyon will be improved with the addition of road base, gravel, to improve drainage from the road. The footprint of the road will not change, and historic features will be avoided.

Evaluation of the cultural resources survey and discussions with both DOGM and SHPO personnel concluded the best mitigative measure to address the impact to the westernmost edge of the Winter Quarters town site was to design and construct an interpretive sign to be placed at the mouth of the canyon that summarizes for the public aspects of the cultural history of the area. The reports detailing the initial investigation, and the second amended report are located in the CONFIDENTIAL FILE.

Revised: 7-22-1012-30-09 2-4c1

North of Graben (NOG) Bleeder Shaft

Preliminary studies for permitting construction of the NOG Bleeder Shaft was conducted in 2014. The permit area is approximately 3.~~1~~00 acres with a disturbed area of approximately 0.4 acres. The area surveyed for cultural resource was significantly larger than the area to be disturbed. Both Class I and Class III cultural resource inventories were conducted in the area. Two(2) isolated occurrences and one (1) new cultural resources sites were identified in the vicinity of the site, but none of the sites will be impacted. In addition, the sites were documented and evaluated for eligibility for inclusion in the National Register of Historic Places, but determined not to be

eligible. See CONFIDENTIAL FILE for Environmental Planning Group (EPG) report, ''A Cultural Resources Inventory for the Skyline Mine Expansion and Transmission Line Construction Project, Carbon and Emery Counties, Utah.''

2.1.2 Threatened and Endangered Species

No currently approved threatened or endangered species, plant or animal, have been identified on the project or adjacent areas with the exception of an occasional transient Bald Eagle, which may pass through the project area during the winter. The mining operation has no impact on these transitory birds. However, a northern goshawk, a candidate for T&E listing, has been identified as a resident adjacent to the permit area. A plan for monitoring and protection of raptors may be found in Sec. 4.18.

Should any threatened or endangered species be identified in the future, their discovery will be promptly reported to the Division.

The Scofield Waste Rock site was expanded into approximately 5 acres of previously undisturbed ground in 2007. Surveys were conducted to identify T&E species of both plants and animals. The surveys did not find any such species. Species listed in Carbon County are found in different elevations and habitats. Results of the surveys are located in Appendix A-2, Volume 2. Additional discussions on vegetation and wildlife are discussed in Sections 2.7 and 2.9, respectively.

Winter Quarters Ventilation Facility

Permitting of the Winter Quarters Ventilation Facility consists of permitting approximately 7.93 acres located along the base of the south-facing slope. Improvements to the existing road encompass approximately 4.9 acres of previously disturbed ground; additional disturbance was added. Particular attention was taken to stay outside the stream buffer zone of Winter Quarters Creek keeping construction activities a minimum of two (2) bankfull widths from the stream. Surveys were conducted to identify T&E species of both plants and animals. The surveys did not find any such species.

North of Graben (NOG) Bleeder Shaft

The NOG Bleeder Shaft consists of approximately 3.100 acres of disturbance located on a south-facing slope approximately 200 feet below the existing Granger Ridge USFS road. The total watershed area contributing to the pad is approximately 0.8 acres. The site includes a 0.19 acre topsoil stockpile area,a short access road, the pad, and a minor re-routing of the existing road to utilize flat ground on top of the ridge to minimize the disturbance associated with the pad. Surveys were conducted to identify T&E species of both plants and animals. Surveys (provided in Appendix A-2)did not note any such species. Although habitat for the three-toed woodpecker exists in the area, none were identified.

Sec. 2.2

north of Winter Quarters Canyon. The ventilation facility will include a 20-foot diameter vertical shaft, and / or a 20-foot wide slope driven at 18 degrees down, and 8-foot diameter escape shaft. The 20-foot shaft will have a 12-inch thick concrete liner, the slope will have a 8-inch thick concrete invert with the ribs and roof having a minimum 3-inch thick shotcrete liner, and the escape shaft will have a 6-inch concrete liner. When sealing at reclamation, the shaft(s) per 30 CFR Part 75.1711-1 and R645-301-551 will be completely backfilled to the surface using an engineered fill. When sealing the slope, sealing will consist of solid, substantial, incombustible material, such as concrete blocks, bricks or tile, or shall be completely filled with incombustible material for a distance of at least 25 feet into the opening. See Section 4.9 for additional details.

2.2.13 North of Graben (NOG) Bleeder Shaft

The NOG Bleeder Shaft is constructed to provide adequate ventilation for completion of the North of Graben mining district. The shaft was necessary due to encountered geologic conditions that required turning two (2) separate mining districts into one (1). The facility will include one (1) 5-foot diameter, unlined shaft. When sealing at reclamation, the shaft will be completely backfilled to the surface using an engineered fill, per 30 CFR Part 75.1711-1 and R645-301-551. Figure 4.9-C illustrates the backfilling of the shaft.

2.2.144 Subsidence Monitoring

Please refer to Section 4.17 - Subsidence Control Plan for details of the Subsidence Monitoring program and commitments to mitigate any effects due to subsidence.

2.7

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08/23/10
Division of Oil, Gas & Mining

2.7.9 North of Graben (NOG) Bleeder Shaft

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

2.9

Habitat Loss

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

2.9.7 WILDLIFE OF THE NORTH OF GRABEN (NOG) BLEEDER SHAFT

The NOG Bleeder Shaft is within the North Lease where multiple wildlife surveys have been conducted The area is considered critical summer habitat for deer and elk. No sage grouse habitat exists in the area. A wildlife survey report conducted in 2014 which addressed goshawk, raptors, American three-toed woodpecker, and Threatened and Endangered species determined no species of concern would be impacted by the construction of the shaft (See Apendix A-2, Volume 2 for Alpine Ecological report).

See 2.10

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

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

The North of Graben (NOG) Bleeder Shaft area is within the North Lease area and has been monitored for raptors on an annual basis. Based on the 2014 survey, no raptors will be affected by the proposed construction of the shaft. A specific raptor survey was conducted in 2014 specifically for the NOG Bleeder Shaft area with no nests being found. See Appendix A-2, Volume 2 for Alpine Ecological report.

THREATENED & ENDANGERED SPECIES

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

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

See. 2.11

North of Graben (NOG)Bleeder Shaft

A detailed description of the soils associated with the NOG Bleeder Shaft is available in Appendix A-2, Volume 2, titled, "Order 2 Soil Survey of the North of Graben (NOG) Bleeder Shaft Area" (January 16, 2015). The survey conducted by Long Resources Consultants, Inc. provides a comprehensive assessment of the various soils within the area. The site encompasses approximately 3.0 acres. The soil type is represented by the McCadden Family, with shallow soil depths overlying shallow sandstone bedrock. It is considered to have good-to-fair available water capacity, and fair-to-good reclamation material with pH values ranging 6.2 - 7.0 and a saturation range of 44.1 - 72 percent. The estimated total salvage depth includes approximately 19-inches of topsoil and 2-inches of subsoil.

Sec. 2.12

TABLE 2.12.2-1

GRAZING POTENTIAL FOR THE AREA TO BE AFFECTED BY
MINING SURFACE OPERATIONS AND FACILITIES
(Does not include State Highway SR-264)

Surface Facilities Area	General Area Classification	Land Area (Acres) (AU)	Units (AUM)	Grazing Potential Animal Animal Unit Month
1. Portal Yard Area	Spruce-Fir	16.47	0.0	0.00
	Aspen	7.93	114.0	3.80
	Sagebrush	2.50	84.0	2.80
	Disturbed	8.50	0.0	0.00
	Riparian	1.00	38.0	1.30
Subtotal		36.40	236.0	7.90
2. Conveyor Corridor	Aspen	3.20	32.0	1.50
	Sagebrush	5.77	151.0	5.00
Subtotal		8.97	183.0	6.50
3. Railroad Loadout Area	Grass-Forb	10.32	126.0	4.20
	Spruce-Fir	3.50	0.0	0.0
	Riparian	.04	1.5	.05
Subtotal		13.86	127.5	4.25
4. Waste Rock Disposal Area	Disturbed	12.81	0.0	0.00
Subtotal		12.81	0.0	0.00
5. Water Tank and Well Pads	Aspen	.26	18.0	1.00
South Fork	Spruce-Fir	.96	0.0	0.00
Breakout Subtotal		1.22	18.0	1.00
6.WQ Vent Pad	Sagebrush	2.36	114	3.80
	Subtotal	2.36	114	3.80
7.NOG Bleeder Shaft	Grass-Aspen	3.00	114	3.80
TOTAL		~~75~~78.62	~~678~~792.5	~~23.45~~27.25

ADDITION TO		TEXT		
Table 2.12.2-1	Page 2-128	Section 2.12	Page 2-128	Date ~~3-24-10~~4-6-15

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TBR (Timber) Management Unit - Emphasis is on management for production and use of wood - fiber for a variety of wood products.

UC (Utility Corridor) Management Unit - Emphasis is on providing transportation corridors for major cross-country pipelines, electrical transmission lines and telephone lines. This unit currently contains a gas transmission pipeline constructed and operated under a Forest Service special-use permit issued to Questar Pipeline Company (main line 41).

RPN (Riparian) Management Unit - Emphasis is on management of riparian areas and all the component ecosystems. The units consist of a zone approximately 100 feet measured horizontally from the edge of all perennial streams and springs, and from the shores of lakes and other still water bodies.

MMA (Minerals Management Area) Management Unit - Emphasis is on making land surface available for existing and potential major mineral developments.

In the "Land and Resource Management Plan" the Forest Service lists specific objectives pertaining to management of resources and resource uses on National Forest System lands. The Forest Service portion of the disturbed area (portal area) is currently identified as a Minerals Management (MMA) Unit. After completion of coal mining activity, the area will revert to a Range (RNG) Management unit. Similarly, the 3.0 acres disturbed by the NOG Bleeder shaft will revert to a Range (RNG) Management unit once mining is complete.

COMPATIBILITY OF MINING OPERATION WITH FOREST SERVICE MANAGEMENT EMPHASIS AND OBJECTIVES

All mining activities related to the Forest Service "Land and Resource Management Plan" will be coordinated with the appropriate Forest Service personnel prior to implementation. While the mine is located on the Forest Service land boundary, creating primarily visual and traffic pattern related impacts, these effects are considered to be rather short term and will be essentially eliminated upon mine closure.

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Chapter 3

Sec. 3.2

Disturbed area ditches are temporary and designed to convey runoff from a 10-year, 24-hour storm event. The Un-disturbed upper road ditch and associated culvert are considered permanent and were designed to convey runoff from a 100-year, 6-hour storm event (See Plate 3.2.4-3D for pond designs and Winter Quarters Ventilation Shaft Pad Runoff and Sediment Control Design Report-Volume 5, Section 24 for calculations).

North of Graben (NOG) Bleeder Shaft

The NOG Bleeder Shaft is constructed to provide adequate ventilation for completion of the North of Graben mining district. The shaft was necessary due to encountered geologic conditions that required turning two (2) separate mining districts into one (1). An associated fan will be powered from within the mine, with the exception of during startup of the fan where a diesel-powered generator will be used to start the fan. The approximately 3.0 acre permitted area will include an access road, a 50-foot by 80-foot pad housing a fan, and a topsoil storage area. On the existing road located approximately 200-ft uphill from the pad, a second smaller fenced area approximately 25-foot by 40-foot will include a generator housed in a shed and a 300-gallon fuel tank housed in a secondary containment for spills. There is no associated sediment pond due to the small nature of the site, and a sediment collection area located on the pad that is designed to let water leave the site through a culvert once sediment has been retained. Total acreage draining to the pad is 0.8 acres. The peak flow in the road ditch resulting from a 10-year, 24-hour event is estimated at 1.86 cfs, with a maximum velocity of 4.97 fps. The ditch will be lined with D50 riprap of 3-inch rock. The site is considered an Alternate Sediment Control Area (ASCA). Plates 3.2.4-5A through 3.2.4-5C illustrate the pad and road designs, cross sections, and watersheds of the site. Located in Appendix A-5, Section 25 are two (2) reports outlining both the hydrologic design and slope stability of the pad, topsoil pile, and road.

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provide the primary sediment control. Following construction of the retaining wall and sediment pond, the area will be roughened, seeded, and mulched. Once vegetation is sufficiently established, the silt fences will be removed.

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, althought not having a erosive velocity, is armored with riprap to further reduce any sediment loading.

Area 40: The NOG Bleeder Shaft pad is an area that addresses runoff from both small undisturbed area UW1, and disturbed areas DW3, DW5, and DW6 that include the cutbank/highwall, road, and pad. The area contributing runoff to the pad is approximately 0.8 acres. The pad is designed to slope back (or north) into the northwest section of the pad. Water will be able to collect and drop out sediment prior to being discharge off the site via a culvert. Sediment can reach a height of 0.40 feet prior to needing cleaning which will accommodate approximately 160 cu-ft of sediment storage. See Appendix A-5, Section 25 for the Earthfax Hydrology Design report.

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.

Ch. 4

4.1

4.1.1 Reclamation Plan - Rock Disposal Site

Reclamation activities will be conducted on portions of the affected areas as twenty foot lifts are filled to design capacity. The final contours of the rock disposal site are presented in Drawing 4.16.1-1B. Part of diversion ditch DD-16 will be removed during final reclamation as needed. Diversion ditch UD-6 will remain after final reclamation. Part of the disturbed are affected by the disposal operation will, at the request of the property owner=s representative, be leveled off and reclaimed to native rangeland for subsequent use as a corral. The access road to the site will not be reclaimed except for the removal of the guard rail (Exhibit 4.1.1-1).

4.1.2 Reclamation Plan - Winter Quarters Ventilation Facility

Reclamation activities will include removing any existing structures such as the fan structure, retaining walls, a mobile field office for emergency evacuation, substation with associated pad, fencing, etc. Compliant to both State Regulations R645-301-551 and MSHA 30 CFR 1711, both the vent shaft and emergency escape shaft will be sealed and backfilled with an engineered fill. The shafts will be backfilled above the pad surface with the excess fill allowed to settle for approximately one year prior to removing the pad (See Section 4.9 for details)closed with a six-inch thick concrete cap or other equivalent means and vented with a two-inch diameter or larger pipe extending a minimum of 15-feet above the surface of the shaft(s). Consistent with the same regulations, the slope will be sealed with solid, substantial, incombustible material such as concrete blocks, bricks or tile, or shall be completely filled with incombustible material for a distance of at least 25-feet into the opening. Once all structures are removed and openings sealed, the slopes will be reclaimed to the approximate original contours (AOC) using extreme surface roughening (pocking) as the primary form of sediment control. The site will be reseeded as outlined in Section 4.7 of the M&RP, and the sediment pond removed. In the event the extreme surface roughening shows signs of failure, additional work will be conducted to insure sediment is controlled on site. Improvements that were made to the preexisting Winter Quarters Canyon road while the WQVF was operational will remain intact for the landowner as outlined in the easement of the lease.

4.1.3 Reclamation Plan – North of Graben (NOG) Bleeder Shaft

Reclamation activities will include removing any structures such as the fan structure, diesel engine, fuel tanks, etc. Compliant to both State Regulations R645-301-551 and MSHA 30 CFR 1711, the shaft will be backfilled with an engineered fill. The shaft will be backfilled above the pad surface with excess fill, allowed to settle for approximately one year prior to removing the pad (See Section 4.9 for details), closed with a six-inch concrete cap or other equivalent means and vented with a two-inch diameter or larger pipe

extending a minimum of 15-feet above the surface of the shaft. Once all structures are removed and the shaft sealed, the slopes will be reclaimed to the approximately original contour (AOC) using extreme surface roughening as the primary form of sediment control. The site will be reseeded as outlined in Section 4.7 of the M&RP. In the event of re-vegetation not achieving reclamation standards, additional work will be conducted to insure sediment control on the site.

Revised: ~~7-22-10~~4-6-2015

4.2

TABLE 4.2-1 **RECLAMATION TIMETABLE**

	Task	Phase I		Phase II					Phase III			Phase IV
	Recovery of Underground Equipment											
	Seal Mine Portals											
	Remove Winter Quarters Fan and housing											
	Remove NOG Shaft fan and housing											
Demolition												
	Mine Site - Lower Bench											
	Winter Quarters Ventilation Facility											
	Mine Site - Middle Bench											
	Mine Site - Upper Bench											
	Overland Conveyor											
	Rail Loadout Facilities											
	Remaining Facilities (pump houses, wells, water tanks)											
Earth Work												
	Seal and Backfill Winter Quarters Mine Openings											
	Install Interim Sediment Control											
	Backfill and Compact											
	Remove Sedimentation Ponds											
	Topsoil Replacement											
	Back fill and compact NOG Shaft											
	Revegetation											

4.3

Skyline Mine TC/007/005
2014 Midterm Review
Task # 4756

Total Required Bond Amount
2014 Dollars

Revised April 6, 2015

Bonding Calculations

Direct Costs

Subtotal Demolition and Removal	$2,152,631	
Subtotal Backfilling and Grading	$1,666,868	
Subtotal Revegetation	$428,869	
Direct Costs Subtotal	$4,248,367.62	

Indirect Costs

Mob/Demob	$424,837	10.0%
Contingency	$212,418	5.0%
Engineering Redesign	$106,209	2.5%
Main Office Expense	$288,889	6.8%
Project Management Fee	$106,209	2.5%
Subtotal Indirect Costs	$1,138,562	26.8%
Total Cost 2014	**$5,386,930**	
Escalation factor		5
Number of years		0.019
Escalation	$531,578	
Reclamation Cost Escalated	$5,918,508	
Reclamation Bond Amount (rounded to nearest $1,000) 2019 Dollars	**$5,919,000**	
Posted Bond March 18, 2015	$5,799,000	
Difference Between Cost Estimate and Bond	-$120,000	
Percent Difference	-2%	

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
	Shop Warehouse 01																			394012
	Administration Bld 02																			27154
	Mine No 1 Transfer Tower 03																			44110
	BC 2 Drive House 04																			9422
	BC 3 Drive House 05																			40300
	Crusher Raw Coal 06																			29295
	Truck Loadout 07																			7090
	Railcar Loadout 08																			23377
	Conveyors 8 total 09																			99678
	Water Tanks Two 10																			6318
	Pump House 11																			1126
	Well House Three 12																			4756
	Water Treatment Bld 13																			17830
	Misc Storage Bld 14																			3598
	Overland Conveyor 15																			95092
	Guard Rail 16																			18195
	Rock Dust Bld 17																			5743
	Overland Dust Collector 18																			1296
	Substation 19																			1797
	Power Line 20																			528
	Cap Magazine 21																			34
	Fuel Storage 22																			2634
	Propane Tanks 23																			470
	Stacking Tube 24																			4900
	Reclaim Tunnel 25																			40535
	Slope Proctection Apron 26																			15574
	Concrete Lined Ditch 27																			431
	Raw Coal Silo 28																			14063
	Parking Area Middle 29																			2178
	Truck Loadout Foundation 30																			206
	Road Pad Lower 31																			3372
	Silo Rail Loadout 32																			124659
	Loadout Foundation RR 33																			5124
	Pavement Rail Loadout 34																			80964
	Steel 35																			11075
	James Canyon 36																			126205
	Culvert Backfilling 37																			8667
	Channel Construction 38																			520548
	Equipment 39																			265747
	Portal Face Door 40																			6297
	Concrete Building 41																			1750
	Winter's Quarters Ventilation																			72809
	North of Graben Bleeder Shaft																			13672
	Total																			2152631

	Equipmer 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															71677
Water Tank 02															12626
Lower Terrace 03															199039
Middle Bench 04															263112
Upper Bench West Fork 05															139434
Southwest Fork 06															99702
Loadout Faclities 07															191024
South Fork Portal Area 08															74000
Waste Rock Disposal 09															413660
Pond Enlargement Interim 10															1899
Pond Diversion DU2 Interim 11															460
Interim Sediment Control 12															5335
Overland Conveyor 13															1875
James Canyon 14															0
Winter Quarters 15															123885
North of Graben Bleeder Shaft 16															69140
Total															1666868

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
	North of Graben Bleeder Shaft 43																			
	Steel																			
	Escape Shaft																			
	Structure's Demolition Cost	Steel Bld large	02 41 16 13 0020	0.27	CF													88	CF	23.76
	Fencing		02 41 13 60 1600	2.1	LF														LF	0
	Generator/Fuel pad	chain link remove 8'-10'	02 41 13 60 1700	4.22	LF													200	LF	844
	Ventilation Pad	chain link remove 8'-10'	02 41 13 60 1700	4.22	LF													280	LF	1181.6
	Ventilation Fan	steel bld large	02 41 16 13 0012	0.36	CF													75	CF	27
	Structure's Demolition Cost																			
	Subtotal																			2076.36
	Concrete																			
	Substation																			
	Bleeder Shaft Pad	Concrete demo		15.5	CY													150	CY	2325
	Generator pad	Concrete demo		15.5	CY													150	CY	2325
	Fuel pad	Concrete demo		15.5	CY													45	CY	697.5
	Misc	Concrete demo		15.5	CY													30	CY	465
	Loading Cost																1.3	488	CY	
	Disposal Costs	Front end loader track 3 CY		2.05	CY													488	CY	1000.4
	Loading Cost	Disposal on site		9.8	CY													488	CY	4782.4
	Subtotal																			11595.3
	Concrete Demolition																			
	Demolition Cost																			
	Concrete's Vol. Demolished																			
	Loading Cost																			
	Transportation Cost																			
	Disposal Costs																			
	Subtotal																			
	Total																			13671.66

	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
NOG Bleeder Shaft 16															
Sealing Shaft - 5-foot diameter, 1,420 foot depth															
(+) 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
966 G serious II ROPS	21000	119.32	0.1	63.03	325.53	1	325.53	HR	67	HR	1		67	HR	21811
Eq Op Medium Equiment				61.72	61.72	1	61.72	HR	67	HR	1		67	HR	4135
Subtotal															**47359**
Subtotal															
Subtotal															
Backfilling and grading															
CAT 345BL II	17095	113.1	0.1	61.72	292.97	1	292.97	HR					12	HR	3516
D10R semi EROPS	31000	352.27	0.1	61.72	642.97	1	642.97	HR					16	HR	10288
Pickup Crew 4x4 ton	1105	15.55	0.1	59.27	83.28	1	83.28	HR					20	HR	1666
CLAB				36.65	36.65	1.5	54.98	HR					20	HR	1100
Foreman average outside				76.35	76.35	1	76.35	HR					20	HR	1527
Subtotal															**11876**
Topsoil															
D10R semi EROPS	31000	352.27	0.1	61.72	642.97	1	642.97	HR					20	HR	12859
Pickup Crew 4x4 ton	1105	15.55	0.1	59.27	83.28	1	83.28	HR					20	HR	1666
CLAB				36.65	36.65	1	36.65	HR					20	HR	733
Foreman average outside				76.35	76.35	1	76.35	HR					20	HR	1527
Subtotal															**9905**
TOTAL															**69140**

Ref.	Description	Materials	Means Referen Number	Unit Cost	Unit	Length	Width	Height	Diamet	Area	Volum	Weigh	Densit	Time	Numb	Unit	Quant Factor	Unit	Cost
	Vegetation Costs																		
	Skyline Mine																		
	South Facing Slopes 1H:3H or Greater																		
	Seeding	South Facing Slope Seed 1H : 3H or gentler	Skyline	775.43	/AC					39.81						AC	39.81	AC	30870
	Mulch	Hay 1" material only 029105000250	Reveg0	600	/AC					39.81						AC	600	AC	23886
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg0	10.346	/MSF					39.81						AC	1734	MSF	17940
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg0	23.016	/MSF					39.81						AC	1734	MSF	39910
	Subtotal																		112606
	North Facing Slopes																		
	Seeding	North Facing Slopes Seed	Skyline	803.25	/AC					20.33						AC	20.33	AC	16330
	Mulch	Hay 1" material only 029105000250	Reveg0	600	/AC					20.33						AC	600	AC	12198
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg0	10.35	/MSF					20.33						AC	886	MSF	9170
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg0	23.014	/MSF					20.33						AC	886	MSF	20390
	Subtotal																		58088
	Riparian Habitat																		
	Seeding	Riparian Habitat Seed	Skyline	50	/AC					0.04						AC	0.04	AC	2
	Mulch	Hay 1" material only 029105000250	Reveg0	600	AC					0.04						AC	600	AC	24
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg0	0	/MSF					0.04						AC	2	MSF	0
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg0	21.41	/MSF					0.04						AC	2	MSF	50
	Subtotal																		76
	Soth to West Facing Slopes																		
	Seeding	Riparian Habitat Seed	Skyline	49.234	/AC					39.81						AC	39.81	AC	1960
	Mulch	Hay 1" material only 029105000250	Reveg0	600	AC					39.81						AC	600	AC	23886
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg0	10.346	/MSF					39.81						AC	1734	MSF	17940
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg0	23.016	/MSF					39.81						AC	1734	MSF	39910
	Subtotal																		83696
	North to East Facing Slopes																		
	Seeding	Riparian Habitat Seed	Skyline	49.188	/AC					20.33						AC	20.33	AC	1000
	Mulch	Hay 1" material only 029105000250	Reveg0	600	AC					20.33						AC	600	AC	12198
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg0	10.35	/MSF					20.33						AC	886	MSF	9170
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg0	23.014	/MSF					20.33						AC	886	MSF	20390
	Subtotal																		42758
	Waste Rock																		
	Seeding	Waste Rock Slopes Seed	Skyline	71.819	/AC					12.81						AC	12.81	AC	920
	Mulch	Hay 1" material only 029105000250	Reveg0	600	AC					12.81						AC	600	AC	7686
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg0	10.341	/MSF					12.81						AC	558	MSF	5770
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg0	23.011	/MSF					12.81						AC	558	MSF	12840
	Subtotal																		27216
	James Canyon																		
	Seeding	Waste Rock Slopes Seed	Skyline	72.185	/AC					4.85						AC	4.85	AC	350
	Mulch	Hay 1" material only 029105000250	Reveg0	600	AC					4.85						AC	600	AC	2910
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg0	10.332	/MSF					4.85						AC	211	MSF	2180
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg0	23.033	/MSF					4.85						AC	211	MSF	4860
	Subtotal																		10300
	Riparian Stem Supplement																		
	Stems	Bare root seedlings, 11" to 16" med. soil	02915 4	1.42	Ea										9800	Ea	13916	EA	19550
	Subtotal																		19550
	Silt Fence Interim Vegetation																		
	Stems	Bare root seedlings, 11" to 16" med. soil	02915 4	1.42	Ea	20000										LF	20000	EA	30460
	Subtotal																		30460
	Reveg Loadout Sediment Pond																		
	Seeding	Riparian Habitat Seed	Skyline	66.667	/AC					0.3						AC	0.3	AC	20
	Mulch	Hay 1" material only 029105000250	Reveg0	81.538	/MSF					0.3						AC	13	MSF	1060
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg0	10	/MSF					0.3						AC	13	MSF	130
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg0	23.077	/MSF					0.3						AC	13	MSF	300
	Subtotal																		1500
	Winter Quarters Ventilation Facility Bond																		
	REVEGETATION																		
	Winter Quarters Ventilation Facility																		
	South facing slopes																		
	Seeding	south facing slope seed mix		207.63	/AC					2.36						AC	2.36	/AC	490
	Mulch	Hay 1" material only 029105000250		65.243	/MSF					2.36						AC	103	/MSF	6720
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only		2.4272	/MSF					2.36						AC	103	/MSF	250
	Equipment	Hydro Spreader (equip. & labor) B-81		26.893	/MSF					2.36						AC	103	/MSF	2770
	Tublings																		
	Quaking Aspen	Bare root seedlings, 11" to 16" med. soil		1.79	ea					2.36						AC	400	AC	1960
	Blue Elderberry	Bare root seedlings, 11" to 16" med. soil		1.79	ea					2.36						AC	400	AC	1960
	Subtotal																		14170
	North of Graben Bleeder Shaft Bond																		
	REVEGETATION																		
	North of Graben Bleeder Shaft																		
	South facing slopes																		
	Seeding	North of Graben Bleeder Shaft seed mix		250	/AC					0.4						AC	0.4	/AC	100
	Mulch	Hay 1" material only 029105000250		66.092	/MSF					0.4						AC	17.4	/MSF	1150
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only		2.4713	/MSF					0.4						AC	17.4	/MSF	43
	Equipment	Hydro Spreader (equip. & labor) B-81		28.736	/MSF					0.4						AC	17.4	/MSF	500
	Tublings																		
	Quaking Aspen	Bare root seedlings, 11" to 16" med. soil		1.79	ea					0.4						AC	200	AC	360
	Red Elderberry	Bare root seedlings, 11" to 16" med. soil		1.79	ea					0.4						AC	20	AC	36
	Mountain Snowberry	Bare root seedlings, 11" to 16" med. soil		1.79	ea					0.4						AC	100	AC	180
	Subtotal																		2369
	Revegetation																		
	25% of Initial Seeding																		26080.25
	Subtotal																		26080.25
	Total																		428869.25

* 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)

4.4

4.4.2 Grading and Final Contour

All highwalls and cutslopes will be reclaimed using geotechnically stable fill slopes with surfaces that have been sufficiently roughened with deep gouging. The operational bench slopes will be graded back to the approximate original contour at a two horizontal to one vertical slope (2h:1v) or shallower upon abandonment, utilizing a bulldozer working along the slopes. A geotechnical analysis will be made of this slope at the time of reclamation and design adjustment made as necessary to insure slope stability. The sediment pond at the portal area will be removed during the initial reclamation phase.

The reclamation plan is shown on in maps 4.4.2-1A, 4.4.2-1AA. 4.4.2-1B. 4.4.2-1BA, 4.4.2-1B1 and 4.4.2-1AC. Costs and mass balance data associated with reclamation may be found in the Engineering Calculations, Volume 5.

Grading operations will be possible at the railroad load-out site which will be returned to the approximate original contour and shown on Maps 4.4.2-1C and 4.4.2-1D. Water Tank final reclamation contours are shown on Maps 4.4.2-1E and 4.4.2-1F. The waste rock disposal site final reclamation contours are shown on Map 4.16.1-1B.

The Winter Quarters Ventilation Facility grading and final contour plan will be similar to the sites listed above. Once excess material has been used in sealing the slope and shaft as outlined in Sections 4.1.2 and 4.9, any retaining walls, highwalls or cutslopes will be reclaimed using geotechnically stable fill slopes with the final surface being roughened with deep gouging. The pad will be graded back to the approximate original contour, unless the post-mining land use changes. The sedimentation pond will be removed once sufficient re-contouring of the pad has taken place. See Plates 4.4.2-3A and 4.4.2-3B for the reclaimed site configuration.

The North of Graben (NOG) Bleeder Shaft is similar to all previously listed sites. Once the shaft has been filled as outlined in 4.1.2 and 4.9, any cut-slopes will be reclaimed with the final surface being roughened with deep gouging. The pad will be graded back to the original contour. Plates 4.4.2-5A and -5B illustrate the reclaimed surface.

4.6

lands. However, a portion (15.295 square yards) was removed from prive land along the conveyor bench. This topsoil be returned to disturbed areas on private land. Topsoil in the RRLO stockpile was originally removed from private lands and will be returned to private lands.

Topsoil and suitable subsoil to be removed from the Winter Quarters Ventilation Facility (WQVF) area will be collected from the disturbed area as construction advances. Based on the Soil survey (see Appendix A-2, Volume 2) the depth of suitable material ranges from approximately 1.0 to 1.5 feet. Due to the limited amount of A horizon material, subsoil will be collected to approximately the 1.52-foot depth - identified by the increased percentage of clastics. Construction will take place on south-facing slopes dominated by sagebrush and bitter brush. The brush, topsoil and suitable topsoil storage area.

The soils identified in the soil survey are a sandy-silty loam. A mixture of alluvial sediments in the minor riparian areas increase the percentage of fine sand, however this soil will remain in place - providing the base to the topsoil pile. Lab analysis of the various pits suggest suitable subsoil will be available to approximately 1.5 feet where the percentage of clastics becomes a problem. In the areas where topsoil/subsoil will be removed, the EC values range from 0.22-0.9 dS/m (>6dS/m), Sodium Absorption Ratio (SAR) values range 0.16-0.37, TKN percentage ranges from <0.01-0.04, Boron ranges from 0.29-0.64ppm(<5), and the Field Capacity/Wilt Point percentage difference ranges from 13-24% - all acceptable ranges to use the available material. The topsoil and suitable subsoil stockpile is designed to store approximately 4,421 cu-yds of material. An area for the topsoil storage area will be located directly east of the pad facility (See Plate 3.2.4-3A through -3C). Once stockpiled two composite samples of the salvaged topsoil will be collected and analyzed for phosphorus and potassium. See section 4.6.3 for Topsoil Protection measures.

Topsoil and suitable subsoil to be removed from the North of Graben (NOG) Bleeder Shaft area will be collected from the disturbed area as construction advances. Based on the Order 2 Soil survey (See Appendix A-2, Long Resources Consultants, Inc.) the depth of suitable material will be approximately 21-inches (soil ~ 19-inches, subsoil ~ 2-inches). Construction will take place predominantly on the south-facing slope (Soil Profile 14SKY07) dominated by quaking aspen, mountain big sagebrush and grasses. Brush, topsoil, and suitable subsoil will be salvaged simultaneously and stored in the

designated topsoil storage area. A small portion of the existing US Forest service road will be re-routed to utilize flat, previously disturbed areas adjacent to the road. The north slope is dominated by Englemann spruce, and other conifers.

The soils identified in the survey are classified as loam and sandy-loam. The slope is 41 percent. The taxonomic classification is McCadden family, lithic Haplocryolls loamy-skeletal, miexed superactive. At site 14SKY07, which is most representative of the site, the EC values rangefrom 0.23-.037dS/m,Sodium Absorption Ration (SAR) 0.14-0.21, and an estimated Available Water Capacity range of 0.76-1.35 in/ft. - all acceptable ranges to use the available material. The topsoil stockpile is designed to store approximately 1,129 cu-yds of material. The topsoil stockpile will be located at the west end of the disturbed area where the pad access road leaves the USFS road (See Plates 3.2.4-5A through -5C). See Section 4.6.3 for Topsoil Protection measures.

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, 3.2.8-2, 3.2.11-1, and Volume 5 Section 24). Four topsoil stockpile areas are utilized: the first at the portal area, the second at the loadout facility, the third at the South Fork Breakout area, the thirdfourth at the waste rock disposal site, and the fourthifth at the Winter Quarters Ventilation Facility.

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

	Acreage	Inches	Cubic Yds
Overland Conveyor Route	.39	12	629 (Private)
NOG Bleeder Shaft 1.7*		19	4,388 (USFS)

*1.7 acres is only the disturbed area. The permit area encompasses approximately 3.0 acres.

			48,05643,966 (Private)
			~~77,464~~81,852 (USFS)
GRAND TOTAL	~~58.60156.91~~60.30		~~125,520~~129,908**

*Both of these areas are located on National Forest lands and 78,~~281~~ 593 cubic yards of National Forest topsoil was removed and stored from these area. 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-LaSalt National.

**~~77,464~~81,852 cubic yards are need for revegetation on National Forest lands and 43,966 cubic yards are needed for revegetation on private lands. As indicated in Section 2.11, there is 79,281 cubic yards of topsoil available for revegetation on National Forest Lands and 44,526 cubic yards of topsoil available for revegetation on private lands.

***2,198 cubic yards are available at the Scofield site. The remainder of the topsoil will come from the portal yard stockpile or other outside source.

CHANGE TO		TEXT		
Table 4.6-4	Page 4-38(d)	Table 4.6-4	Page 4-38(d)	Date ~~3-24-1008/10/93~~4-6-15

4.6.6 Winter Quarters Ventilation Facility Topsoil Redistribution

Topsoil redistribution will commence once removal of all facilities and modification of the pad site to achieve the approximate original contours (AOC) is completed. Distribution of the topsoil will take place immediately prior to re-vegetation activities to minimize erosion. Topsoil will be placed with a bulldozer or comparable machinery to approximate grade. Following topsoil placement to approximate grade, a trackhoe or comparable machinery will deep-gouge or roughen the surface prior to commencement of re-vegetation activities.

4.6.7 NOG Bleeder Shaft Topsoil Redistribution

The topsoil redistribution will start one-year after the shaft has been backfilled to allow for settling, any facilities have been removed, and the earthwork has regarded the road and pad to the approximate original contours (AOC). Re-vegetation activities will immediately follow the distribution of topsoil to minimize erosion. Topsoil will be placed with a bulldozer or comparable machinery to approximate grade, followed by deep-gouging of the surface.

4.7

4.7.9 Winter Quarters Ventilation Facility (WQVF)

Refer to both Section 2.7 and the Mt. Nebo Vegetation report located in Appendix A-2, Volume 2 for a discussion of the vegetation for the WQVF. The interim and final revegetation seed mixes for the WQVF area are listed in Tables 4.7-8A through 4.7-8C. Reclamation success standards are based on the reference area(s) identified in the Mt. Nebo report. Noxious plants invading the WQVF permit area will be controlled by hand-grubbing, and/or approved herbicides. Surveillance will be monitored annually during the liability period.

4.7.10 NOG Bleeder Shaft

Refer to both Section 2.7 and the Mt. Nebo Vegetation report located in Appendix A-2 Volume 2 for a discussion of the vegetation of the NOG Bleeder Shaft site. Portions of the area were previously disturbed and re-vegetated, while other portions are undisturbed. Both the interim and final re-vegetation seed mixes are listed in Tables 4.7.-10A and -10B. Reclamation success standards are based on the reference areas identified in the Mt. Nebo report. Noxious weeds will be controlled during the liability period.

Table 4.7-10A

Interim Revegetation seed Mixture for the North of Graben Bleeder Shaft

Species [a)]	Rate [b)] (# PLS/Ac)	Seeds/ft^2
Forbs		
Achillea millefolium (Common yarrow)	0.6	51
Rudbeckia occidentalis (Western coneflower)	1	51
Grasses		
Bromus carinatus (Mountian brome)	8	15
Elymus trachycaulus (Slender wheatgrass)	8	25
Poa secunda (Sandberg bluegrass)	3	46

a) Depending on commercial availability, species can be substituted by a qualified botanist

b) Rates based on broadcast seeding methods

Table 4.7-10B

Final Revegetation seed Mixture for the North of Graben Bleeder Shaft

Species [a]	Rate [b] (#/ac or Lbs PLS/Ac)	Seeds/ft^2
Shrubs and Trees [c]	**(#/ac)**	
Populus tremuloides (Quaking Aspen)	200	n/a
Sambucus racemosa (Red Elderberry)	20	n/a
Symphoricarpos oreophilus (Mountain snowberry)	100	n/a
Forbs	**(Lbs PLS/ac)**	
Achillea millefolium (Common yarrow)	0.6	46
Rudbeckia occidentalis (Western coneflower)	1	51
Heliomeris miltiflora (Showy goldeneye)		
Grasses	**(Lbs PLS/ac)**	
Bromus carinatus (Mountian brome)	8	51
Elymus trachycaulus (Slender wheatgrass)	8	15
Elymus spicatus (Bluebunch wheatgrass)	6	26
Poa secunda (Sandberg bluegrass)	3	25

a) Depending on commercial availability, species can be substituted by a qualified botanist
b) Rates based on broadcast seeding methods
c) Containerized Planting as appropriate

4.9

Shafts

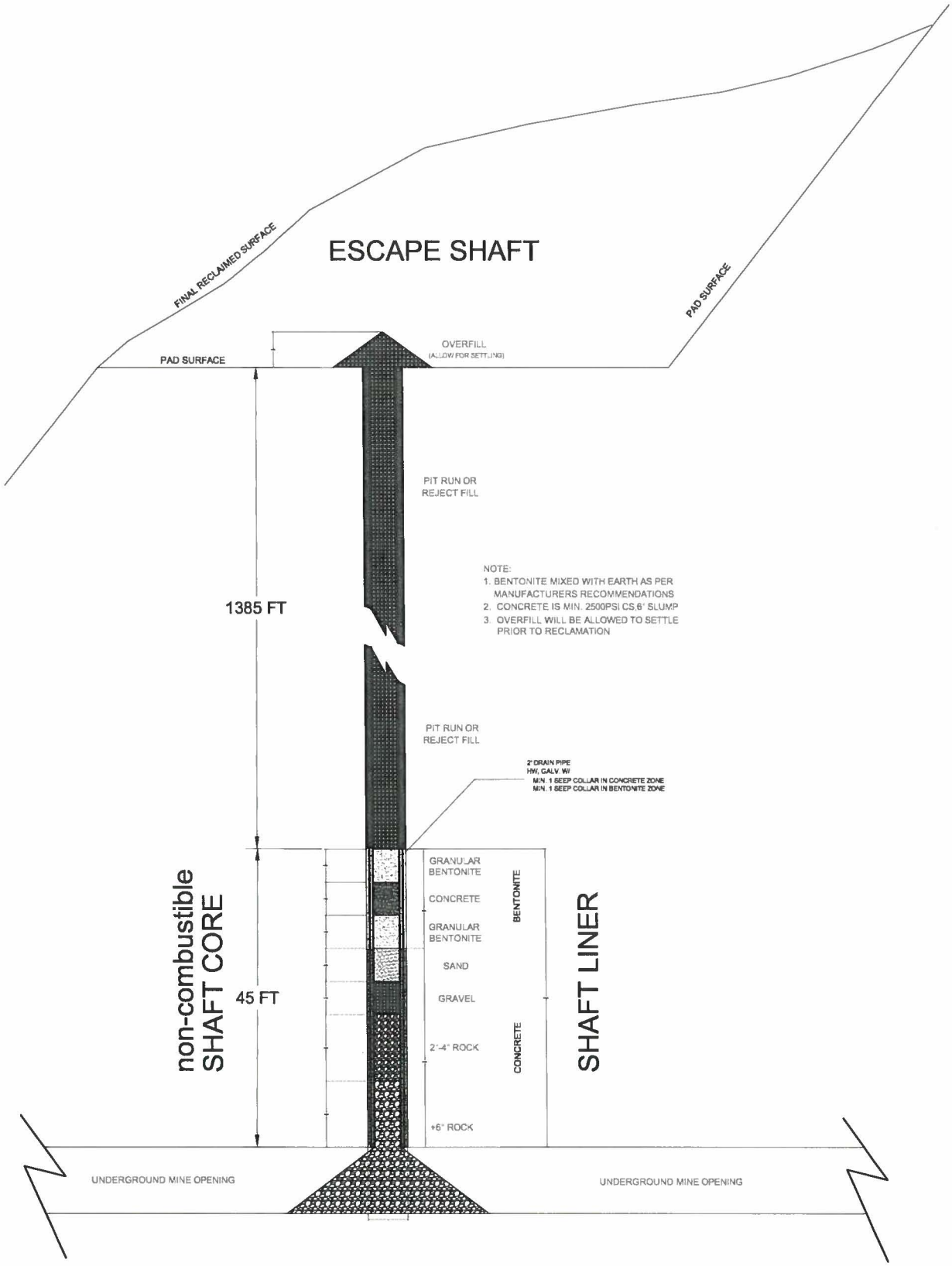
Skyline Mine does not have any shafts initiated permitting the Winter Quarters Ventilation Shaft (WQVF) in 2010. Should any be designed in the future, Rreclamation will be in compliance with State regulation R645-301-551 and consistent with MSHA, CFR 75.1771. Shafts or other opening to the surface from an underground mine will be capped, sealed and backfilled, or otherwise properly managed, as required by the Division. Permanent closure measures will be designed to prevent access to mine workings by people, livestock, fish and wildlife, and to keep acid or other toxic drainage form entering groundwater or surface waters.

Figure 4.9-B illustrates how the WQVF shafts will be reclaimed through backfilling. The bottom 50-feet of the shaft will be filled with non-combustible material as follows: starting at the bottom with large, course 6+ inch rock for approximately 20 feet (including mine area); followed by successively by smaller rock; culminating with a 5-foot bentonite layer, 5-foot concrete layer, and an additional 5-foot bentonite layer. The remainder of the shaft will be filled to the surface with pit run or other reject fill. The bottom 50 feet of the shaft has been designed to both minimize accumulation of gas and filling of the shaft with water - should either condition occur. The shaft(s) reclamation design addresses both mass stability and movement in multiple ways: grading of the fill from coarse to fine minimized movement while allowing pore space for possible saturation; the bentonite-concrete layers (~15 total feet) are utilized as both a cap and seal, providing a barrier for both saturation and mass movement; and finally, once the shaft is full to the surface, a 20-foot mound is placed over the former opening to accommodate additional compaction. The mound provides approximately an additional 5 percent of material for compaction. It is proposed the shaft be filled and allowed to settle for approximately one (1)year prior to completely reclaiming the WQVF pad to approximate original contours (AOC).

A shaft in the North of Graben area (NOG Bleeder Shaft) will be abandoned in the same fashion. Figure 4.9-D illustrates the abandonment. Notable differences include the diameter of the shaft (5-feet) and the depth (~1,400-feet). The shaft will not be lined and since the shaft was drilled using the raise-bore method, all the backfill material will need to be imported to the site.

Mine Entries

In compliance with 30 CFR 75.1711-2, seals will be installed in all entries as soon as mining is completed and the mine is to be abandoned. (See Figure 4.9-A for typical portal seal.) The seals will be located at least 25 feet inside the portal entry. The opening will be sealed with solid, substantial, incombustible material, such as concrete blocks, bricks or tile, or shall be completely filled with incombustible material. Figure 4.9-C illustrates a cross section of the WQVF seal. The WQVF seal has incorporated a water-tight seal in the event water is encountered at reclamation.



Skyline Mine
NOG Bleeder Shaft
Shaft Detail

Canyon Fuel Company, LLC
Skyline Mines

NOR 36 BOX[illegible], HELPER, UT, 84[illegible] 435-[illegible]	DATE: 4/6/15	CK.BY: GGalecki	REVISION: 0
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4.11

concern of any gravity discharge during the operation of the mine. Mine water can be discharged from this location when discharge parameters are met. A Utah Pollution Discharge Elimination System (UPDES) water discharge point was added to the Skyline Mine water discharge permit in December 2009 to accommodate discharging water to Winter Quarters Creek both from the sedimentation pond and potentially future mine water discharge.

The Winter Quarters decline slope portal is at an elevation of 8120 feet which is down dip and at a lower elevation than portions of the Mine workings. To safeguard against a gravity discharge at reclamation, should the mine flood to the portal level, both the shafts and slope have been sealed and backfilled to prevent any discharge at reclamation (See Section 4.9).

4.11.10 North of Graben (NOG) Bleeder Shaft

The NOG Bleeder shaft includes a total 0.40 acre disturbance with a 50-ft by 80-ft pad, 784-ft road, topsoil pile, diesel storage tanks, generator, and a 5-ft diameter shaft. The site is adjacent to an existing USFS road located at the top of Granger Ridge. No pond is necessary for sediment control due to minimal disturbance. The shaft opening is located approximately 1,400 feet above the mine workings eliminating concern of any gravity discharge during the operation of the shaft.

4.12

TABLE 4.12-1

PROPOSED POSTMINING LANDUSE

Area	Present Ownership	Premining Landuse	Proposed Postmining Use	Alternative Use	Capacity To Support Proposed Use	Relationship To Existing Landuse Policies
Mine Site and Exploratory Excavations	USFS	Wildlife/ Grazing Habitat	Wildlife/ Grazing Habitat	Picnic Area	Adequate	Compatible
Conveyor and Pipeline	Private	Grazing/ Wildlife Habitat	Grazing/ Wildlife Habitat	Wildlife	Adequate	Compatible
Main Access Road	State	Forest Compatible Access and Service Road	State Road	None		Adequate
Loadout	Private	Grazing, Picnic and Stock Pens*	Grazing/ Wildlife Habitat	Wildlife	Adequate	Compatible
Waste Rock Disposal	Private	Grazing/ Wildlife Habitat	Grazing/ Wildlife Habitat	Wildlife	Adequate	Compatible
South Fork Breakout	USFS	Wildlife/ Grazing Habitat	Wildlife/ Grazing Habitat	Wildlife Habitat	Adequate	Compatible
James Canyon	USFS/Private	Wildlife/ Grazing Habitat	Wildlife/ Grazing Habitat	Wildlife Habitat	Adequate	Compatible
Winter Quarters	Private	Grazing	Grazing		Adequate	Adequate
Ventilation Facility		Mining Wildlife	Wildlife	Compatible		
NOG Bleeder Shaft	USFS	Wildlife	Wildlife	Adequate	Adequate	Compatible

* Note: The loadout area picnic facilities and stock pens are not proposed to be included in the proposed post-mining use. The permittee is the landowner of this site and is not in the recreation or livestock business, and therefore, elects not to reestablish the picnic and livestock facilities. This land was purchased by quit-claim deed dated, May 24, 1991, for the area occupied by the loadout facilities in 5-1/2S E1/4, Section 1), T.13S R.7E SLBM. There is no pending litigation subject to the quit-claim deed. The grantor reserves the coal rights under the lands.

The owner's representative requests that the pit fill be leveled off so that it can be used for corrals. The leveled-off fill will be reclaimed to native rangeland per the Reclamation Plan.

4.12.7Winter Quarters Ventilation Facility (WQVF)

The pre-mining land use was native rangeland providing habitat for grazing and wildlife, with associated impacts from mining and timber harvesting. The WQVF pad site and access are all on private land. The pre-existing road will not be reclaimed and any associated road improvements will remain. At reclamation, the mine openings will be sealed and/or backfilled, the pad, pad-access road, and associated facilities will be removed and the Approximate Original Contour (AOC) be returned. Once the reclamation commitments have been achieved, the pre-mining land uses will be adequately re-established.

4.12.8 NOG Bleeder Shaft

The pre-mining land use provided habitat for grazing and wildlife with associated impacts from timber harvesting. At reclamation, the mine opening will be backfilled, capped, the pad, access road, and associated facilities will be removed and the approximate original contours (AOC) will be returned. At the completion of reclamation activities, the pre-mining land uses will be adequately re-established prior to liabilities being released.

4.18

Waste Rock Site

Fish and Wildlife Enhancement Measures:

$ Species to be planted and the rates per acre will follow the specifications in Table 4.7-6A.

$ Seeds and seedlings planted during reclamation will include diverse palatable species.

$ See Section 2.9 for additional discussion of Wildlife at the Waste Rock site.

Winter Quarters Ventilation Facility (WQVF)

Fish and Wildlife Enhancement Measures:

$Species to be planted and seeded and rates per acre are outlined in Mt Nebo Report (Appendix A-2, Volume 2).

will be used in reclamation as outlined by Dr. Shiozawa (Appendix A-3, Volume 2)

• Photo documentation of the pre-disturbed stream wcollected for re-construction of the stream bank morphology

• The WQVF was specifically designed to be constructed a minimum of two (2) stream widths from the stream channel, thus providing a buffer zone of riparian and other upland vegetation to minimize impacts and maintain appropriate habitat.

• During construction, operation, and reclamation of the WQVF site, noxious plants invading the permit area will be controlled by hand-grubbing, and/or approved herbicides. Surveillance will be monitored annually during the liability period.

NOG Bleeder Shaft

Fish and Wildlife Enhancement Measures:

- Species will be planted and seeded as outlined in Section 4.7
- During construction, operation, and reclamation of the site, noxious plants invading the site will be controlled by approved herbicides. Monitoring and treatment will continue annually during the liability period.

4-20

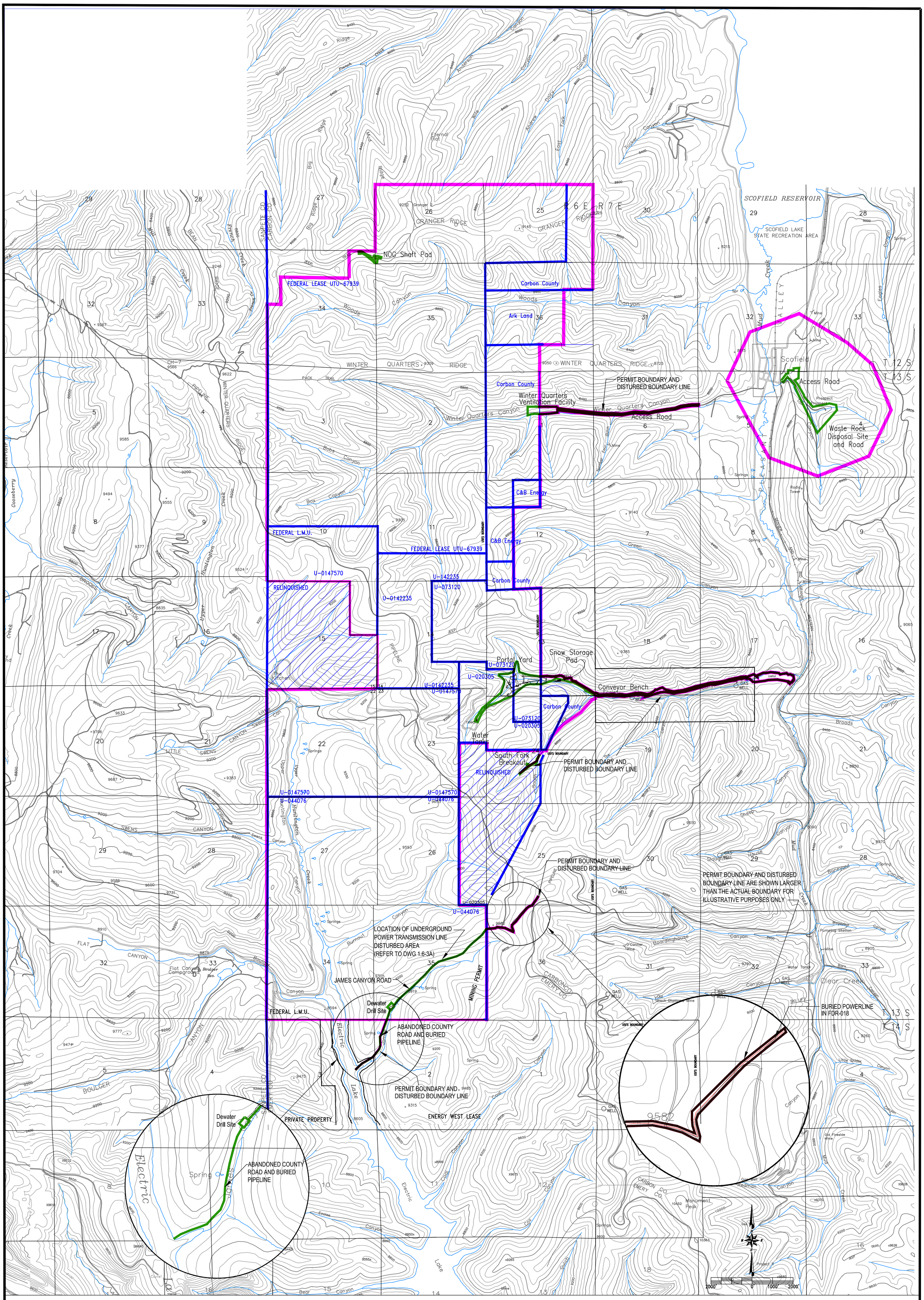
4.20.5 Winter Quarters Ventilation Facility Road

The pre-existing road in Winter Quarters Canyon is classified as an ancillary road based on the following criteria: it is not used to transport coal or spoil; it is not used for access or other purposes for a period in excess of six months; and it will not be retained for a specifically approved postmining land use. The access is primarily across private land. Although improvements to the road were made by the Mine, the improvements were included in the easement of the lease and will not be altered during reclamation.

The approximately 450 foot access road built for the Winter Quarters Ventilation Facility pad will be removed during reclamation. See Plates 3.2.4-3b and -3e for detailed road illustrations and Plates 4.4.2-3A and 4.4.2-3B for reclamation details.

4.20.6 North of Graben (NOG) Bleeder Shaft Road.

The NOG Bleeder Shaft access road is classified as an ancillary road since 1) it is not used to transport coal or spoil: 2) it is not used for access or other purposes for a period in excess of six (6) months; and 3) it will not be retained for a specifically approved post-mining land use. The access is located on land exclusively managed by the US Forest Service. The approximately 780-foot road built for the NOG Bleeder Shaft will be removed during reclamation. See Plates 3.2.4-5A through -5D for detailed road illustrations and Plates 4.4.2-5A and -5B for reclamation details.



ADJACENT AREA SITE DESCRIPTION:

Active Lease Areas, Permit Boundary, and 1/2 Mile beyond Waste Rock Disposal Site

13,525 ACRES SITE PERMIT BOUNDARY

PERMIT AREA	SITE DESCRIPTION
13.86	RAIL LOADOUT
42.55	PORTAL YARD
0.60	WATER TANKS, TRANSMISSION LINES (not reclaimed) & WELL PADS
0.96	SOUTH FORK PORTALS
14.18	CONVEYOR BENCH
32.48	WASTE ROCK DISPOSAL SITE
7.93	WINTER QUARTERS VENTILATION FACILITY
4.90	WINTER QUARTERS ROAD (not reclaimed)
1.60	JAMES CANYON BURIED PIPELINE
0.30	JAMES CANYON BURIED POWER LINE
2.95	JAMES CANYON WATER WELLS AND ROAD
122.31	

LEGEND

- ADJACENT AREA: Areas Authorized for Coal Mining and Reclamation Activities (SEE CHIA FOR HYDROLOGIC ADJACENT AREA)
- PERMIT BOUNDARY
- LEASE BOUNDARY

NOTES:

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

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

LEASE ACREAGE WITHIN ADJACENT AREA

FEDERAL COAL	ACREAGE
U-0147570	1532.70
U-0142235	520.0
U-073120	557.22
U-044076	2489.32
U-020305	279.40
UTU-67939	4061.52
TOTAL	9,440.16

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

NOT ALL ACREAGE FOR EACH LEASE IS WITHIN THE PERMIT BOUNDARY, REFER TO PART 1, TABLE 1.114.

DATE	No.	REVISIONS	DR. / CHKD.
AUG 02	1		/ VSM
NOV 02	2		/ VSM
JUNE 07	3	MODIFIED PERMIT BOUNDARY (IBC & WASTE ROCK) SKYLINE MINES PERMIT AREA, LEASE AREAS.	BR / GG
MAR 2010	4	ADDED ADJACENT AREA, MODIFIED PERMIT AND LEASE BOUNDARIES	AB / GG
JUL 2010	5	ADDED WINTER QUARTERS ACCESS ROAD	AB / GG
AUG 2010	6	MODIFIED ADJACENT AREA	AB / GG
OCT 2012	7	Modified Adjacent Area with Lease Mod. and Relinquishments	GG / GG
July 2014	8	Corrected permit boundary to include water line from Tanks	GG / GG
April 2015	9	Added the NOG shaft pad	TE / GG
			/
			/

SKYLINE MINE PERMIT AREA

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

SCALE: 1" = 2000'	DATE: 9/24/01	CK.BY: G. Galecki	REVISION: 9
DWG. NO.: 1.6-3		DR.BY: JLP/CDH	4/6/15
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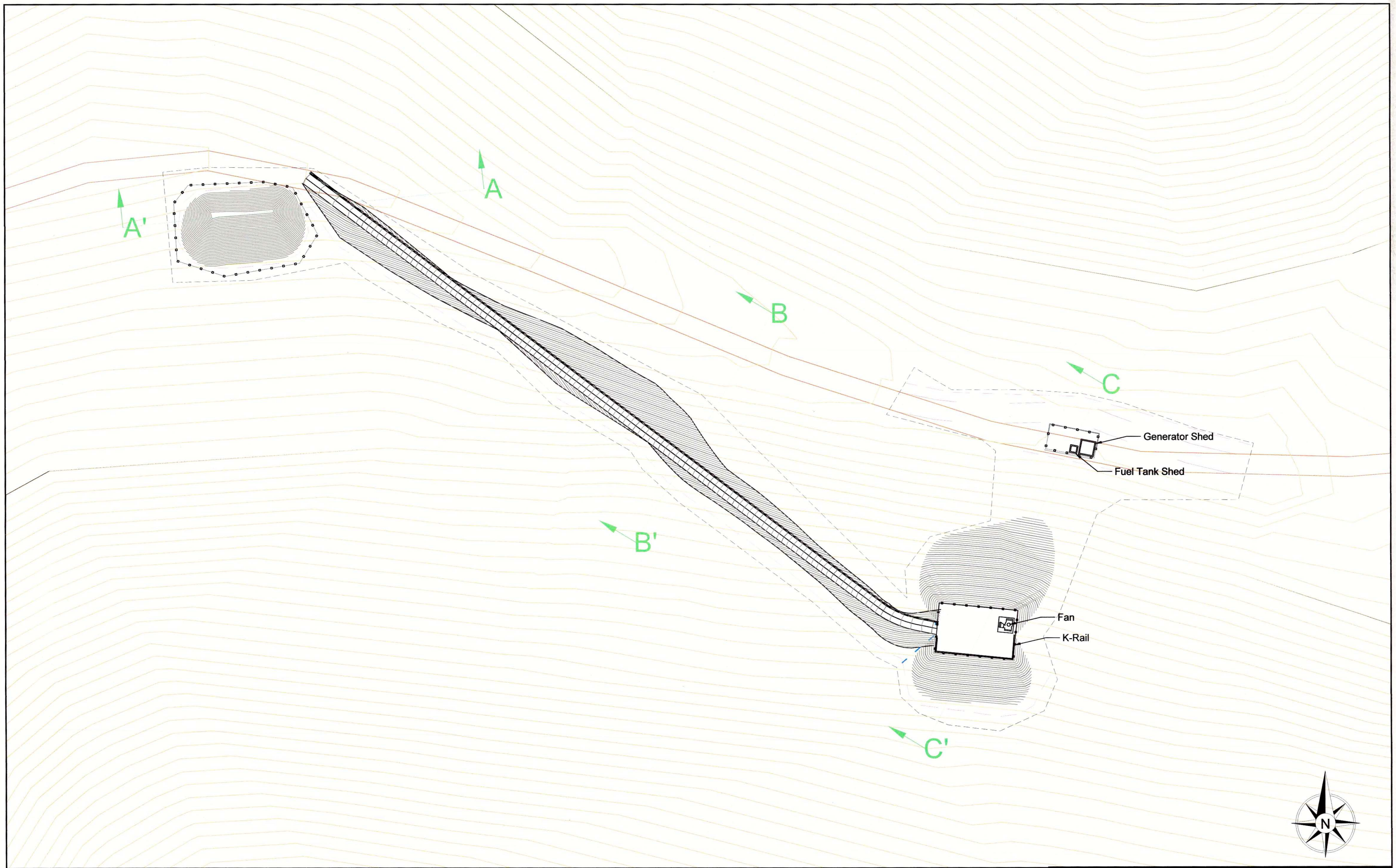

Legend

- Existing 5' Contours
- Operational 1' Contour
- Silt Fence
- Fence
- Ditch
- Permit Area

Disturbed Area is 1.7 Acres

Permit Area is 3.0 Acres

Seal:

REGISTERED PROFESSIONAL ENGINEER
CARL W WINTERS
NO 22 167958-2202
STATE OF UTAH
4-15-15

Skyline Mine
NOG Shaft Pad
General Layout

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435-448-2632	DATE: 4/6/2015	CK.BY:GAG	REVISION: 0 4/6/2015
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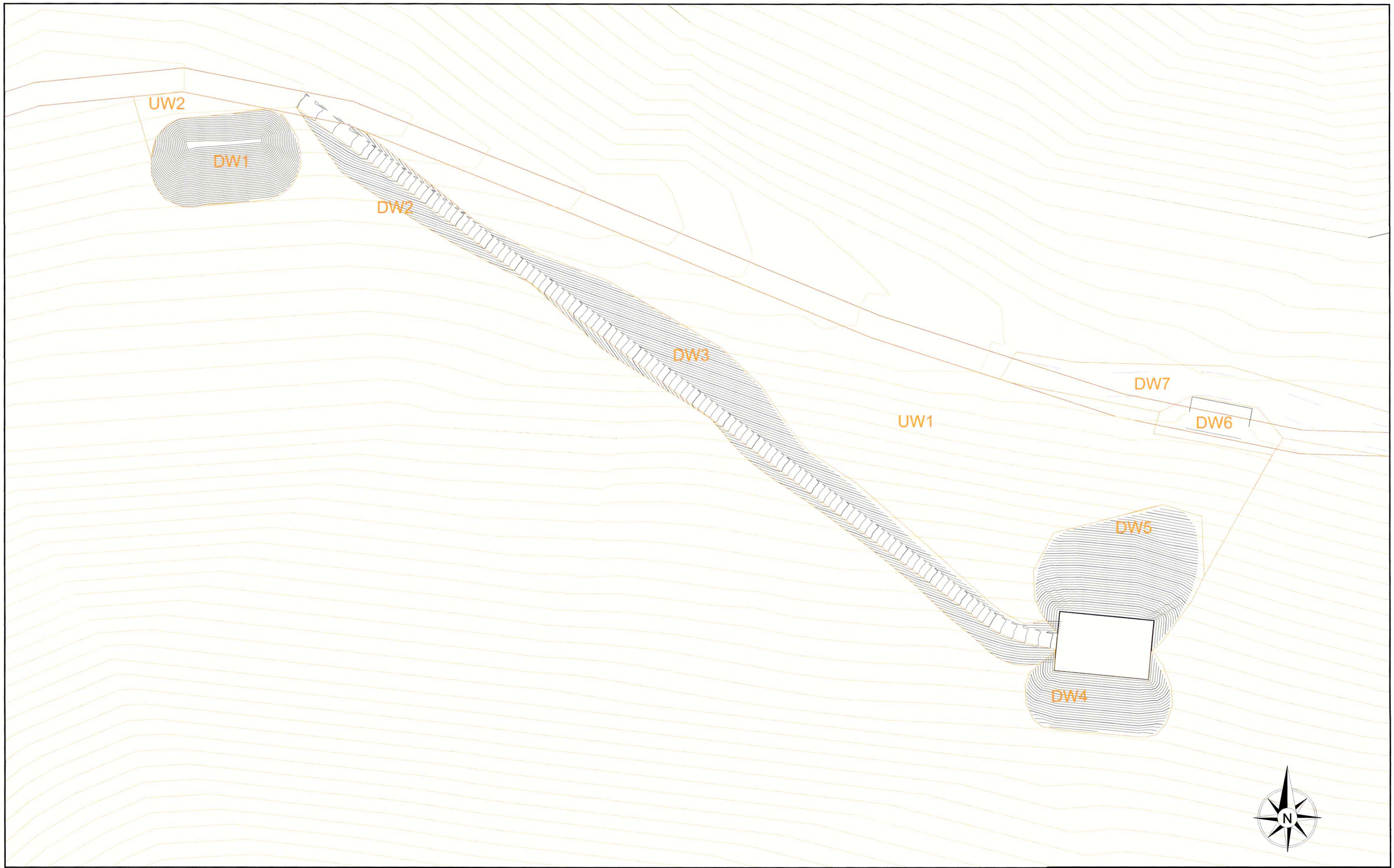

DW Developed Watershed

UW Undeveloped Watershed

Seal:

REGISTERED PROFESSIONAL ENGINEER
CARL W WINTERS
NO 22 157958-2202
STATE OF UTAH
4-15-15

Skyline Mine
NOG Bleeder Shaft
Watershed Map

Canyon Fuel Company, LLC
Skyline Mines

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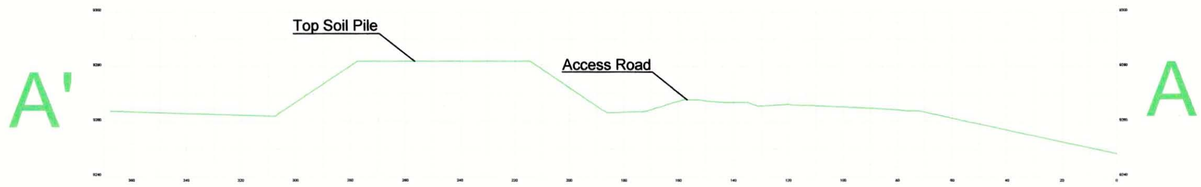
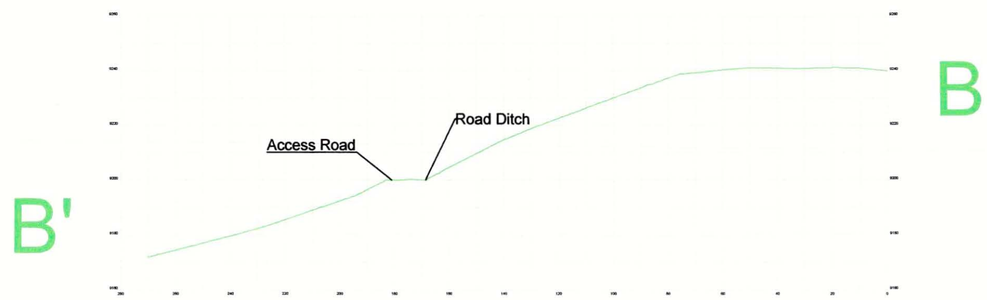
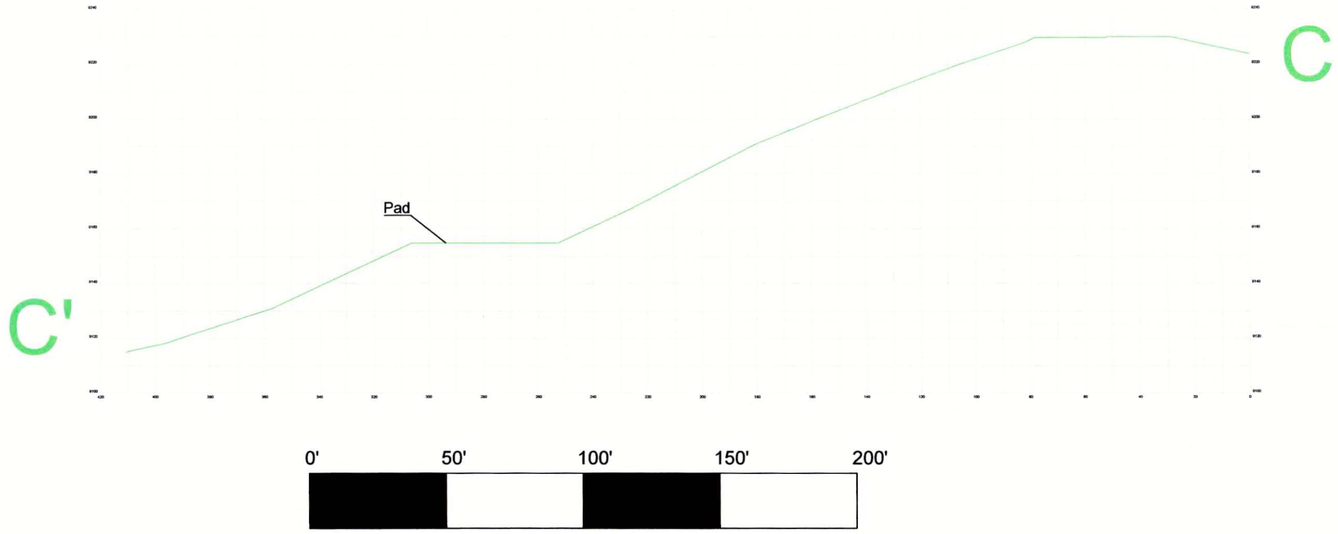
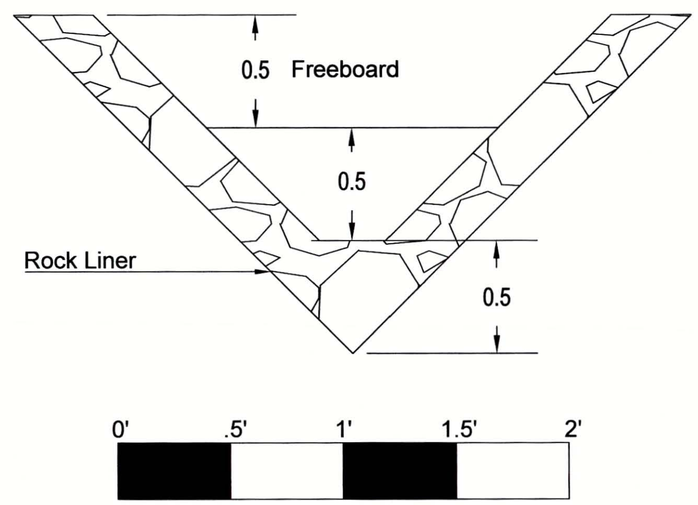






Access Road Ditch Detail



Seal:

REGISTERED PROFESSIONAL ENGINEER
CARL W WINTERS
NO 22 157958-2202
STATE OF UTAH

4/15/15

Skyline Mine
NOG Bleeder Shaft
Profiles and Ditch Detail

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435-448-2632	DATE: 4/6/15	CK.BY: GGalecki	REVISION: 0 4/6/2015
CAD FILE: 2015 NOG Bleeder Shaft\Plates	SCALE: Shown	DR.BY: TEarl	
DWG. NO.: 3.2.4-5C			

Legend

- Existing 5' Contours
- 5' Reclaim Contours
- Pad Outline

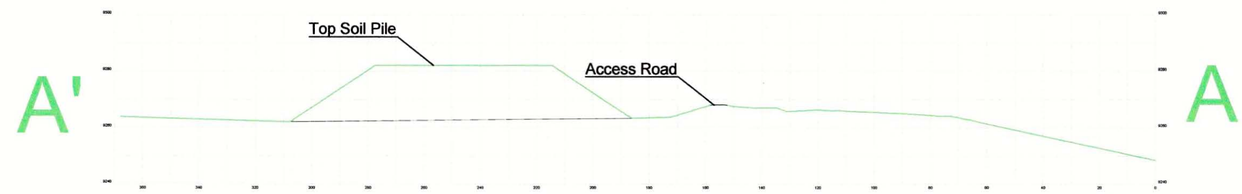
Seal:

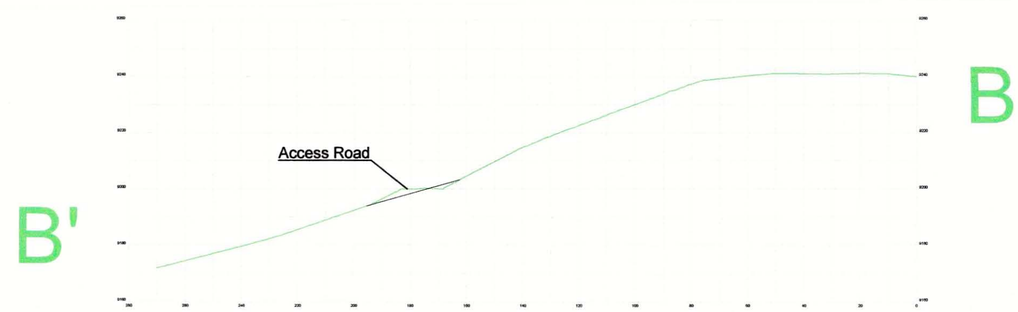
REGISTERED PROFESSIONAL ENGINEER
CARL W WINTERS
NO. 22 157058-2202
STATE OF UTAH
4/15/15

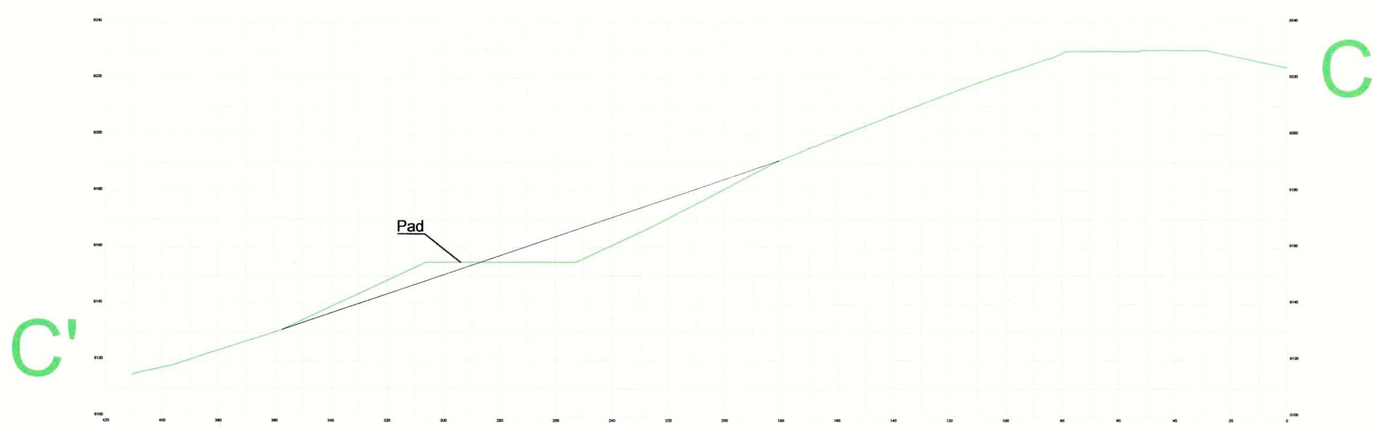
Skyline Mine
NOG Bleeder Shaft
Reclaim Surface

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435-448-2632	DATE: 4/6/15	CK.BY:GGalecki	REVISION: 0 4/6/15
CAD FILE:	SCALE: 1"=100'	DR.BY:TEarl	
DWG. NO.: 4.4.2-5A			







0' 50' 100' 150' 200'

Legend

Operational Surface

Reclaimed Surface

Seal:

REGISTERED PROFESSIONAL ENGINEER
CARL W WINTERS
NO 22-157958-2202
STATE OF UTAH
4/15/15

Skyline Mine
NOG Bleeder Shaft
Reclaim Surface Profiles

Canyon Fuel Company, LLC
Skyline Mines

HCR 35 BOX380, HELPER, UT, 84526 435-448-2632	DATE: 4/6/15	CK.BY: GGalecki	REVISION: 0 4/6/15
CAD FILE: 2015 NOG Bleeder Shaft\Plates	SCALE: Shown	DR.BY: TEarl	
DWG. NO.: 4.4.2-5B			

2014 Wildlife Survey Report

NOG Graben Bleeder Shaft

Northern Goshawk Protocol, Raptors,
American three-toed woodpecker, and
General Wildlife Survey

Prepared for:

Skyline Mine
Gregg Galecki
Environmental Engineer
Canyon Fuel Company, LLC

Prepared By:

Alpine Ecological
HC 80 Box 570
Greenwich, UT 84732

3.28.15

1.0 Introduction

The following narrative is submitted pursuant to requirements regulating potential impacts to terrestrial threatened, endangered, candidate and sensitive species and their associated habitats. The following report details the results of wildlife surveys conducted for the NOG Graben Bleeder Shaft Project; surveys included northern goshawk (*Accipiter gentilis*), American three-toed woodpecker (*Picoides dorsalis*), general raptor, and general wildlife surveys No other special status wildlife species were identified as a result of the pre-field research. The areas surveyed are displayed on Figure 1.

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. Research included historic records, species ecology, life history, known distributions, and habitat requirements.

2.0 Project Description

Skyline Mine proposed to construct a bleeder shaft in the Granger Ridge Area. As required by UDOGM, northern goshawk, American three-toed woodpecker, general raptor, and general wildlife surveys were conducted around the proposed shaft site and associated buffer area (Survey Area).

3.0 Habitat

South and East facing slopes, at higher elevations are dominated by quaking aspen communities with large open areas. These open areas are typically grass and tall forb communities. The North and West facing slopes are dominated by conifer communities. The tree species within the conifer community are mostly dead or dying, and the area has 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.

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. 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

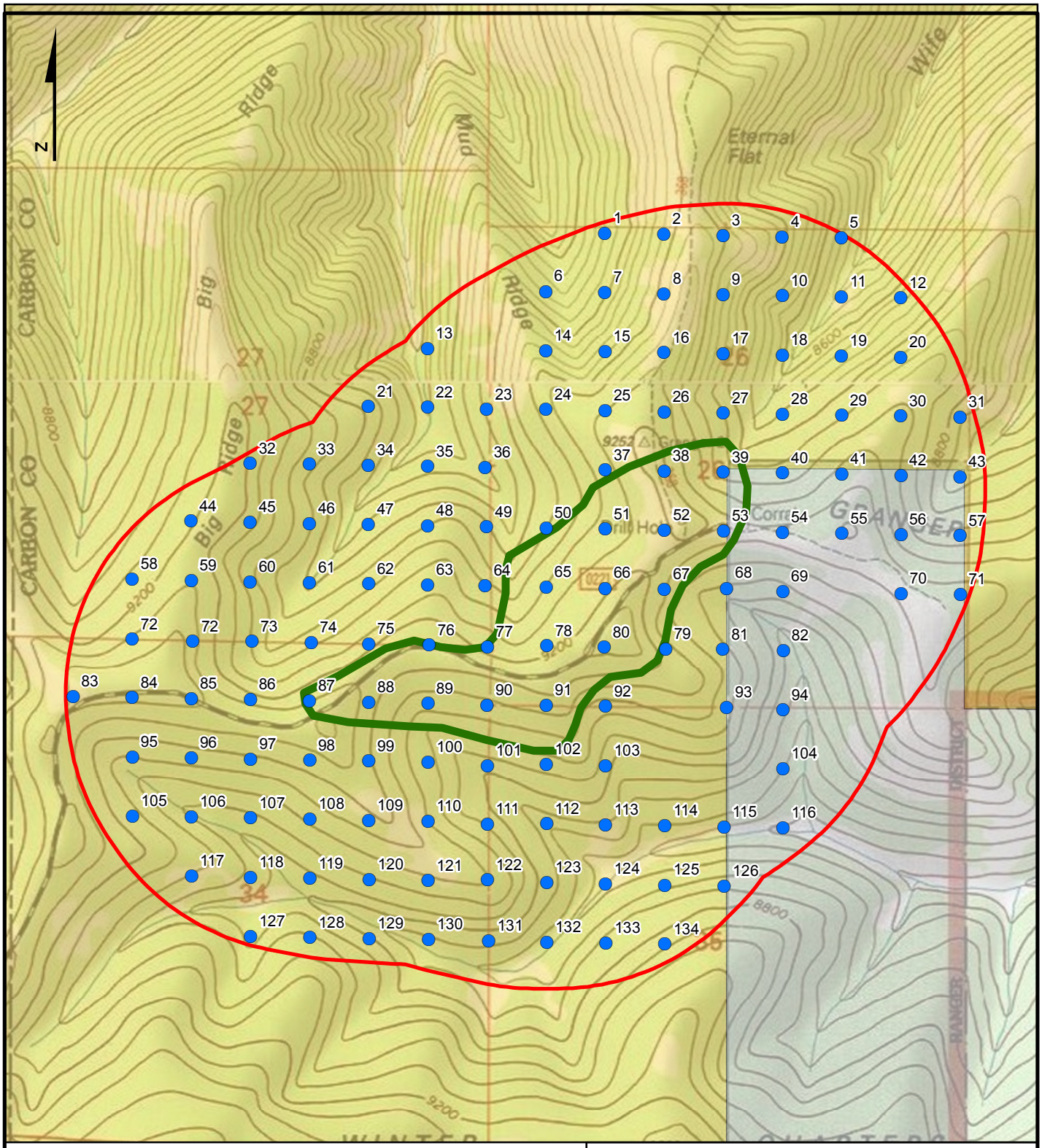
sequence was then repeated. Once the sequence of 10 seconds of calling and 30 seconds of looking and listening was completed 3 times and no response was elicited the surveyor then repeated the sequence before moving to the next calling station. Surveys were timed in accordance to the survey requirements 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. This survey was conducted twice as outlined in the protocol. There are a 134 call stations within the Survey Area.

American three-toed woodpecker surveys are conducted simultaneously with the northern goshawk survey in areas of suitable habitat. 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.

General raptor and wildlife surveys were conducted along transects designed during the northern goshawk protocol surveys.

5.0 Survey Results

There were no raptor observations documented within the Survey Area. Red tailed hawks were observed, on two separate occasions, soaring to the east of the Survey Area, while biologists traveled along the Granger Ridge Road. Common ravens (*Corvus corax*) were also observed along Granger Ridge Road and within the Survey Area. There were no other raptor species observed during the course of the inventory. No other special status species were observed during the course of the inventory. There were no audio or visual observations of American three-toed woodpecker during the course of the 2014 surveys.



BASE MAP:1:24,000 USGS Quad (Accessed at ArcGIS Online)

Goshawk Call Stations
0.5-Mile Buffer
Potential Shaft Location
Ownership
BLM
Private

1,000 500 0 Meters

1 in = 473 meters

NOG Bleeder Shaft

FIGURE - 1

DATE DRAWN 07/30/2014

Vegetation of the NOG Ventilation Site

2014

Skyline Mine
Carbon County, Utah

Aspen/Grass Reference Area

Prepared by

MT. NEBO SCIENTIFIC, INC.
330 East 400 South, Suite 6
P.O. Box 337
Springville, Utah 84663
(801) 489-6937

by

Patrick D. Collins, Ph.D.

for

CANYON FUEL COMPANY, LLC.
Skyline Mines
HC 35 Box 380
Helper, Utah 84526

January 2015

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VEGETATION STUDY AREAS MAP A . . . . . Attachment

INTRODUCTION

To continue mining in their North Graben (NOG) district, Canyon Fuel Company plans to construct a ventilation facility that will include a 1,425 ft bleeder shaft to accommodate an exhaust fan for the Skyline Mine. A short access road, a 50 ft x 80 ft pad, a topsoil pile, a backup generator and fuel tank will all be necessary for the facility. Total disturbance associated with the new site will be approximately 1.5 acres in which Canyon Fuel is proposing a permit area of about 4.2 acres.

The Skyline Mine is a coal mine with its surface facilities located about 5 miles by road (or 4 air-miles) southwest of the town of Scofield in Carbon County, Utah. The new ventilation facility will be located near Granger Ridge within the Manti-La Sal National Forest and approximately 4.5 air-miles north-northwest of Scofield. Located primarily in aspen stands (and the more open grasslands between them), elevation of the proposed permit area ranges from 8,900 ft to 9,200 ft above sea level.

METHODS

Quantitative Sampling

Methodologies used for this study were performed in accordance with the vegetation guidelines supplied by the State of Utah, Division of Oil, Gas and Mining (DOGM). In the growing season of 2014, quantitative and qualitative data were recorded in the plant communities proposed for disturbance along with the reference area that was chosen for future revegetation success standards.

Transect & Quadrat Placement

Random/regular placement of sample quadrats were designed to provide unbiased accuracy of the data compiled. This was accomplished by establishing several transect lines in the study areas. At regular intervals along the transect lines, random numbers were generated and used to measure distances at right angles from the line to determine sample locations.

Whether these random numbers were odd or even determined which side of transect line a given quadrat was placed.

Cover, Frequency & Composition

Cover estimates were made by employing ocular methods with meter square quadrats. Species composition and relative frequencies were also assessed from the quadrats. Plant nomenclature follows *A Utah Flora* (Welsh et al. 2008).

Density

Density estimates for the woody plant species on the proposed disturbed and reference areas were made using a distance method called the point-quarter technique. In this method, random points were placed on the sample sites and measured into four quarters. The distances to the nearest woody plant species were then recorded in each quarter. The average point-to-individual distance was equal to the square root of the mean area per individual.

Sample Adequacy

Sample adequacy for cover and density was attempted using the following formula.

$$nMIN = \frac{t^2 s^2}{(dx)^2}$$

where,

nMIN	= minimum adequate sample
t	= appropriate confidence t-value
s	= standard deviation
x	= sample mean
d	= desired change from mean

Threatened, Endangered, Candidate & Sensitive Species

The inventory of federally listed threatened, endangered and candidate plant species for Carbon County, Utah was consulted prior to field work in the study areas. Additionally, the State of Utah, Department of Natural Resources' biodiversity database was also consulted with regard to threatened, endangered or otherwise sensitive Species (TES) in the area. Finally, the USDA Forest Service Intermountain Region's list of proposed, endangered, threatened and sensitive species for the Manti-La Sal National Forest was consulted for possible impacts to such taxa by the proposed project. When applicable, these information sources would be used to drive sensitive species field surveys if any such species or habitats were known to be at or near the proposed new projects.

Photographs & Study Area Map

Several color photographs were taken of the sample areas some of which have been included in this report. An aerial image map showing the study area has also been prepared and included herein.

RESULTS

Aspen/Grass (Previously Disturbed)

A portion of the new access road that will be constructed in conjunction with the ventilation facility is located in an aspen area that had been disturbed previously by other activities. This area also appears to have been later re-seeded.

The vegetation in this previously disturbed area was sampled separately for comparison purposes. The only overstory species recorded here was aspen (*Populus tremuloides*). The most common understory plants were musk thistle (*Carduus nutans*), cheatgrass (*Bromus tectorum*), bluebunch wheatgrass (*Elymus spicatus*), mountain brome (*Bromus carinatus*), Sandberg's bluegrass (*Poa secunda*) and slender wheatgrass (*Elymus trachycaulus*). For a list of all species encountered in the sample quadrats, refer to Table 1.

Figure 1: Aspen/Grass (Previously Disturbed)

The total living cover for this area was estimated at 78.00%, of which 62.75% was from understory and 15.25% from overstory cover (Table 2-A). The composition of the understory cover was comprised of 62.46% grasses, 22.65% forbs and 14.89% trees and shrubs (Table 2-B).

When woody species density was measured, the total was only 174 individuals per acre (Table 3), with the dominant two species being aspen and red elderberry (*Sambucus racemosa*).

Aspen/Grass (Undisturbed)

Most of the remaining disturbance caused by the proposed construction activities for the access road, pad and topsoil pile will be in aspen communities and the associated open herbaceous areas between the aspen stands. Because there were several options and the *precise* location of the ventilation facility pad was still under consideration during the time that the vegetation data needed to be recorded (the growing season), a much larger area was sampled to represent the general plant community types once the final pad site was determined. Ultimately, the pad site will be placed within one of the general plant communities sampled.

The dominant overstory species for this community by far was aspen, but white fir (*Abies concolor*) was also encountered in the sample quadrats. The most common understory species were: mountain brome, bluebunch wheatgrass, musk thistle, western coneflower (*Rudbeckia occidentalis*) and aspen (Table 4).

Figure 2: Aspen/Grass (Undisturbed)

The total living cover for the Aspen/Grass community was estimated at 78.50%. The understory cover was 49.50% and overstory was 29.00% (Table 5-A). The composition for the understory consisted of 50.84% grasses, 31.79% forbs and 17.37% trees/shrubs (Table 5-B).

The total density for this area was also relatively inconsequential at 218 plants per acre, of which were mostly aspen trees (Table 6).

Aspen/Grass (Reference Area)

The plant community chosen to represent future revegetation success standards was located about 3.5 air-miles south of the ventilation facility. It was also used as a reference area for the proposed new powerline that runs from the mine's surface facilities to Swens Canyon. Called the Aspen/Grass Reference Area, this community's overstory was comprised of only quaking aspen. The understory dominants consisted of mountain brome, Sandberg's bluegrass and slender wheatgrass (Table 7).

Figure 3: Aspen/Grass (Reference Area)

Total living cover in this area was estimated at 80.33%; of that total, overstory and understory cover were estimated at 23.17% and 57.17%, respectively (Table 8-A). The composition of the understory here was comprised of 62.39% grasses, 23.07% forbs and 14.54% trees/shrubs (Table 8-B).

Like the community it was chosen to represent for final revegetation success standards, this area also had relatively few woody species per acre. The total woody species density was estimated at 68 plants per acre and consisted of quaking aspen and red elderberry (Table 9).

The summary tables referenced above are found on the following pages. *Subsequent to the summary tables, the following information has been provided*:

- Statistical comparisons data sets,
- An analysis of the threatened, endangered, candidate & sensitive species in the area,
- A final summary of the report,
- An aerial map of the study areas.

Data Summary Tables

Table 1: Skyline Mine Total cover, standard deviation and frequency by species (2014).

NOG Ventilation Facility Access Road
Aspen/Grass (Previously Disturbed) n=20

	Mean Percent	**Standard Deviation**	**Percent Frequency**
OVERSTORY			
Populus tremuloides	15.25	19.97	40.00
UNDERSTORY			
TREES/SHRUBS			
Populus tremuloides	1.00	4.36	5.00
Sambucus racemosa	8.50	13.61	30.00
FORBS			
Achillea millefolium	2.75	6.22	20.00
Carduus nutans	11.25	14.04	50.00
Lathyrus lanszwertii	0.25	1.09	5.00
Urtica dioica	0.50	2.18	5.00
GRASSES			
Bromus carinatus	6.75	10.87	35.00
Bromus tectorum	10.50	16.27	35.00
Elymus smithii	2.00	8.72	5.00
Elymus spicatus	8.75	10.94	45.00
Elymus trachycaulus	5.00	6.52	40.00
Poa secunda	5.50	12.34	30.00

Table 2: Skyline Mine. Total Cover and composition (2014).

NOG Ventilation Facility Access Road
Aspen/Grass (Previously Disturbed) n=20

	Mean Percent	**Standard Deviation**
A. TOTAL COVER		
Overstory Cover (o)	15.25	19.97
Understory Cover (u)	62.75	6.42
Litter	13.00	9.14
Bareground	11.95	6.46
Rock	12.30	7.25
Total Living Cover (o+u)	78.00	16.84
B. % COMPOSITION		
Shrubs	14.89	22.03
Forbs	22.65	20.85
Grasses	62.46	22.03

Table 3: Skyline Mine. Woody Species Density (2014).

NOG Ventilation Facility Access Road
Aspen/Grass (Previously Disturbed) n=20

SPECIES	**Number/Acre**
Artemisia tridentata	4.35
Chrysothamnus nauseosus	6.52
Chrysothamnus viscidiflorus	6.52
Populus tremuloides	84.81
Sambucus racemosa	65.23
Symphoricarpos oreophilus	6.52
TOTAL	**173.96**

Table 4: Skyline Mine Total cover, standard deviation and frequency by species (2014).

NOG Ventilation Facility Topsoil Pile, Access Road & Pad Site

Aspen/Grass (Undisturbed) n=30

	Mean Percent	**Standard Deviation**	**Percent Frequency**
OVERSTORY			
Abies concolor	1.67	8.98	3.33
Populus tremuloides	27.33	21.01	70.00
UNDERSTORY			
TREES/SHRUBS			
Populus tremuloides	4.67	7.30	33.33
Sambucus racemosa	1.17	4.41	6.67
Symphoricarpos oreophilus	0.67	3.59	3.33
FORBS			
Achillea millefolium	0.50	1.98	6.67
Carduus nutans	5.83	9.49	33.33
Lathyrus lanszwertii	2.33	4.23	23.33
Rudbeckia occidentalis	5.33	9.03	33.33
Thalictrum fendleri	0.67	3.59	3.33
Tragopogon dubius	0.67	3.59	3.33
Urtica dioica	0.33	1.80	3.33
Viola adunca	0.50	1.50	10.00
GRASSES			
Bromus carinatus	10.50	11.21	53.33
Elymus spicatus	10.17	14.40	10.00
Elymus trachycaulus	2.67	5.12	23.33
Poa secunda	3.50	11.63	13.33

Table 5: Skyline Mine. Total Cover and composition (2014).

NOG Ventilation Facility Topsoil Pile, Access Road & Pad Site

Aspen/Grass (Undisturbed) n=30

	Mean Percent	**Standard Deviation**
A. TOTAL COVER		
Overstory Cover (o)	29.00	20.75
Understory Cover (u)	49.50	16.09
Litter	14.83	8.11
Bareground	28.10	17.94
Rock	7.57	8.58
Total Living Cover (o+u)	78.50	17.23
B. % COMPOSITION		
Shrubs	17.37	27.97
Forbs	31.79	25.22
Grasses	50.84	26.23

Table 6: Skyline Mine. Woody Species Density (2014).

NOG Ventilation Facility Topsoil Pile, Access Road & Pad Site

Aspen/Grass (Undisturbed) n=30

SPECIES	**Number/Acre**
Abies concolor	5.44
Abies lasiocarpa	1.81
Populus tremuloides	193.94
Sambucus racemosa	16.31
TOTAL	**217.50**

Table 7: Skyline Mine Total cover, standard deviation and frequency by species (2014).

NOG VENTILATION FACILITY

Aspen/Grass (Reference Area) n=30

	Mean Percent	**Standard Deviation**	**Percent Frequency**
OVERSTORY			
Populus tremuloides	23.17	23.43	56.67
UNDERSTORY			
TREES/SHRUBS			
Populus tremuloides	3.50	11.19	10.00
Sambucus racemosa	2.50	7.72	16.67
FORBS			
Achillea millefolium	2.00	5.26	13.33
Cymopteris sp.	0.67	1.70	13.33
Helianthella uniflora	5.17	6.77	46.67
Lathyrus lanszwertii	1.33	2.87	20.00
Orthocarpus tolmiei	0.33	1.80	3.33
Rudbeckia occidentalis	2.83	7.38	13.33
Taraxacum officinalis	0.67	2.13	10.00
Viguiera multiflora	1.00	2.38	16.67
GRASSES			
Bromus carinatus	18.17	17.39	63.33
Elymus lanceolatus	0.17	0.90	3.33
Elymus spicatus	1.50	6.47	6.67
Elymus trachycaulus	8.17	11.65	40.00
Poa secunda	9.17	18.12	16.67

Table 8: Skyline Mine. Total Cover and composition (2014).

NOG VENTILATION FACILITY

Aspen/Grass (Reference Area) n=30

	Mean Percent	**Standard Deviation**
A. TOTAL COVER		
Overstory Cover (o)	23.17	23.43
Understory Cover (u)	57.17	17.50
Litter	13.80	5.76
Bareground	25.23	18.88
Rock	3.80	2.79
Total Living Cover (o+u)	80.33	15.65
B. % COMPOSITION		
Trees/Shrubs	14.54	31.53
Forbs	23.07	19.96
Grasses	62.39	29.26

Table 9: Skyline Mine. Woody Species Density (2014).

NOG VENTILATION FACILITY

Aspen/Grass (Reference Area) n=30

SPECIES	**Number/Acre**
Populus tremuloides	61.54
Sambucus racemosa	6.84
TOTAL	**68.38**

Statistical Analyses

Specific parameters for those plant communities that would be disturbed by the proposed construction activities were compared statistically with the reference area, or that area that could be used for revegetation success standards following final reclamation of the site. When **total living cover** values of the Aspen/Grass (Previously Disturbed) and the Aspen/Grass (Undisturbed) were compared statistically to the reference area, the differences were non-significant (Figure 4-A).

When the **total woody species density** values of these same communities were compared to the reference area, the differences were statistically significant (Figure 4-B). This, however, may be unimportant because none of these communities – those proposed for disturbance or the reference area – had high density values. Therefore, the final revegetation standard for woody species density could be set at the reference area value *or* the current proposed disturbance area values; either standard would be appropriate of final reclamation.

Figure 4. STUDENT'S T-TEST - NOG Bleeder Site at the Skyline Mine. Total living cover and woody species density comparisons between the proposed disturbed and reference areas (2014).

A. Total Living Cover

Aspen/Grass (Previously Disturbed): $\bar{x}$=78.00; s=16.84; n=20
Aspen/Grass (Reference Area): $\bar{x}$=80.33; s=15.65; n=30
t = 0.5003; df = 48; SL= NS

Aspen/Grass (Undisturbed): $\bar{x}$=78.50; s=17.23; n=30
Aspen/Grass (Reference Area): $\bar{x}$=80.33; s=15.65; n=30
t = 0.4306 ; df = 58; SL= NS

B. Woody Species Density

Aspen/Grass (Previously Disturbed): $\bar{x}$=173.96; s=163.62; n=20
Aspen/Grass (Reference Area): $\bar{x}$=68.38; s=39.98; n=30
t = 3.3819; df = 48 ; SL= p<0.01

Aspen/Grass (Undisturbed): $\bar{x}$=217.50; s=149.74; n=30
Aspen/Grass (Reference Area): $\bar{x}$=68.38; s=39.98; n=30
t = 5.2699; df =58; SL= p<0.01

$\bar{x}$= sample mean
s = sample standard deviation
n = sample size
NS = non-significant
t = Student's t-value
df = degrees of freedom
SL = significance level
p = probability level

Threatened, Endangered, Candidate & Sensitive Species

Table 10 provides a list of potential threatened, endangered, candidate and sensitive plant species known to occur in Carbon County as well as in the Manti-La Sal National Forest. The table also provides information about the likelihood of occurrence for each species in the proposed new ventilation site at the Skyline Mine.

Table 10: Federally listed threatened, endangered and candidate species for Carbon County[1], Utah (last updated January 12, 2012). The table also includes proposed, endangered, threatened and sensitive plant species in the Manti-La Sal National Forest[2] (last updated February 13, 2013).

ENDANGERED		**SITE-SPECIFIC NOTES**
THREATENED		
Astragalus montii [2]	Heliotrope milkvetch	This endemic plant is known to occur in Utah only on the Flagstaff Limestone formation in Sanpete and Sevier Counties and usually near or above 11,000 ft. elevation. The project area is not within the above-mentioned Utah counties. The study area is well below the elevation range for this species, and Flagstaff Limestone does not occur in the study area. The proposed project will not impact this plant species.
Penstemon grahamii [1] *(proposed)*	Graham penstemon	Graham penstemon is uncommon and is mostly found on shale and talus ledges in the Green River formation. This formation does not outcrop in the study area. There should be no impacts to this species as a result of proposed construction.

Table 10: Federally listed threatened, endangered and candidate species for Carbon County[1], Utah (last updated January 12, 2012). The table also includes proposed, endangered, threatened and sensitive plant species in the Manti-La Sal National Forest[2] (last updated February 13, 2013).		
Sclerocactus wetlandicus [1]	Uinta Basin fishhook cactus	*Sclerocactus wetlandicus* (also known as *S. glaucus* and *S. whipplei var. roseus*) generally occurs on cobblely, gravelly, or rocky surfaces on river terrace deposits along the White and Green Rivers of Utah. *S. wetlandicus* occurs on varying exposures, but is more abundant on south facing exposures, and on slopes to about 30 percent grade; it is most abundant at the point where river terrace deposits break from level tops to steeper side slopes. Plant communities and species associated with this species are bud sage, shadscale, black sagebrush and horsebrush. The above habitats and geologic formations are not found in the study area. Experience by the author with field studies/collections of this species resulted in the opinion that there is little chance for it to be present in the study area. This plant will not be impacted by the ventilation pad site or access road proposed by the Skyline Mine.
CANDIDATE		
SENSITIVE		
Allium geyeri var. chatterleyi [2]	Chatterley onion	This plant is a San Juan County, Utah endemic, probably collected in the Manti-La S al National Forest in the southeast portion of the state. The project area is significantly out of the range of the species. There should be no impact to this species as a result of construction in the study area.
Androsace chamaejasme ssp. carinata [2]	Sweet-flowered rock jasmine	The boreale rockjasmine is an alpine tundra plant and is known to be collected in La Sal Mountains in San Juan and Grand Counties, Utah. The project area is out of the range for the known collections of the species. There should be no impact to this species as a result of construction in the study area.

Table 10: Federally listed threatened, endangered and candidate species for Carbon County[1], Utah (last updated January 12, 2012). The table also includes proposed, endangered, threatened and sensitive plant species in the Manti-La Sal National Forest[2] (last updated February 13, 2013).		
Aquilegia flavescens var. rubicunda [2]	Link Canyon columbine	Knowing its habitat from experience by the author collecting this species resulted in the opinion that there is very little chance it would be present in the study area. There should be no impact to this species as a result of construction in the study area.
Astragalus iselyi [2]	Isely's milkvetch	The plant is known to occur on the west foothills of the La Sal Mountains in desert shrub and pinyon-juniper communities in Grand and San Juan Counties, Utah – mostly in Mancos Shale, Morrison and Paradox formations. The project area is outside the range for the known collections of the species. There will be no impact to this species as a result of construction in the study area.
Cryptantha creutzfeldtii [2]	Creutzfeldt-flower cryptanth	This plant has been collected in Mancos Shale, mostly in salt desert communities. The habitat is not found in the study area. Also, experience by the author with field studies/collections of this species resulted in the opinion that there is little chance it would be present in the study area. There will be no impact to this species as a result of construction in the study area.
Cymopterus beckii [2]	Pinnate spring-parsley	The endemic plant is known to occur only in Kane, San Juan and Wayne Counties, Utah, or well beyond the range of the project area. This plant will not be impacted by the ventilation pad site or access road proposed by the Skyline Mine
Draba abajoensis [2]	Abajo peak draba	In Utah, this plant has been collected in the Abajo Mountains in the southeast portion of the state, or well beyond the project area. There will be no impact to this species as a result of construction in the study area.

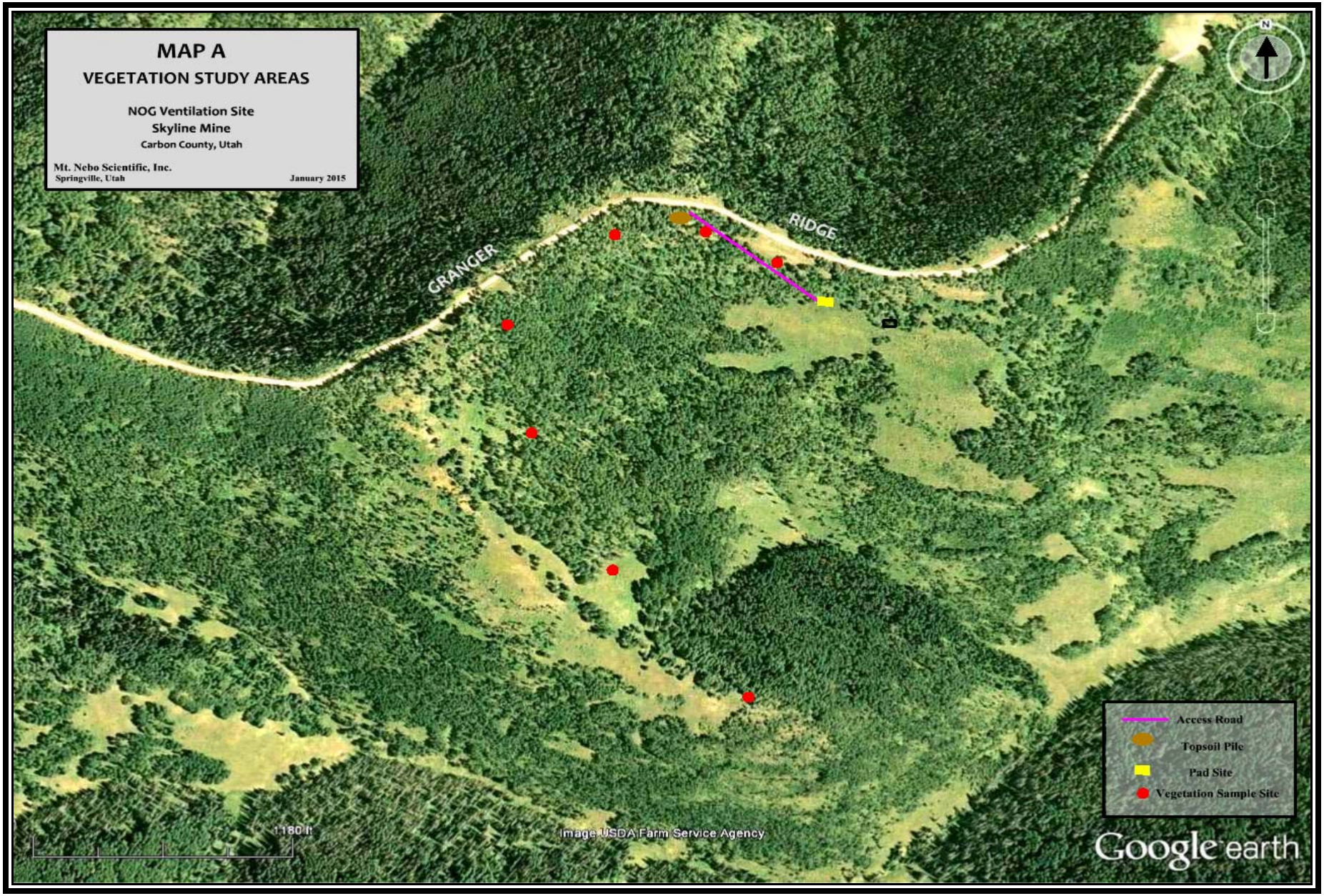
Table 10: Federally listed threatened, endangered and candidate species for Carbon County[1], Utah (last updated January 12, 2012). The table also includes proposed, endangered, threatened and sensitive plant species in the Manti-La Sal National Forest[2] (last updated February 13, 2013).		
Erigeron abajoensis [2]	Abajo daisy	This plant is an endemic known in Garfield, Piute, San Juan and Wayne Counties and not in Carbon and Emery Counties where the proposed construction is located. There is very little chance this species would occur in the study area so no impact is expected.
Erigeron carringtonae [2]	Carrington daisy	This plant is known to occur almost exclusively on the Flagstaff Limestone formation in Sanpete and Emery Counties. The study area is well below the elevation range of this species and Flagstaff Limestone does not occur in the area. The proposed project will not impact this plant species.
Erigeron kachinensis [2]	Kachina daisy	In Utah, this endemic plant species in known only in hanging gardens in San Juan County. The habitat and range for this species suggested there is almost no chance of impacts to it by the proposed construction.
Hedysarum occidentalis var. canone [2]	Canyon sweetvetch	Experience by the author with field studies/collections of this species resulted in the opinion that there is little chance it would be present in the study area. The study area does not have the habitat for this species. The project will not impact this plant.
Lomatium latilobum [2]	Canyonlands lomatium	In Utah, this plant species in known to occur on Entrada sandstone in Grand and San Juan Counties. The habitat and range for this species suggested there is almost no chance of impacts to it by the proposed construction.
Salix arizonica [2]	Arizona willow	Although this willow could occur relatively close to the project area, it is a riparian species. No impacts to riparian habitat is expected by the proposed construction projects. This plant will not be impacted by the ventilation pad site or access road proposed by the Skyline Mine

Table 10: Federally listed threatened, endangered and candidate species for Carbon County[1], Utah (last updated January 12, 2012). The table also includes proposed, endangered, threatened and sensitive plant species in the Manti-La Sal National Forest[2] (last updated February 13, 2013).		
Senecio musiniensis [2]	Musinea groundsel	This endemic plant is known to occur almost exclusively on ridgetops in the Flagstaff Limestone formation on talus slope on Musinea Peak in Sanpete County, Utah. The habitat and range for this species suggested there is almost no chance of impacts to it by the proposed construction.
Silene petersonii [2]	Maguire campion	This endemic plant is known to occur on plateau margins in Flagstaff and Claron formations in Garfield, Iron, Sanpete and Sevier Counties in Utah. The project area is not within the above counties. Also, the geology does not occur within the study area. The proposed project will likely not impact this plant species.

SUMMARY

Canyon Fuel Company has designed and engineered a ventilation facility to be constructed for the Skyline Mine near Granger Ridge located within the Manti-La Sal National Forest in Carbon County, Utah. The ventilation facility and its components will include: a pad, access road, topsoil pile, 1,425 ft bleeder shaft, exhaust fan, backup generator and fuel tank.

Construction of the site will necessitate disturbance to the vegetation supported in the area. The plant communities impacted will be Aspen/Grass types, some of which have were disturbed before, whereas others were present in their native condition. The plant communities types proposed for new disturbance were quantitatively sampled along with a reference area chosen to be used for final revegetation success standards. Additionally, a summary table prepared of the potential threatened, endangered, candidate and sensitive plant species known to occur in Carbon County, Utah as well as in the Manti-La Sal National Forest suggests there will likely be no impact to any of the species listed on that table by the proposed new construction site at the Skyline Mine.


MAP A
VEGETATION STUDY AREAS
NOG Ventilation Site
Skyline Mine
Carbon County, Utah
Mt. Nebo Scientific, Inc.
Springville, Utah
January 2015
GRANGER
RIDGE
Access Road
Topsoil Pile
Pad Site
Vegetation Sample Site
1180 ft
Image USDA Farm Service Agency
Google earth

Skyline Mine
North of Graben (NOG) Bleeder Shaft Area
Slope Stability Analysis

Canyon Fuel Company
Skyline Mine
Scofield, Utah

March 2015

REGISTERED PROFESSIONAL ENGINEER
No. 168246
RICHARD B. WHITE
15 Apr. 2015
STATE OF UTAH

EarthFax EarthFax Engineering Group, LLC.

Engineers / Scientists
www.earthfax.com

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SKYLINE MINE
NOG BLEEDER SHAFT AREA
SLOPE STABILITY ANALYSIS

CHAPTER 1

INTRODUCTION

Canyon Fuel Company (Canyon Fuel) is planning the construction of a bleeder shaft along the existing road along the north side of Woods Canyon approximately 3.8 miles west of Scofield, Utah (the site), near Neihart, Montana. Surface facilities associated with this site will include a fan, an earthen pad, a site access road, and a remote topsoil stockpile.

The purpose of this report is to summarize the methods and findings of geotechnical analyses performed for the site. As shown in Plate 3.2.4-5A- Layout, the proposed operational site will be constructed through a combination of excavation and utilizing the native or imported material to construct working surfaces. A berm or silt fence will be installed around the perimeter of the topsoil stockpile and the shaft pad to contain sediment and runoff discharges from the disturbed areas. Additionally, a road side ditch will direct runoff off from the road and upstream area to the berm or silt fence at the shaft pad. Significant ponded water is not anticipated at this site and therefore was not analyzed as part of the slope stability analysis. The slope stability analysis has been checked for the applicable criteria outlined by the Utah Division of Oil, Gas, and Mining (R645-301-500). This document has been prepared for Canyon Fuel Company by EarthFax Engineering Group, LLC, and contains the following information:

- Location and background information;
- Evaluation of the topsoil stockpile, access roadway and shaft pad;
- Results and recommendations based on the slope stability evaluation.

Slope stability geometry and outputs are included as attachments to this document.

CHAPTER 2
BACKGROUND INFORMATION

Long Resource Consultants, Inc. (LRC) conducted a field investigation, including the collection of soil samples, for characterizing the soil profile and soil types representative of the site. Soil samples were analyzed for grain size distribution, texture, K-factor, structure and permeability. For the project location, two soil samples are representative of the site (samples 14SKY06 and 14SKY07). Soil profile descriptions and laboratory results are provided in Attachment B, along with a site map showing soil sample locations. Soil data specific to the geotechnical analyses are listed in Table 1. From the soil data collected, soil types were correlated to typical soil strength values for analysis and modeling. These values (including unit weight, permeability, cohesive strength, angle of internal friction) are listed in Table 1. It is strongly recommended that soil conditions be verified during construction. If conditions differ or vary from what is presented in this report, a qualified geotechnical engineer should be contacted to reevaluate or give further guidance.

The LRC field investigation generally encountered Sandy Loam topsoil throughout the site. The field log for sample 14SKY06 contains a note that describes an exposed sandstone outcrop at that sample location. From the soil profile description of 14SKY07, it is reasonable to anticipate a typical 19 inch layer of Sandy Loam topsoil overlaying fractured sandstone. The actual rock structure of the sandstone is unknown and should be evaluated during construction. Previous reports from other bleeder shaft projects in the area indicate shale bedrock underneath the sandstone, but the field soil investigation conducted by LCR did not verify this information. If conditions differ or vary from what is presented in this report, a qualified geotechnical engineer should be contacted to reevaluate or give further guidance.

CHAPTER 3
EVALUATION METHODS

Slope stability analyses were performed using the slope stability software *Slide 5.0 ("Slide")* by Rocscience. This program uses an iterative procedure to evaluate the factor of safety against rotational shear failure for tens of thousands of potential failure surfaces that may develop within a given slope. Each trial failure surface is discretized into small slices and the driving and resisting forces/moments are calculated for each according to Bishop's Simplified Method of Slices and Janbu Simplified Method of Slices. These forces are then summed over the entire failure surface to obtain a factor of safety defined as the sum of the resisting forces divided by the sum of the driving forces. Therefore, a factor of safety less that 1.0 indicates an imminent potential for slope failure.

The analysis discussed herein relied on soils data collected during the LCR field investigation, as this investigation encompassed the same general area as the proposed shaft pad. Stability analyses were performed for three locations throughout the site: topsoil stockpile, access roadway, and shaft pad. The engineering properties summarized in Chapter 2 were assumed for this evaluation. Details on each of the slope-stability scenarios analyzed and soil properties used for these analyses are included in the following subsections. Geometries of each of the analyses are included in Attachment A.

3.1 Topsoil Stockpile

One scenario was analyzed for this section, which reaches from the north side of Granger Ridge Road south through the proposed topsoil stockpile and down slope to the undisturbed, existing grade. This scenario evaluated the stability of the topsoil stockpile with side slopes of 1.5H:1V (horizontal to vertical) constructed on top of exposed sandstone bedrock. It is our understanding that the topsoil stockpile will be constructed to a maximum height of 20 feet with a maximum side slope of 1.5H:1V.

3.2 Roadway

One scenario was analyzed for this section, located approximately halfway along the length of the road from Granger Ridge Road to the shaft pad. The analyzed section reaches from upslope of the roadway cut to beyond the down slope fill of the roadway. This scenario evaluated the stability of the roadway cut and embankment fill. A ditch parallels the road that, in reality, will only be filled intermittently and with a limited quantity of water incapable of saturating all underlying soils. Ponded water is not anticipated at this site and therefore was not analyzed as part of the slope stability analysis.

3.3 Shaft Pad

One scenario was analyzed for this section. Perpendicular to the shaft pad, this section reaches from up slope of the shaft pad cut to down slope of the embankment fill. It is our understanding that the shaft pad will be constructed with cut and fill slopes of 2H:1V. This scenario evaluatedthe stability of the shaft pad cut and embankment fill

CHAPTER 4
RESULTS

The soil properties used as input for *Slide* analyses are summarized in Table 1. As discussed above, these data are taken from the LCR field investigation, laboratory testing results, and correlated typical values. In the interest of conservatism, soil properties and analyses were assumed to provide worst-case estimates of geotechnical conditions at the operational shaft pad site. Reclamation of the site will return the operational phase to its former existing topography and slope stability would expect to hold the same factor of safety as modeled in the operational phase, if constructed with the same recommendations.

The calculated minimum factors of safety for the various scenarios described above are summarized in Table 2. As shown in this table, the minimum factor of safety for against slope failure of the topsoil stockpile is expected to be 1.7. The minimum factor of safety for the access roadway is 4.6. The shaft pad minimum factor of safety is 2.8 globally and 2.9 for the pad embankment fill.

The minimum acceptable factor of safety promulgated by DOGM for the spoil stockpile is 1.5 (R645-301-535.110). The minimum static safety factor for all roadway embankments is 1.3 (R645-301-535.130). The factors of safety calculated in this slope stability analysis are therefore considered acceptable. Topsoil stockpile and the constructed embankments are expected to remain stable under the geometry and loading conditions presented herein.

CHAPTER 5
RECOMMENDATIONS

The results of this investigation apply to the slope geometries and soil conditions discussed above. If actual conditions differ from those assumed in this report, topsoil stockpile, pond embankment, access road and sediment basin embankment slope stability should be re-evaluated as necessary.

The following recommendations are specific to the design and construction of the shaft pad and any sandstone bedrock excavation:

- From the soil profile descriptions provided by LRC, it is likely to anticipate fractured sandstone underlying the topsoil. The friable fractured sandstone should be removed to expose competent sandstone bedrock. The actual rock structure of the sandstone is unknown and should be evaluated during construction. If conditions differ or vary from what is presented in this report, a qualified geotechnical engineer should be contacted to reevaluate or give further guidance.
- It is recommended that the final exposed cut slope be designed to mitigate rockfall and erosion concerns, especially for the cut slope adjacent to the shaft pad. This would include, but not be limited to, removing all loose rocks throughout the face and rocks along the top of the cut face to prevent rockfall hazards. Surface drainage should be continually monitored for effects of erosion on the bedrock.
- Shear strengths for design and analysis are generally based on preconstruction rock mass conditions. Rock slopes are commonly excavated by drill and blast techniques. If improperly used, these excavation techniques can significantly alter the material properties of the rock mass comprising the slope. These alterations are more commonly evident as loosened rock which results in a reduction of strength. Excavation techniques should be properly evaluated and implemented for the conditions encountered.
- Stability and surface conditions should be continually monitored during and after construction of the pad.

The following recommendations are specific to the design and construction of the topsoil stockpile:

- New lifts should be placed only over existing lifts that have had time to drain and provide a stable base for a new lift. Areas which remain wet and soft should be allowed more time to dry and/or be scarified, if necessary.

- The stockpile surface should be graded to facilitate drainage away from recently placed fill toward surface drainage courses. It may be advantageous to bulldoze shallow ditches at each lift elevation to improve surface drainage.
- Care should be taken not to fill over any frozen material which has not been properly drained and compacted.
- It may often be necessary to place soil material, allow time for drying, and then to compact the lift.
- In the unlikely event that severe material handling, placement and compaction problems are encountered, consider temporarily flattening of stockpile face slope angles or utilizing artificial waste rock stabilization measure. Other measures may be considered on a case-by-case basis.

The following recommendations are specific to the design and construction of the roadway and embankments:

- The embankment should be placed on a well-prepared and compacted subgrade free from any organic soils, vegetation, debris, frozen soils, soft soils, or other deleterious materials.
- The embankments should be well keyed into the underlying subgrade and adjacent slopes.
- Embankment soils should be compacted with an appropriate compactor to at least 95% of the Standard Proctor maximum dry density (ASTM D698) at ±2% of the soil's optimum moisture content. Compacted lifts should not exceed 8 inches in thickness.
- The inside slope of the access road ditch should be armored with 3 inch diameter protective rock to form a liner.
- It is recommended that topsoil be placed on the outer slope of constructed embankments and vegetation established in order to reduce the potential for erosion.
- Embankments should be regularly inspected for signs of damage, erosion, and piping and repairs made as necessary.

CHAPTER 6
LIMITATIONS

The conclusions and recommendations presented in this report are based upon both the results of field and laboratory tests and correlated typical soil strength values for analysis and modeling. It should be recognized that soil materials are inherently heterogeneous and that conditions may exist throughout the site which could not be defined during this investigation and analyses. It is recommended that a soils engineer observeconditions during excavation to verify the existing in-situ conditions. If, during construction, conditions are encountered which appear to be different than those presented in this report, EarthFax should be advised in order that appropriate action be taken.

CHAPTER 7

REFERENCES

Long Resource Consultants, Inc. 2014. *Order 2 Soil Survey of the North of Graben (NOG) Bleeder Shaft Area at the Skyline Mine.*

Rocscience Inc. 2009. Slide 5.0 Toronto, Ontario

U.S. Army Corps of Engineers. 1994. Engineering and Design Rock Foundations. Engineer Manual 1110-1-2908. Department of the Army. Washington, D.C.

Utah Division of Oil, Gas, and Mining. 1996. Utah Coal Mining Regulations. Salt Lake City, Utah.

Wyllie, Duncan., & Mah, Christopher. *Rock Slope Engineering, Civil and Mining.* 4th ed. New York: Spon Press, 2008.

TABLE 1

Summary of Soil Properties

Sample ID Depth (in)	Grain Size Analysis				Typical Soil Values			
	Sand	Silt	Clay	Very Fine Sand	Unit Weight (lb/ft³)	Permeability (ft/s)	Cohesive Strength (psf)	Angle of Internal Friction (degrees)
14SKY06 0 [(a)]	-	-	-	-	-	-	-	-
14SKY07 0-4 [(b)]	62	32	6	8	115	8.2e-6	200	33
14SKY07 4-11 [(b)]	62	30	8	19.6	115	8.2e-6	200	33
14SKY07 11-19 [(b)]	62	31	7	14.2	115	8.2e-6	200	33
Fractured Sandstone Bedrock [(c)]	-	-	-	-	135	-	1040	34

*Samples 14SKY06 and 14SKY07 were analyzed as a homogenous soil for slope stability models.

(a) Sandstone outcrop. Landform note, no physical sample collected.
(b) Sandy Loam. Soil sample was analyzed for particle size. Other soil properties were based on typical values for the anticipated conditions at the project site.
(c) Fractured sandstone bedrock. Soil properties were based on typical values for the anticipated conditions at the project site[1].

[1]Wyllie, Duncan., & Mah, Christopher. *Rock Slope Engineering, Civil and Mining.* 4th ed. New York: Spon Press, 2008.

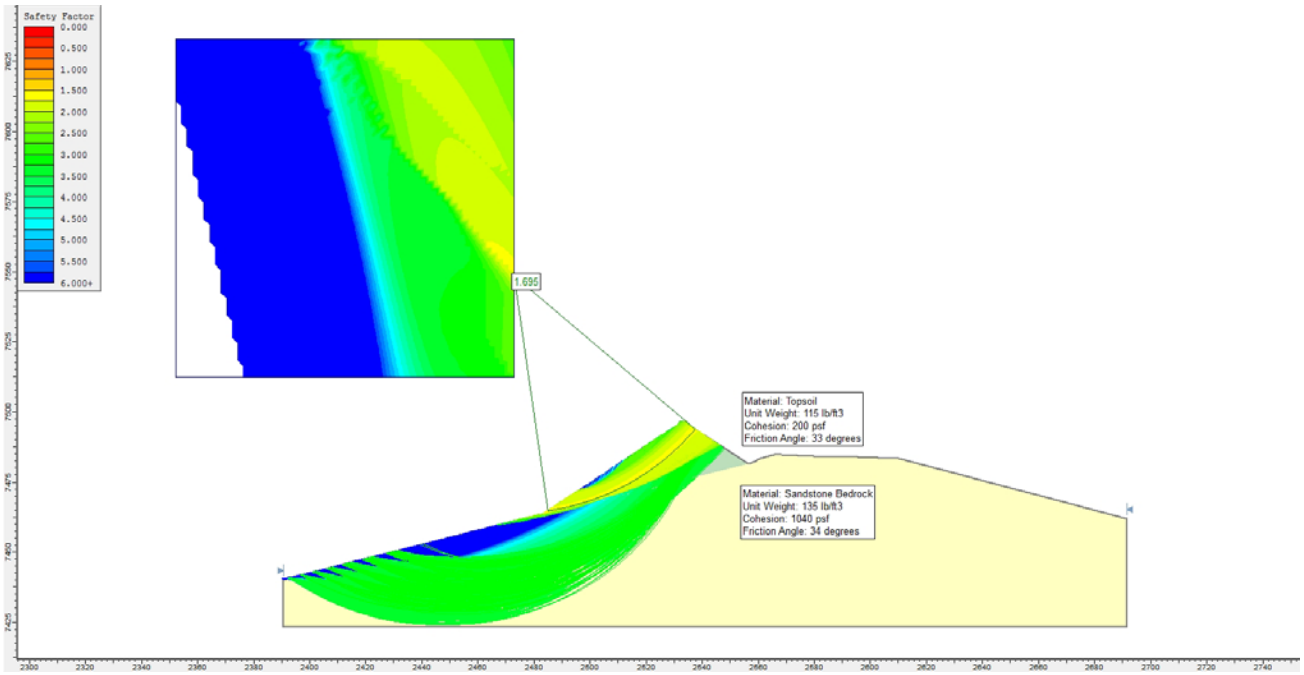
TABLE 2

Summary of *Slide* Analysis

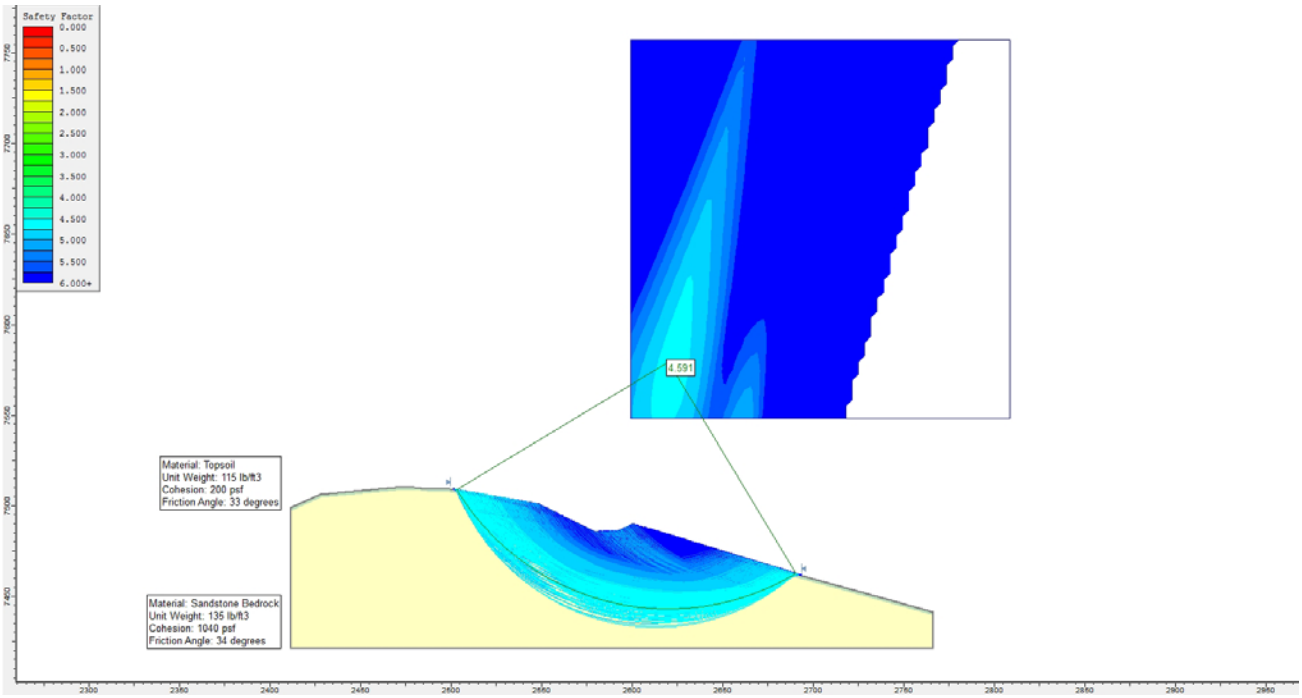
Location/ Condition	Minimum Factor of Safety	Minimum Acceptable Factor of Safety
Topsoil Stockpile	1.7	1.5
Access Roadway	4.6	1.3
Shaft Pad	2.8	-

ATTACHMENT A

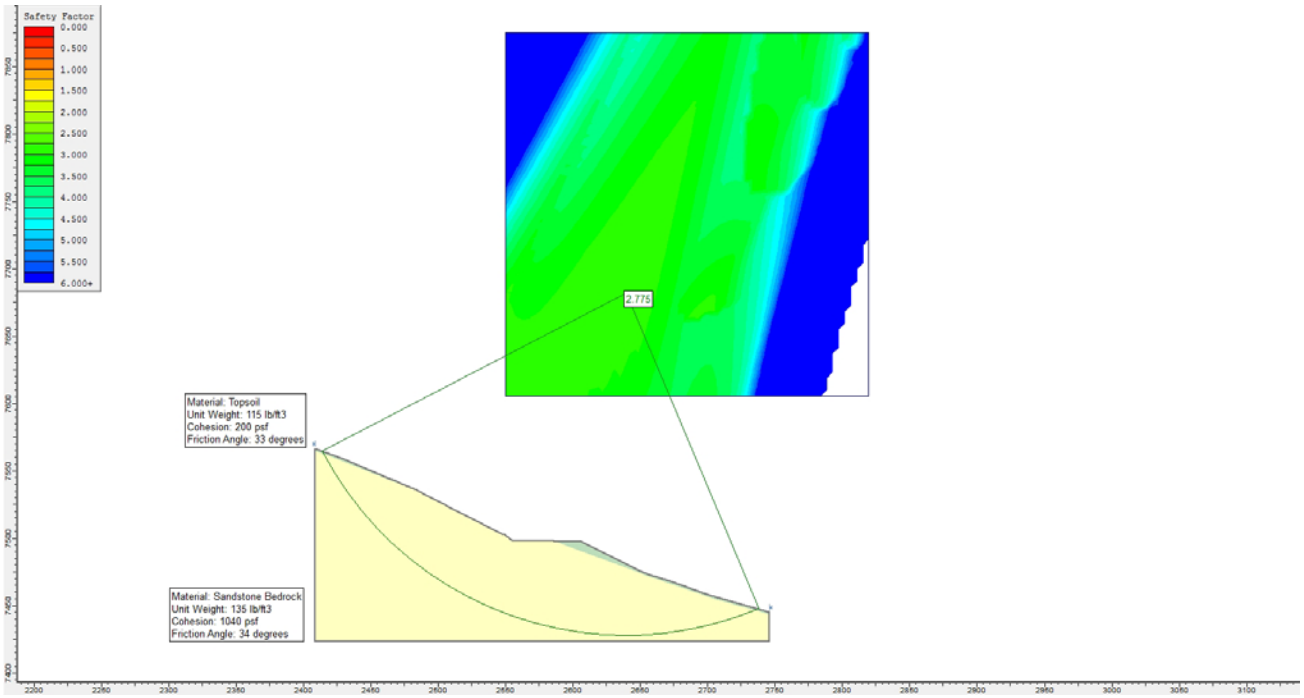
Slide Geometry and Output



Topsoil Stockpile: Stockpile placed on top of exposed sandstone bedrock.



Access Roadway: Access Roadway cut into topsoil and bedrock.



Shaft Pad: Shaft pad cut into topsoil and bedrock.

ATTACHMENT B

Long Resource Consultants, Inc.

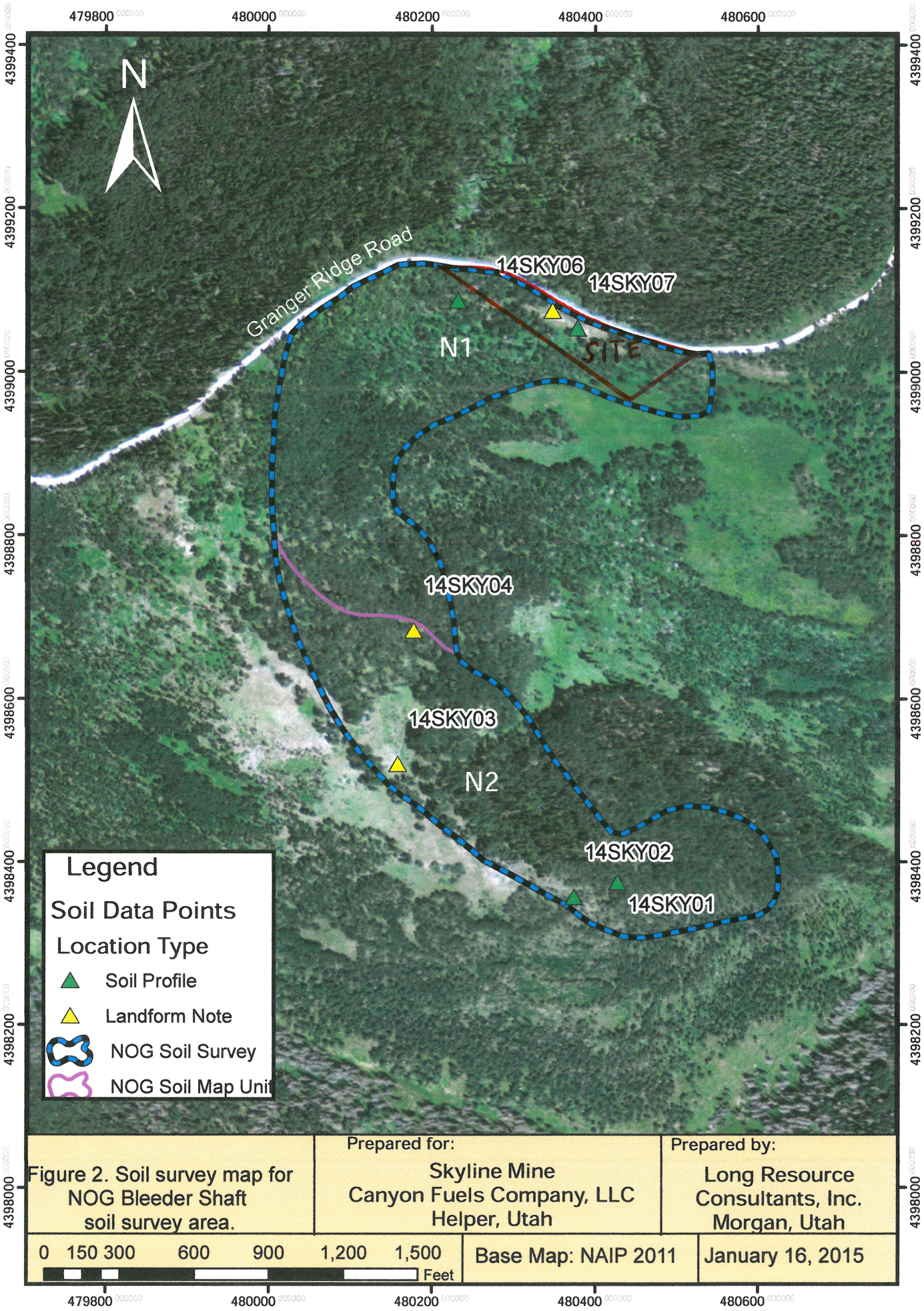


Figure 2. Soil survey map for NOG Bleeder Shaft soil survey area.

Prepared for:
Skyline Mine
Canyon Fuels Company, LLC
Helper, Utah

Prepared by:
Long Resource Consultants, Inc.
Morgan, Utah

Base Map: NAIP 2011

January 16, 2015

14SKY06

Pedon ID: 14SKY06
Description Date: 9/18/2014
Describer: Robert Long

Site Notes: sandstone outcrop

UTM: 480346E, 4399075N -- Datum NAD83, Zone 12
Legal Description: Section 34, Township 12 South, Range 6 East of the 29 Meridian

Landscape: mountains
Landform: mountain slope
Geomorphic Component: Free face
Profile Pos: Shoulder

Slope:
Elevation: 2822 meters (9258.5 feet)
Aspect: 225
Shape: up/down: Convex; **across:** Convex
Runoff: High

14SKY07

Pedon ID: 14SKY07
Description Date: 9/18/2014
Describer: Robert Long

Soil Name As Correlated: McCadden family
Current Taxonomic Class: Loamy-skeletal, mixed, superactive Lithic Haplocryolls
Current Taxon Kind: Family

County or Parish: UT007 - Carbon
State or Territory: UT - Utah
UTM: 480377E, 4399054N -- Datum NAD83, Zone 12
Legal Description: Section 34, Township 12 South, Range 6 East of the 29 Meridian

Landscape: mountains
Landform: mountain slope
Geomorphic Component: Upper third of mountainflank
Profile Pos: Shoulder
Slope: 41 percent
Elevation: 2816 meters (9238.8 feet)
Aspect: 225°
Shape: up/down: Convex; **across:** Linear

Drainage: Well drained
Runoff: High
Erosion: Class 1 - Sheet erosion

Primary Earth Cover: Grass/herbaceous cover;
Existing Vegetation: AGROP2 - wheatgrass (*Agropyron*)

Surface Fragments: 10 percent subangular sandstone gravels

Parent Materials: residuum weathered from sandstone

Particle Size Control Section: 25 to 48 centimeters (9.8 to 18.9 inches)
Diagnostic Features: Mollic epipedon: 0 to 28 centimeters (0 to 11 inches), Cambic horizon: 11 to 28 centimeters (4.3 to 11 inches) and Lithic contact: 28 centimeters (11 inches)
Restrictions: Lithic bedrock: 28 centimeters (11 inches)

A --- 0 to 11 centimeters (0 to 4.3 inches); black (10YR 2/1) moist, gravelly sandy loam; dark grayish brown (10YR 4/2) dry; 62 percent sand; 32 percent silt; 6 percent clay; weak fine subangular blocky parting to moderate medium granular structure; very friable, slightly hard, nonsticky, nonplastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 2 percent flat subangular sandstone flags and 20 percent subangular sandstone gravels; electrical conductivity of 0.37 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; slightly acid, pH 6.4, pH meter; clear smooth boundary; CaCO3 1.4 Percent.

Bw1 --- 11 to 28 centimeters (4.3 to 11 inches); very dark grayish brown (10YR 3/2) moist, cobbly sandy loam; brown (10YR 5/3) dry; 62 percent sand; 30 percent silt; 8 percent clay; moderate medium subangular blocky structure; very friable, hard, slightly sticky, nonplastic; common medium roots throughout, common fine roots throughout and common very fine roots throughout; 5 percent subangular sandstone cobbles and 15 percent subangular sandstone gravels; electrical conductivity of 0.24 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; neutral, pH 7, pH meter; clear smooth boundary; CaCO3 0.6 Percent.

Bw2 --- 28 to 48 centimeters (11 to 18.9 inches); very dark grayish brown (10YR 3/2) moist, very cobbly sandy loam; grayish brown (10YR 5/2) dry; 62 percent sand; 31 percent silt; 7 percent clay; weak medium subangular blocky structure; very friable, slightly hard, slightly sticky, nonplastic; common fine roots throughout and common very fine roots throughout; 5 percent flat subangular sandstone channers, 15 percent sandstone cobbles and 25 percent subangular sandstone gravels; electrical conductivity of 0.23 mmhos/cm by EC meter, saturated paste; noneffervescent by HCl, 1 normal; neutral, pH 6.9, pH meter; abrupt smooth boundary; CaCO3 0.9 Percent.

R --- 48 centimeters (18.9 inches); fractured sandstone.

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

Canyon Fuel Company
HC 35 Box 380
Helper, UT 84526

Report ID: S1410053001

Project: Skyline Mine Topsoil
Date Received: 10/1/2014

Date Reported: 10/29/2014
Work Order: S1410053

Lab ID	Sample ID	Depths cm	Sand %	Silt %	Clay %	Texture	Very Fine Sand %	Total Carbon %	TOC %
S1410053-001	14SKY01	0-15	53.0	39.0	8.0	Sandy Loam	22.7	4.7	4.5
S1410053-002	14SKY01	15-38	47.0	44.0	9.0	Loam	14.2	3.3	3.2
S1410053-003	14SKY01	38-58	47.0	44.0	9.0	Loam	19.2	2.3	2.2
S1410053-004	14SKY02	0-29	59.0	33.0	8.0	Sandy Loam	3.3	5.1	5.0
S1410053-005	14SKY05	0-14	58.0	31.0	11.0	Sandy Loam	6.8	2.8	2.7
S1410053-006	14SKY05	14-36	58.0	30.0	12.0	Sandy Loam	15.0	2.0	1.9
S1410053-007	14SKY05	36-58	58.0	30.0	12.0	Sandy Loam	11.5	1.8	1.7
S1410053-008	14SKY07	0-11	62.0	32.0	6.0	Sandy Loam	8.0	3.7	3.5
S1410053-009	14SKY07	11-28	62.0	30.0	8.0	Sandy Loam	19.6	1.3	1.2
S1410053-010	14SKY07	28-48	62.0	31.0	7.0	Sandy Loam	14.2	1.5	1.4
S1410053-011	14SKY08	0-9	44.0	41.0	15.0	Loam	6.4	3.3	3.2
S1410053-012	14SKY08	9-36	34.0	51.0	15.0	Silty Loam	18.1	1.7	1.7
S1410053-013	14SKY09	0-13	58.0	33.0	9.0	Sandy Loam	12.2	3.8	3.6
S1410053-014	14SKY09	13-30	56.0	33.0	11.0	Sandy Loam	16.4	1.7	1.6
S1410053-015	14SKY10	4-15	58.0	35.0	7.0	Sandy Loam	20.4	2.3	2.2
S1410053-016	14SKY10	15-34	54.0	39.0	7.0	Sandy Loam	19.8	3.1	3.0
S1410053-017	14SKY10	34-56	62.0	32.0	6.0	Sandy Loam	25.5	2.4	2.3
S1410053-018	14SKY10	56-80	82.0	14.0	4.0	Loamy Sand	12.7	22.4	22.0
S1410053-019	14SKY10	80-130	90.0	10.0	<0.1	Sand	7.6	1.2	1.1
S1410053-020	14SKY10	130-160	92.0	8.0	<0.1	Sand	9.2	0.5	0.5

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Skyline Mine
North of Graben (NOG) Bleeder Shaft Area
Hydrology Design Report

Canyon Fuel Company
Skyline Mine
Scofield, Utah

March 2015

REGISTERED PROFESSIONAL ENGINEER
No. 168246
RICHARD B. WHITE
1 Apr 2015
STATE OF UTAH

EarthFax EarthFax Engineering Group, LLC.

Engineers / Scientists
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SKYLINE MINE
NOG BLEEDER SHAFT AREA
HYDROLOGY DESIGN REPORT

CHAPTER 1

INTRODUCTION

Canyon Fuel Company (Canyon Fuel) is planning to construct a bleeder shaft pad along the existing road on the north side of Woods Canyon approximately 3.8 miles west of Scofield, Utah (the site). Site surface facilities will consist of a fan, an earthen pad, an access road, and a remote topsoil stockpile. To prevent adverse hydrologic impacts downstream of the site, Canyon Fuel will construct a storm water runoff conveyance system including berms or silt fences and a road side ditch.

The purpose of this document is to present design information for the planned runoff and sediment controls. A berm or silt fence will be installed around the perimeter of the topsoil stockpile and the pad to contain sediment and runoff discharges from the developed areas. Additionally, a road side ditch will direct runoff off from the access road and upstream area to the berm or silt fence at the pad. The runoff and sediment controls have been designed to conform to the applicable criteria outlined in the Utah Administrative Code Titles R645-300 and 301. This document has been prepared for Canyon Fuel by EarthFax Engineering Group, LLC (EarthFax), and contains the following information:

- Location and background information;
- Hydrologic analyses to determine runoff and sediment discharge for design storm events;
- Sediment control design criteria;

Engineering calculations are included as attachments to this document.

CHAPTER 2
LOCATION AND BACKGROUND INFORMATION

The general layout of the proposed shaft pad (the pad), access road, and topsoil stockpile (the stockpile) is shown on Plate 3.2.4-5A. The total watershed area contributing to the pad is 0.8 acres, which includes 0.4 acre of disturbed area and 0.4 acres of undisturbed area. The total watershed area contributing to the stockpile is 0.19 acre of disturbed area. A berm or silt fence will be installed around the stockpile to contain runoff and sediment from the stockpile. A ditch along the cut-slope side of the access road will direct runoff from the road and upstream area to a culvert along the downstream end of the access road. Runoff and sediment from the pad and area upstream of the pad will be directed into a berm or silt fence along the north and west side of the pad. From the silt fence or berm runoff will flow west and then south into the culvert at the downstream end of the access road. Due to the small size of the development the pad and stockpile are being developed as an Alternate Sediment Control Area (ASCA) in accordance with R645-301-742.240. Construction is planned for the summer of 2015.

The ASCA system has been designed to safely convey site runoff as specified in the Utah Administrative Code Titles R645-301-742 and 751. Thus, the conveyance systems have been designed to comply with the following criteria:

- The conveyance system will safely convey the peak flow resulting from a 10-year, 24-hour storm event.
- Berms or silt fences, culvert, and ditches will be installed according to standard engineering practices.
- Berms or silt fences will be installed to contain one year of calculated sediment yield.
- Berms and ditches will be constructed from native or imported materials and not from coal mine waste rock.

CHAPTER 3
HYDROLOGICAL DESIGN

3.1 Hydrology Introduction

Storm water discharge for the area was calculated using Carlson Hydrology 2014. The curve number (CN) values were determined using vegetation cover and type and soil types. The vegetative and soil information was provided by the Order 2 soil survey report for the site by Long Resource Consultants, Inc. (Long Resource). The soils were described as a mixture of loam with some gravel and clay. To be conservative hydrologic soil group C was assumed. The vegetative condition in undisturbed area was assumed to be fair with an Oak-Aspen and mountain brush mixture. In disturbed areas, a curve number of 86 was assumed (i.e., similar to the value reported by the NRCE Natural Engineering Handbook for dirt roads in areas of hydrologic soil group C and equivalent to the value provided in the Carlson Hydrology software for poor vegetative cover with less than 50% grass cover).

Design storm magnitudes were taken from the National Oceanic and Atmospheric Administration (NOAA) ATLAS 14, Point Precipitation Frequency Estimates web page (http://hdsc.nws.noaa.gov/hdsc/pfds/sa/ut_pfds.html). Site watershed areas and average slopes were calculated from a 1-foot contour interval topographic map provided by Skyline Mine using AutoCAD 2014 software. Off-site watershed areas and average slopes were calculated from 5-foot contour interval topographic map provided by Skyline Mine using AutoCAD 2014 software. All storm runoff calculations are included in Attachment A.

3.2 Drainage Area Characteristics

The drainage area contributing to the site watershed is delineated in Plate 3.2.4-5B. As indicated previously, the total area contributing to the pad is 0.8 acres, which includes 0.4 acre of

disturbed area and 0.4 acres of undisturbed area. The total area contributing to the stockpile is 0.19 acre of disturbed area. Disturbed Watershed 3 (DW-3) and approximately 75% of Undisturbed Watershed 1 (UW-1) contribute runoff to the access road ditch and culvert. DW-5 and approximately 25% of UW-1 contribute runoff to the berm or silt fence along the north and west side of the pad. Runoff to the stockpile area is contributed by DW-1 and UW-2. Watersheds DW-2 and DW-4 consist of the areas downstream of the pad and road and will not contribute runoff to the site. Runoff from DW-6 will be directed away from the pad via a berm or silt fence. Runoff from DW-7 will drain along the existing road above the site.

3.3 Runoff Volume Calculations

Estimated runoff volumes and associated calculations are presented in the Carlson Hydrology worksheets in Attachment A. Total runoff volume resulting from the 10-year, 24-hour storm event contributing to the access road ditch was 2,130 cubic feet (cf). Total runoff volume resulting from the 10-year, 24-hour storm event at the pad was 1,363 cf. Total runoff volume resulting from the 10-year, 24-hour storm event at the stockpile was 710 cf.

3.4 Runoff Conveyance System Details

Peak flow calculations for the access road ditch are presented in Attachment A. Rock lining size was determined in accordance with the U.S. Department of Transportation Table provided in Attachment A. For design details, see Plate 3.2.4-5C. The access road ditch will have a maximum slope of 16% with 1:1 horizontal:vertical side slopes with a liner consisting of 3 inch diameter rock and a depth of 1 foot. The ditch will be excavated into native materials. No coal waste or deleterious material will be used in ditch construction. The peak flow in the ditch resulting from a 10-year, 24-hour event was estimated to be 1.86 cfs, with a maximum velocity of 4.97 fps and depth of 0.50 foot.

Runoff from UW-1, DW-3, and DW-5 will flow into a culvert under the access road. UW-1 contributes 300 cf of runoff to the culvert with a peak flow of 0.30 cfs. DW-3 contributes 1,830 cf of runoff to the culvert with a peak flow of 1.56 cfs. DW-5 contributes 1,363 cf of runoff to the culvert. No flow information was available for DW-5. However, overall slopes and cover are similar to DW-3. DW-5 consists of an area approximately 75% the size of DW-3. Additionally, runoff from DW-5 is approximately 75% of DW-3. Therefore, it is reasonable to assume the peak flow of DW-5 is also 75% of DW-3 or approximately 1.17 cfs. The total peak runoff for the culvert will be 3.03 cfs.

A 10 foot wide section of the berms will be armored with gravel at the lowest topographic point to act as an emergency spillway. A 10 foot wide and 5 foot gravel pad will placed downstream of emergency spillway. If a silt fence is used a 10 foot wide and 5 foot long gravel pad will be placed along the downstream side of the lowest topographical point to act as an emergency spillway. For the silt fence spillway detail see Plate 3.2.4-5D.

CHAPTER 4
SEDIMENT CONTROL CALCULATIONS

4.1 Sediment Volume Calculations

The average annual anticipated sediment yield from the watersheds was calculated using the Universal Soil Loss Equation as developed by the Utah Water Research Laboratory (Israelsen et al., 1984). This method estimates the average annual sediment yield per acre based on the following equation:

$$A = R \cdot K \cdot LS \cdot VM$$

Where A = Average annual sediment yield in tons per acre
R = Precipitation factor based on site location
K = Soil erodibility factor
LS = Slope length and steepness factor
VM = Erosion control factor

Results from these calculations are included in Table 1. Input variables used in this analysis are included in Attachment B. Derivations of each factor in the sediment yield equation for each watershed are summarized below:

- The value for R was obtained from an isoerodent precipitation map of Utah (Israelsen et al., 1984) and adjusted using figures from (Israelsen et al., 1984).
- Values for K were obtained for the InterMountain Labs soil analysis found in Long Resource soils report in Attachment B.
- Values for LS were calculated using the algorithms provided by Israelsen et al. (1984). Slope angles were read from the topographic map of the site (1 and 5 foot contour interval).
- Values for VM were taken from a table provided by Israelsen et al. (1984).

This method assumes that all the soil mobilized by erosion in the entire watershed travels down slope along berms or silt fences and the access road ditch within the watersheds (i.e., a sediment delivery ratio of 1.0). Thus, the sediment volume predicted by this equation is conservatively high. Only sediment yields for the watersheds contributing to the site were calculated. DW-2 and DW-4 do not contribute sediment or runoff to the site.

The average annual sediment yield in tons per acre for each watershed was multiplied by that watershed's area to find the annual weight of sediment participated from the area. This value was then divided by the saturated density of the affected soil types to find a volume (the saturated density was used since erosion would occur during precipitation events and would thus involve saturated soil). Finally, the volumes for each watershed were summed to determine the total annual yield of the area draining into the berm or silt fence around the pad and topsoil stockpile. The maximum calculated annual sediment yield for the area draining to the berm or silt fence for pad and the stockpile are 367 cf and 73 cf, respectively.

4.2 ASCA Berm and Silt Fence Capacities

The berm around pad will be constructed with 2:1 (horizontal:vertical) side slopes and a minimum height of 1 foot. The berm will be approximately 120 feet in length, allowing for 1,500 cf of sediment storage. Sediment behind the berm will be cleaned when sediment reaches 60% of the maximum volume or an elevation within 0.4 foot from the top of the 1-foot tall berm. If a silt fence is constructed, sediment behind the silt fence will be cleaned when sediment reaches 60% of the maximum volume or an elevation within 1.2 feet from the top of the 3-foot tall silt fence.

The south section of berm around the topsoil stockpile will be constructed with 2:1 (horizontal:vertical) side slopes and a minimum height of 1 foot. The berm will be approximately 80 feet in length, allowing for 160 cf of sediment storage. Sediment behind the berm will be cleaned when sediment reaches 60% of the maximum volume or an elevation within 0.4 feet from the top of

the 1-foot tall berm. If a silt fence is constructed, sediment behind the silt fence will be cleaned when sediment reaches 60% of the maximum volume or an elevation within 1.2 feet from the top of the 3-foot tall silt fence.

CHAPTER 5
REFERENCES

Carlson Hydrology, 2014. Carlson Maysville, Kentucky.

Israelson, C. Earl, Joel E. Fletcher, Frank W. Haws, and Eugene K. Israelson, 1984. *Erosion and Sedimentation in Utah: A guide for Control*, Hydraulics and Hydrology Series UWRL/H-84/03, Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah. 89 p.

National Oceanic and Atmospheric Administration, 2015. *Point Precipitation Frequency Estimates*

U.S. Department of Transportation. 1978. Use of Riprap for Bank Protection. Hydrology Engineering Circular No. 11. Federal Highway Administration. Washington, D.C.

TABLE 1

Sediment Yield Volumes

Watershed	Sediment Yield (tons/acre-year)	Area (acres)	Sediment Yield (cf/year)
UW-1	8.6	1.47	243
DW-1	19.4	0.20	73
DW-5	41.8	0.38	305

ATTACHMENT A

Hydrology Calculations

NOAA Atlas 14, Volume 1, Version 5
Location name: Helper, Utah, US*
Latitude: 39.7410°, Longitude: -111.2120°
Elevation: 9088 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.147 (0.126-0.176)	0.189 (0.162-0.227)	0.261 (0.221-0.312)	0.322 (0.270-0.387)	0.417 (0.341-0.502)	0.501 (0.403-0.604)	0.596 (0.469-0.722)	0.706 (0.540-0.862)	0.881 (0.646-1.09)	1.04 (0.733-1.31)
10-min	0.224 (0.192-0.268)	0.288 (0.246-0.346)	0.397 (0.336-0.475)	0.491 (0.412-0.589)	0.635 (0.520-0.764)	0.762 (0.612-0.920)	0.908 (0.714-1.10)	1.07 (0.822-1.31)	1.34 (0.983-1.67)	1.58 (1.12-2.00)
15-min	0.278 (0.238-0.333)	0.357 (0.306-0.429)	0.493 (0.417-0.589)	0.608 (0.510-0.730)	0.787 (0.644-0.948)	0.945 (0.759-1.14)	1.13 (0.885-1.36)	1.33 (1.02-1.63)	1.66 (1.22-2.07)	1.96 (1.38-2.48)
30-min	0.374 (0.320-0.448)	0.481 (0.412-0.577)	0.663 (0.561-0.794)	0.819 (0.687-0.983)	1.06 (0.868-1.28)	1.27 (1.02-1.54)	1.52 (1.19-1.83)	1.79 (1.37-2.19)	2.24 (1.64-2.78)	2.64 (1.86-3.34)
60-min	0.463 (0.396-0.555)	0.595 (0.509-0.715)	0.821 (0.695-0.982)	1.01 (0.850-1.22)	1.31 (1.07-1.58)	1.57 (1.27-1.90)	1.88 (1.48-2.27)	2.22 (1.70-2.71)	2.77 (2.03-3.44)	3.27 (2.31-4.13)
2-hr	0.573 (0.493-0.682)	0.726 (0.622-0.863)	0.960 (0.820-1.15)	1.17 (0.987-1.40)	1.50 (1.24-1.80)	1.79 (1.45-2.16)	2.13 (1.69-2.58)	2.52 (1.94-3.07)	3.13 (2.31-3.88)	3.69 (2.63-4.67)
3-hr	0.640 (0.559-0.753)	0.802 (0.699-0.942)	1.03 (0.895-1.21)	1.23 (1.07-1.46)	1.56 (1.33-1.85)	1.84 (1.53-2.19)	2.18 (1.78-2.60)	2.56 (2.04-3.09)	3.18 (2.44-3.91)	3.74 (2.78-4.68)
6-hr	0.838 (0.746-0.955)	1.04 (0.925-1.18)	1.27 (1.13-1.46)	1.48 (1.31-1.69)	1.78 (1.55-2.04)	2.05 (1.76-2.37)	2.38 (2.01-2.77)	2.74 (2.28-3.22)	3.35 (2.71-4.00)	3.90 (3.09-4.73)
12-hr	1.08 (0.976-1.20)	1.33 (1.20-1.48)	1.61 (1.45-1.80)	1.85 (1.66-2.07)	2.19 (1.94-2.46)	2.45 (2.15-2.77)	2.74 (2.38-3.11)	3.10 (2.65-3.56)	3.70 (3.11-4.31)	4.26 (3.52-5.02)
24-hr	1.24 (1.11-1.40)	1.54 (1.37-1.74)	1.87 (1.66-2.11)	2.13 (1.89-2.41)	2.49 (2.20-2.81)	2.76 (2.42-3.13)	3.04 (2.65-3.44)	3.31 (2.87-3.77)	3.73 (3.14-4.35)	4.30 (3.55-5.07)
2-day	1.50 (1.33-1.71)	1.86 (1.65-2.12)	2.26 (2.00-2.58)	2.59 (2.28-2.95)	3.03 (2.65-3.45)	3.37 (2.93-3.84)	3.72 (3.21-4.25)	4.07 (3.48-4.67)	4.54 (3.85-5.24)	4.90 (4.11-5.68)
3-day	1.70 (1.50-1.95)	2.11 (1.86-2.42)	2.58 (2.26-2.96)	2.96 (2.59-3.39)	3.47 (3.02-3.97)	3.87 (3.34-4.43)	4.27 (3.66-4.91)	4.68 (3.98-5.39)	5.23 (4.39-6.06)	5.65 (4.70-6.58)
4-day	1.91 (1.68-2.20)	2.37 (2.08-2.73)	2.90 (2.53-3.34)	3.32 (2.90-3.83)	3.90 (3.39-4.50)	4.36 (3.75-5.02)	4.82 (4.11-5.56)	5.29 (4.47-6.10)	5.92 (4.94-6.88)	6.41 (5.28-7.48)
7-day	2.34 (2.05-2.71)	2.90 (2.54-3.36)	3.56 (3.11-4.12)	4.08 (3.56-4.73)	4.80 (4.16-5.57)	5.36 (4.61-6.22)	5.92 (5.06-6.90)	6.50 (5.51-7.59)	7.28 (6.10-8.57)	7.88 (6.54-9.33)
10-day	2.69 (2.35-3.12)	3.34 (2.92-3.87)	4.09 (3.56-4.74)	4.68 (4.06-5.43)	5.47 (4.72-6.36)	6.07 (5.21-7.07)	6.68 (5.69-7.79)	7.29 (6.17-8.53)	8.10 (6.76-9.52)	8.71 (7.22-10.3)
20-day	3.64 (3.18-4.25)	4.54 (3.97-5.29)	5.57 (4.86-6.52)	6.39 (5.55-7.49)	7.47 (6.45-8.77)	8.29 (7.11-9.76)	9.13 (7.76-10.7)	9.96 (8.40-11.8)	11.1 (9.19-13.1)	11.9 (9.79-14.2)
30-day	4.49 (3.91-5.19)	5.57 (4.87-6.46)	6.79 (5.91-7.89)	7.74 (6.71-8.98)	8.96 (7.73-10.4)	9.89 (8.49-11.5)	10.8 (9.21-12.6)	11.7 (9.91-13.7)	12.9 (10.8-15.1)	13.8 (11.4-16.2)
45-day	5.60 (4.89-6.53)	6.96 (6.08-8.12)	8.48 (7.38-9.91)	9.65 (8.37-11.3)	11.2 (9.64-13.1)	12.3 (10.6-14.4)	13.5 (11.5-15.8)	14.6 (12.4-17.2)	16.0 (13.4-19.0)	17.1 (14.2-20.4)
60-day	6.68 (5.85-7.68)	8.31 (7.30-9.58)	10.1 (8.87-11.7)	11.5 (10.1-13.3)	13.3 (11.6-15.4)	14.6 (12.6-16.9)	15.9 (13.7-18.5)	17.2 (14.7-20.0)	18.9 (15.9-22.1)	20.1 (16.8-23.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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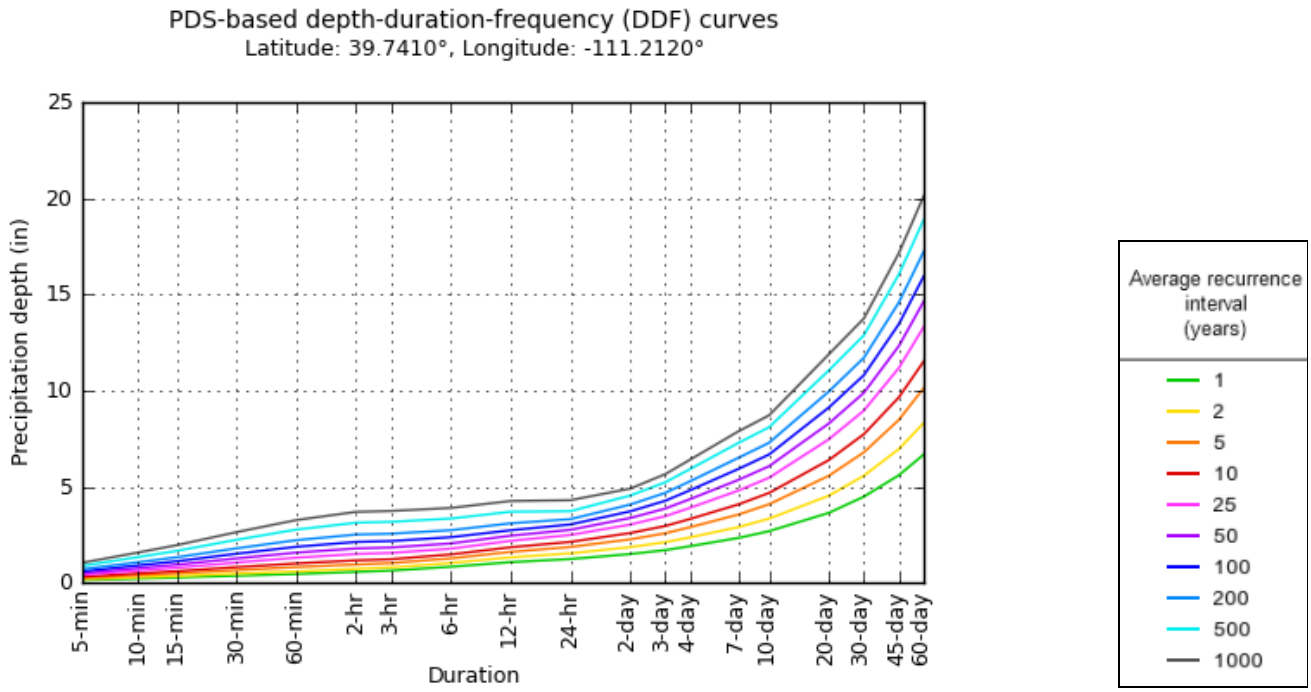
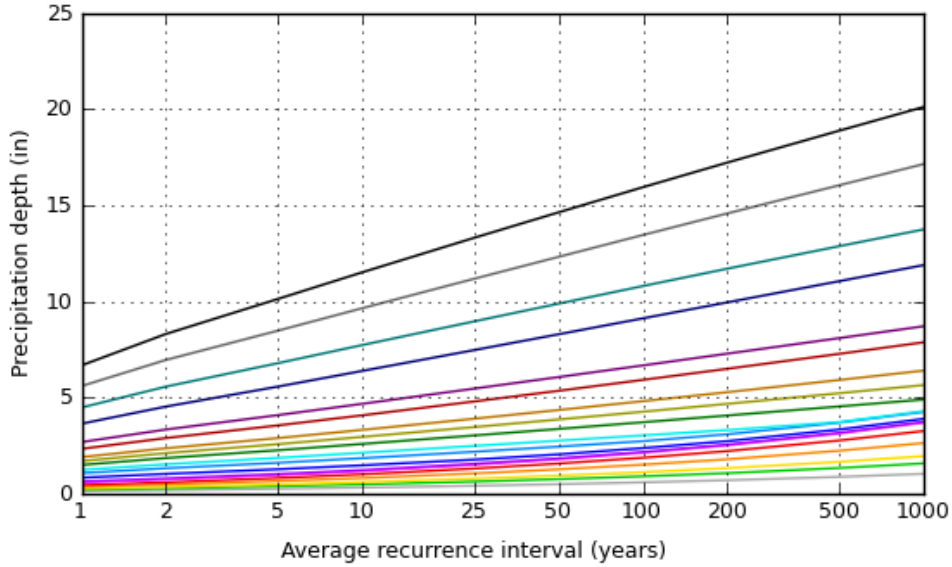
PF graphical





NOAA Atlas 14, Volume 1, Version 5

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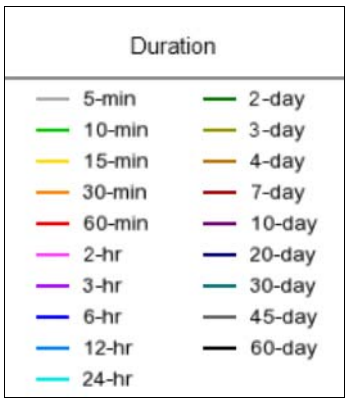

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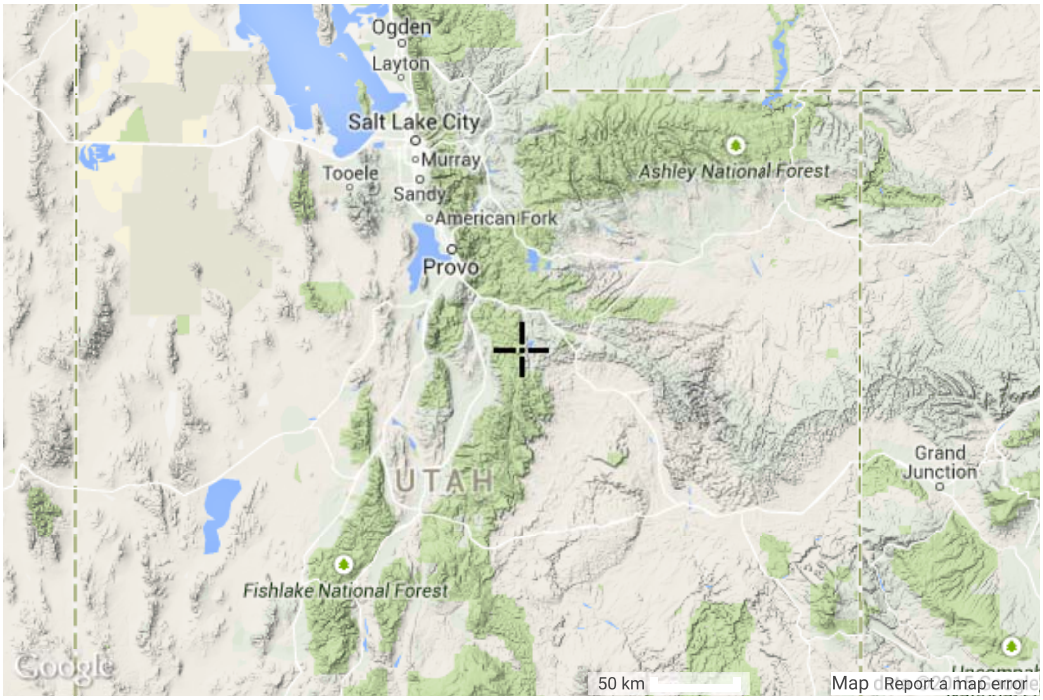
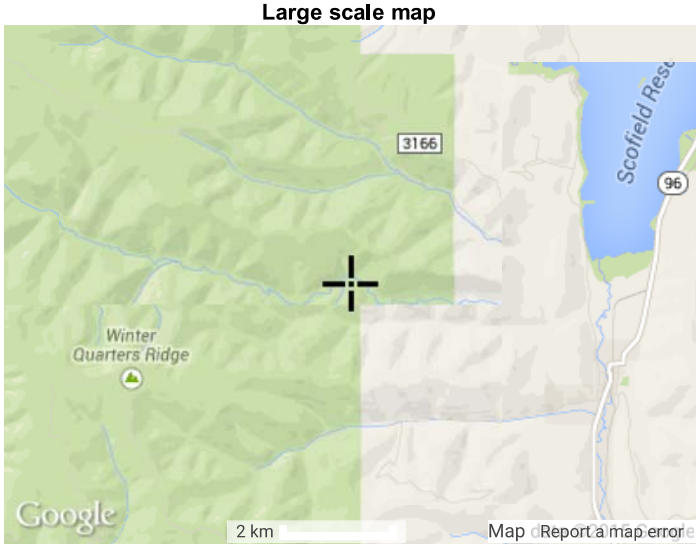
Maps & aerials

Small scale terrain



Large scale terrain

Large scale map



Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Hydrologic Development
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Runoff Curve Number and Runoff Mon Feb 16 08:58:24 2015

Project: NOG Bleeder Shaft By: Date: 02/16,
Location: UW1 Checked: Date:
Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Sq.Ft.)
Oak-Aspen & Mt brush (Fair)	57	C	63833.300

CN (weighted): 57.0
Total Area: 63833.300 Sq.Ft.

2. Runoff

Return Period:	10-Year	
Rainfall, P:	2.19	in
Runoff, Q:	0.0564	in
Runoff Volume:	0.0069	Acre-Ft

Runoff Curve Number and Runoff Mon Feb 16 08:57:24 2015

Project: NOG Bleeder Shaft By: Date: 02/16
Location: UW2 Checked: Date:
Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Sq.Ft.)
Oak-Aspen & Mt brush (Fair)	57	C	2051.800

CN (weighted): 57.0
Total Area: 2051.800 Sq.Ft.

2. Runoff

Return Period:	10-Year	
Rainfall, P:	2.19	in
Runoff, Q:	0.0564	in
Runoff Volume:	0.0002	Acre-Ft

Runoff Curve Number and Runoff Mon Feb 16 08:58:59 2015

Project: NOG Bleeder Shaft By: Date: 02/16
Location: DW1 Checked: Date:
Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Sq.Ft.)
Open Space-Poor (<50% grass)	86	C	8579.400

CN (weighted): 86.0
Total Area: 8579.400 Sq.Ft.

2. Runoff

Return Period:	10-Year	
Rainfall, P:	2.19	in
Runoff, Q:	0.9953	in
Runoff Volume:	0.0163	Acre-Ft

Runoff Curve Number and Runoff Mon Feb 16 08:59:23 2015

Project: NOG Bleeder Shaft By: Date: 02/16
Location: DW2 Checked: Date:
Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Sq.Ft.)
Open Space-Poor (<50% grass)	86	C	7410.500

CN (weighted): 86.0
Total Area: 7410.500 Sq.Ft.

2. Runoff

Return Period:	10-Year	
Rainfall, P:	2.19	in
Runoff, Q:	0.9953	in
Runoff Volume:	0.0141	Acre-Ft

Runoff Curve Number and Runoff Mon Feb 16 09:00:22 2015

Project: NOG Bleeder Shaft By: Date: 02/16
Location: DW3 Checked: Date:
Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Sq.Ft.)
Open Space-Poor (<50% grass)	86	C	22047.600

CN (weighted): 86.0
Total Area: 22047.600 Sq.Ft.

2. Runoff

Return Period:	10-Year	
Rainfall, P:	2.19	in
Runoff, Q:	0.9953	in
Runoff Volume:	0.0420	Acre-Ft

Runoff Curve Number and Runoff Mon Feb 16 09:00:44 2015

Project: NOG Bleeder Shaft By: Date: 02/16,
Location: DW4 Checked: Date:
Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Sq.Ft.)
Open Space-Poor (<50% grass)	86	C	6122.300

CN (weighted): 86.0
Total Area: 6122.300 Sq.Ft.

2. Runoff

Return Period:	10-Year	
Rainfall, P:	2.19	in
Runoff, Q:	0.9953	in
Runoff Volume:	0.0117	Acre-Ft

Runoff Curve Number and Runoff Mon Feb 16 09:01:14 2015

Project: NOG Bleeder Shaft By: Date: 02/16
Location: DW5 Checked: Date:
Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Sq.Ft.)
Open Space-Poor (<50% grass)	86	C	16417.700

CN (weighted): 86.0
Total Area: 16417.700 Sq.Ft.

2. Runoff

Return Period:	10-Year	
Rainfall, P:	2.19	in
Runoff, Q:	0.9953	in
Runoff Volume:	0.0313	Acre-Ft

Runoff Curve Number and Runoff Mon Feb 16 09:01:43 2015

Project: NOG Bleeder Shaft By: Date: 02/16,
Location: DW6 Checked: Date:
Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Sq.Ft.)
Open Space-Poor (<50% grass)	86	C	3403.100

CN (weighted): 86.0
Total Area: 3403.100 Sq.Ft.

2. Runoff

Return Period:	10-Year	
Rainfall, P:	2.19	in
Runoff, Q:	0.9953	in
Runoff Volume:	0.0065	Acre-Ft

Project: NOG Bleeder Shaft By: Date: 02/16
Location: DW7 Checked: Date:
Present

1. Runoff Curve Number (CN)

Cover description	CN	Soil Group	Area(Sq.Ft.)
Open Space-Poor (<50% grass)	86	C	12184.300

CN (weighted): 86.0
Total Area: 12184.300 Sq.Ft.

2. Runoff

Return Period:	10-Year	
Rainfall, P:	2.19	in
Runoff, Q:	0.9953	in
Runoff Volume:	0.0232	Acre-Ft

Channel Design (Non-Erodible) Thu Feb 19 09:26:25 2015

Channel Type: Triangular, Equal Side Slopes
Dimensions: Left Side Slope 1.50:1
Right Side Slope 1.50:1

Wetted Perimeter: 1.80
Area of Wetted Cross Section: 0.38

Channel Slope: 16.0000
Manning's n of Channel: 0.0420

Discharge: 1.86 cfs
Depth of Flow: 0.50 feet
Velocity: 4.97 fps

Channel Lining: Rock
Freeboard: 0.50 feet

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Culvert

Label	Diameter (in)	Discharge (cfs)	Slope (ft/ft)	Depth (ft)	Velocity (ft/s)
Culvert	18	3.03	0.01	0.78	3.27

ATTACHMENT B

Sediment Calculations

STEP-BY-STEP PROCEDURE FOR DETERMINING EROSION

The following step-by-step procedures l lead one through the proper use of appro- ate tables, figures, maps, and graphs in s handbook for determining sheet erosion.

1. Determine as precisely as is practi- le the latitude and longitude of the struction site in question.

nple: A construction site near Park City. From an appropriate map, the location is determined to be 40°38'52"N, 111°30'53"W.

2. Using the location information from enter the appropriate iso-erodent map and ermine the annual R value for the site. nember that these R values for Utah include wmelt as well as rainfall.)

mple: From Salt Lake City iso-erodent (R) values map (in map pocket) the R value is determined to be 13.

3. Estimate as nearly as possible the gth of time the site will be exposed to sive forces.

mple: The site will be exposed for approximately 8 months, beginning in January.

4. With the information from number 3, er Figure 1 and read the percentage of ual R for each month or fraction thereof t the site will be exposed. These individ- percentages are added together to give a centage for the total time period. This al percentage is then multiplied by the ual R value from number 2 to obtain the per value of R to use in the soil loss ation.

mple: From Figure 1, Zone II distribution graph (and Table 1), the cumulative percentage of R for 8 months is 68 percent. (Enter the bottom of the distribution graph at the end of the 8th month [follow dotted line], move vertically until graph is intercepted, then horizontally to the left and read 68 percent on the percentage scale.) Therefore, the proper value of R to use in the equation is

$$0.68 \times 13 = 8.84$$

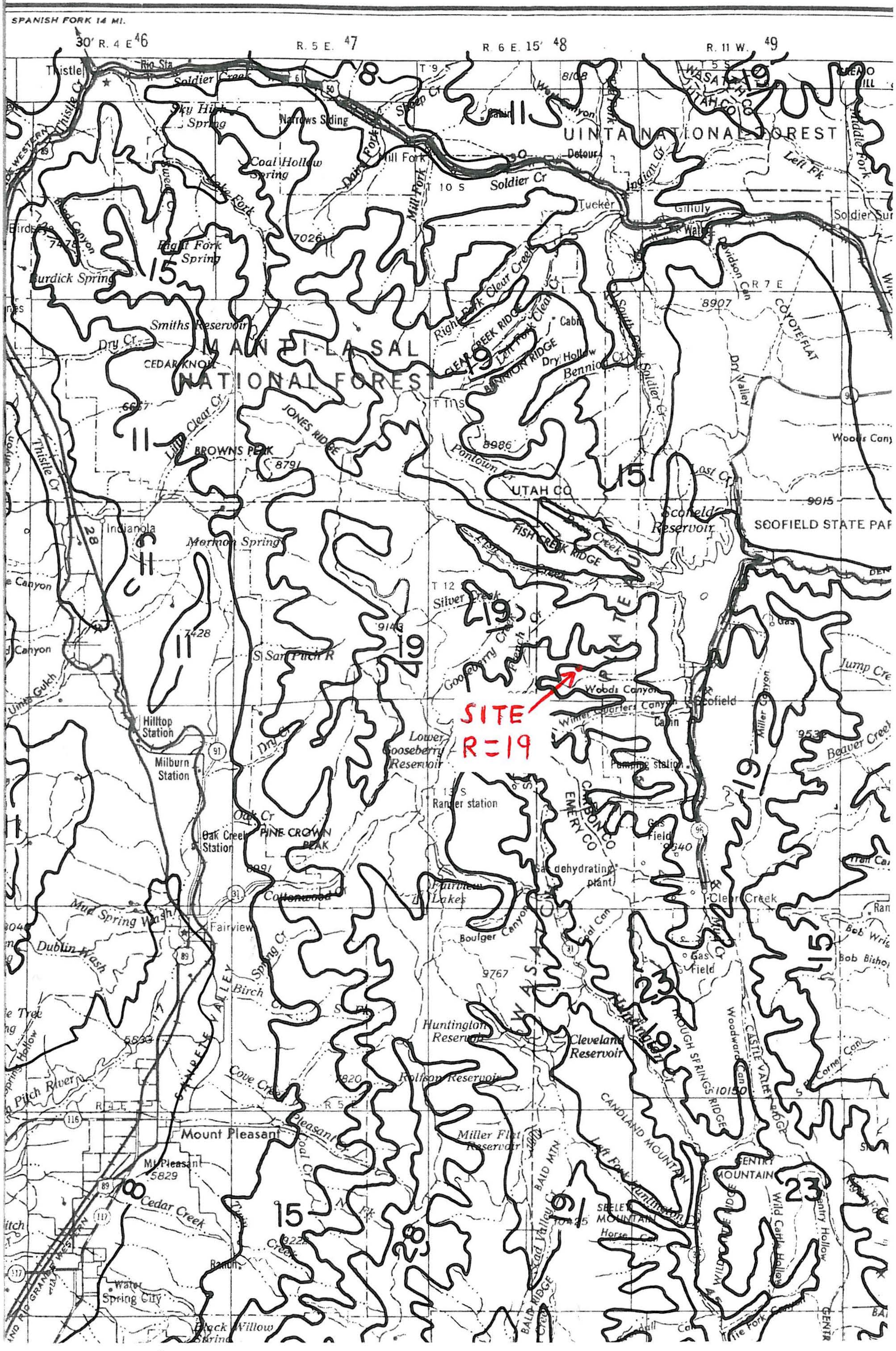
R values shown on the maps are based on a 2-year recurrence interval. Other recurrence intervals will require larger values of R and thus greater protection for exposed areas of construction. For purpose of this example, let us use a recurrence interval of 100 years. Then from Figure 9 we read a ratio of EI/R of about 2.51. (Follow the 100 year recurrence interval line vertically until it intercepts the diagonal, then move horizontally and read the appropriate EI/R value.) The R value to use in the equation then is 2.51 x 8.84 = 22.19.

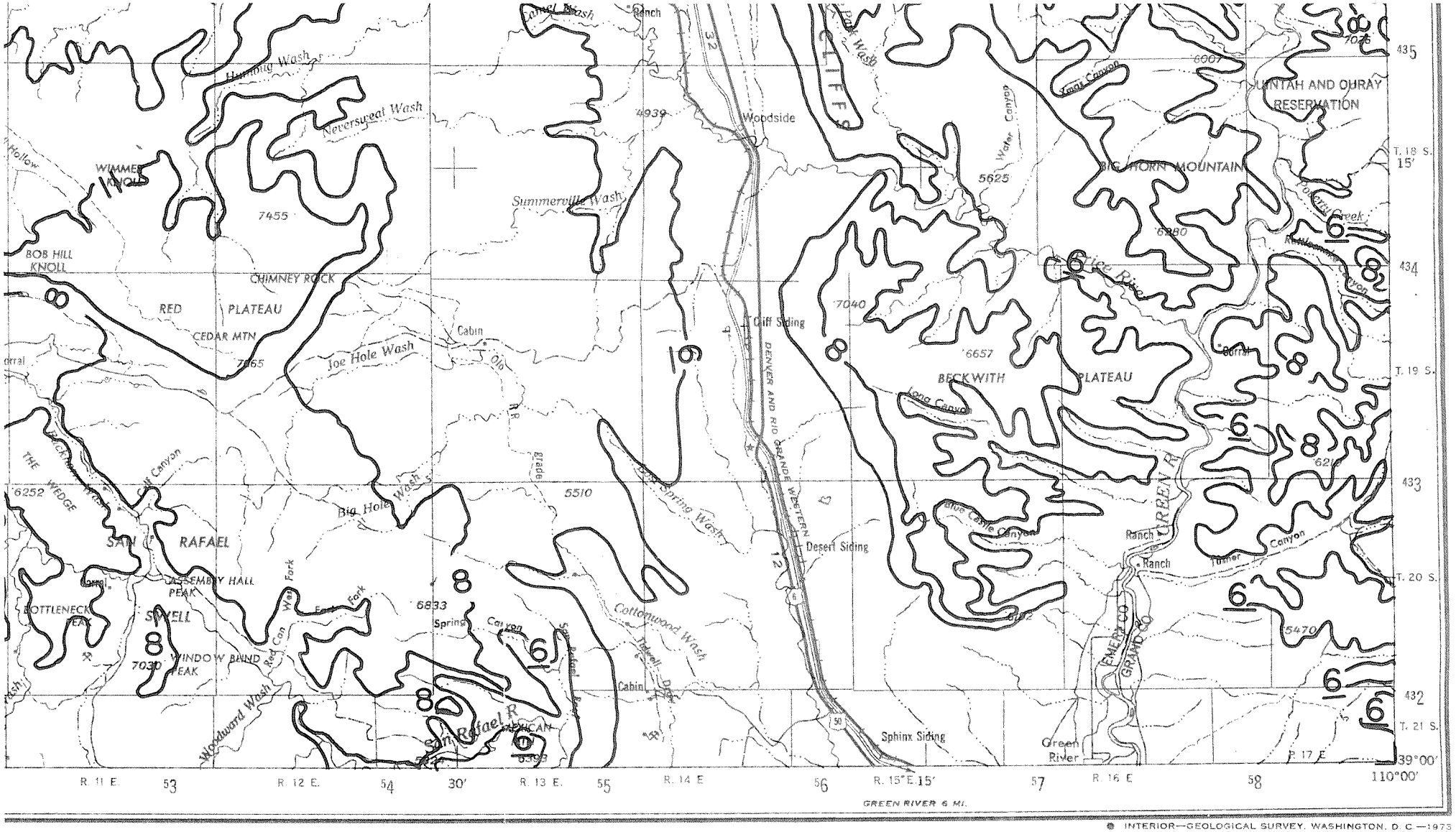
5. With the location information from number 1, enter an appropriate soil survey map and determine the soil erodibility factor K for the site in question. A better way than using a soil survey map is to take appropriate samples at the site and analyze them for particle size, percent organic matter, soil structural class, and relative permeability. With this information, use the nomograph in Figure 2 to determine the K factor.

In the absence of both of these, enter the soil erodibility map in the map pocket and determine the approximate value for K.

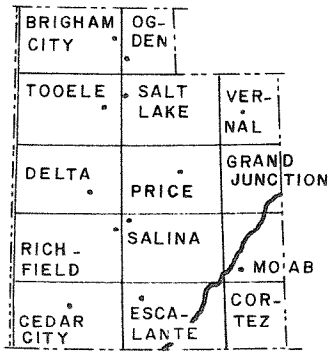
Example: From the colored soil erodibility index map in the map pocket, the K factor is near the boundary between yellow and green (value range 0.21 to 0.40). Soil samples were collected at the site and analyzed. Then using Figure 2 the actual value of K was determined to be 0.31.

6. Determine slope steepness as percent gradient. (For example, 2.5:1 slope equals a gradient of 40 percent.)


SPANISH FORK 14 MI.
R. 4 E.
R. 5 E.
R. 6 E.
R. 11 W.
R 7 E
T 9 S
T 10 S
T 11 S
T 12 S
T 13 S
Thistle
Soldier Creek
Sky High Spring
Narrows Siding
Coal Hollow Spring
Mill Fork
Soldier Cr
Tucker
Detour
Gilluly
UINTA NATIONAL FOREST
WASATCH CO
UTAH CO
Birdseye
Right Fork Spring
Burdick Spring
Smiths Reservoir
MANTI-LA SAL NATIONAL FOREST
CEDAR KNOLL
Dry Cr
JONES RIDGE
BROWNS PEAK
8791
Right Fork Clear Creek
CLEAR CREEK RIDGE
BENNION RIDGE
Dry Hollow
Bennion Cr
Pontown
8986
UTAH CO
Lost Cr
Scofield Reservoir
SCOFIELD STATE PARK
FISH CREEK RIDGE
Indianola
Mormon Spring
Silver Creek
Gooseberry Creek
San Pitch R
Woods Canyon
Winter Quarters Canyon
Scofield
SITE
R=19
Hilltop Station
Milburn Station
Lower Gooseberry Reservoir
Pumping station
Ranger station
CARBON CO
EMERY CO
Gas Field
Oak Cr
Oak Creek Station
PINE CROWN PEAK
Gas dehydrating plant
Cottonwood Cr
Fairview Lakes
Clear Creek
Mud Spring Wash
Fairview
Dublin Wash
Boulger Canyon
9767
Birch Cr
Huntington Reservoir
Cleveland Reservoir
Huntington
ROUGH SPRINGS RIDGE
CASTLE VALLEY RIDGE
Cove Cr
Rolfson Reservoir
CANDLAND MOUNTAIN
Miller Flat Reservoir
Mount Pleasant
Pleasant Cr
BALD MTN
SENTRY MOUNTAIN
Mt Pleasant
5829
Cedar Creek
Left Fork Huntington
SEELEY MOUNTAIN
Wild Cattle Hollow
Water Spring City
BALD RIDGE
Black Willow Spring



LOCATION DIAGRAM



Note:
R values shown are for rain and snowmelt together. R value for snowmelt alone = $R_s = 0.23881\,R + 1.34328$.

MEAN ANNUAL ISO-ERODENT (R) VALUES

Units of R
English R = foot tons/acre/hour
Metric Rm = meter tonnes/hectare/hour
Rm = 1.735 x R

UTAH WATER RESEARCH LABORATORY UTAH STATE UNIVERSITY LOGAN, UTAH 1983

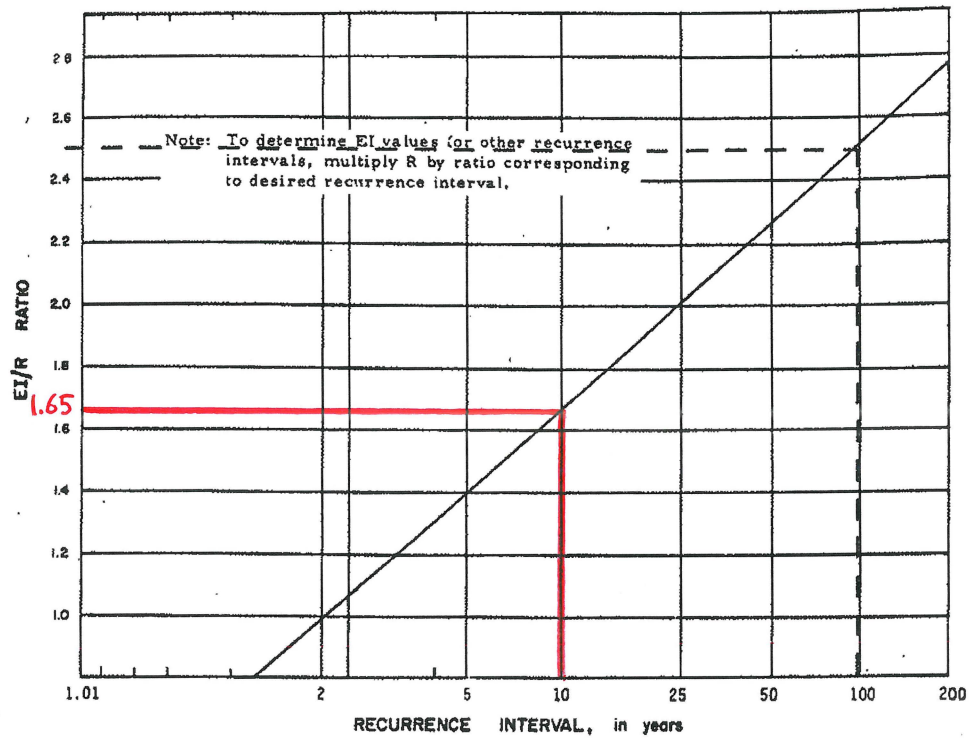


Figure 9. The relationship between the EI/R ratio and recurrence interval.

Example: The slope at the site is 2 to 1 or 50 percent.

7. Determine the slope length in feet.

Example: The measured length of the slope is 350 ft.

8. Using data from numbers 6 and 7 enter Table 2 and determine the topographic factor, LS. (For multiple slopes, follow the procedure detailed in Appendix C.)

Example: The LS value from Table 2 for a 50 percent slope, 350 feet long, is 33.34.

9. The product of values determined in 4, 5, and 8 is the R·K·LS value, or potential erosion.

Example: $A = R \cdot K \cdot LS = 22.19 \times 0.31 \times 33.34$

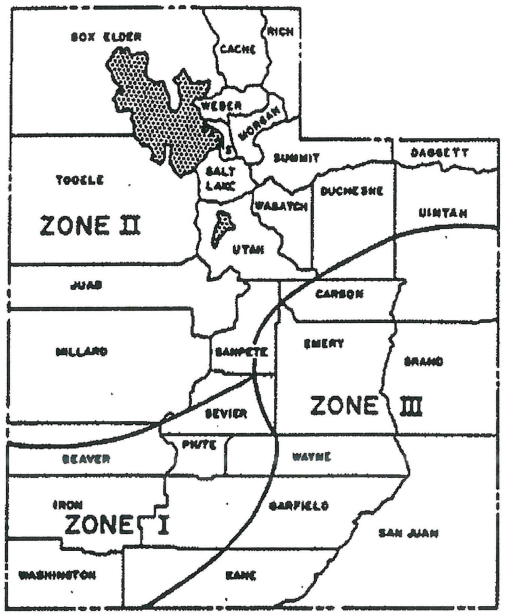
$= 229.34$ t/ac/yr

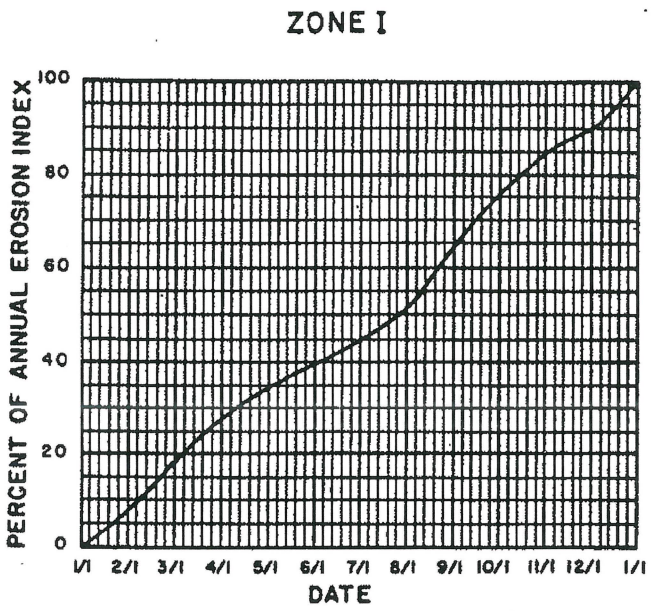
10. The amount of mulch required to reduce the potential erosion to the amount of 1 ton/acre can be determined from Figures 3 through 6. Other control measures are listed in Table 3 together with their approximate VM values. The VM value of any particular control measure, multiplied by the R·K·LS value determined in number 9, will give an indication of the effectiveness of that particular measure in controlling erosion.

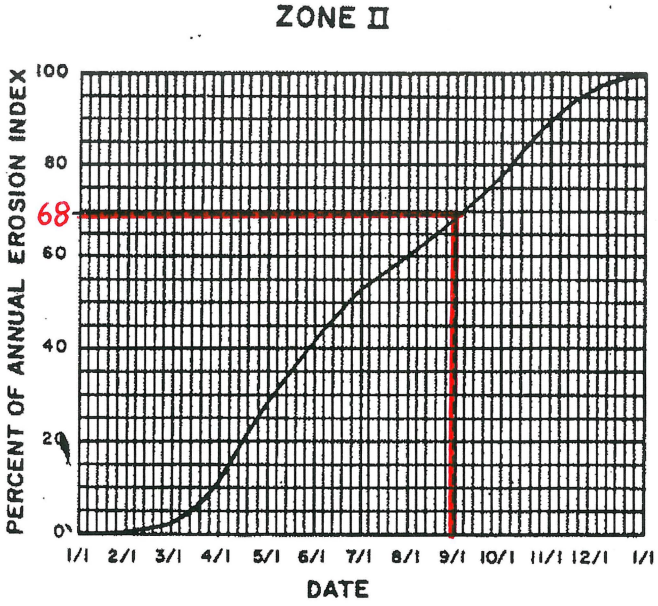
Example: Control measures: One may select from several alternatives, such as the following.

$A = R \cdot K \cdot LS \cdot VM$

If $R \cdot K \cdot LS = 229.34$ and we wish to reduce it to say <10 tons/acre/yr the VM required $= 10/229.34 = 0.04$. Any one of several treatments having







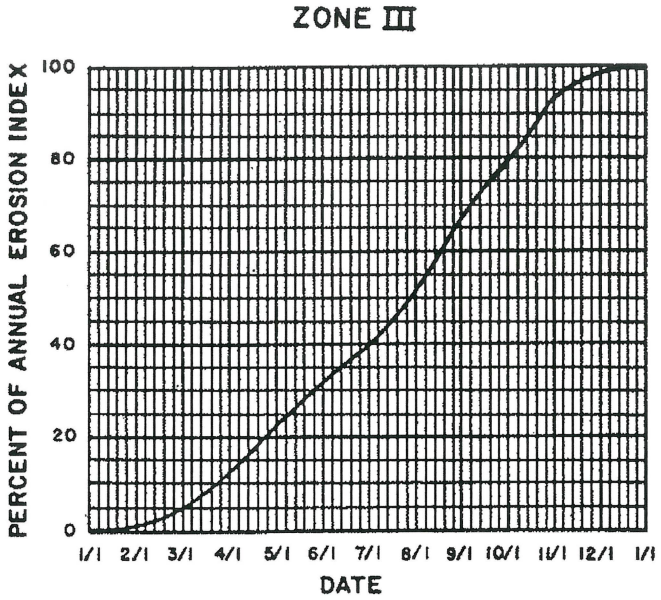


Figure 1. Erosion index distribution curves.

Table 2. LS values.

Slope Ratio	Slope Gradient "S" (%)	Slope Length "L" (ft.) (λ = summation of "L" segments)																						
		10	20	30	40	50	60	70	80	90	100	150	200	250	300	350	400	450	500	600	700	800	900	1000
	0.5	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.15	0.15
100:1	1	0.08	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.12	0.12	0.14	0.14	0.15	0.16	0.16	0.16	0.17	0.17	0.18	0.18	0.19	0.19	0.20
	2	0.10	0.12	0.14	0.15	0.16	0.17	0.18	0.19	0.19	0.20	0.23	0.25	0.26	0.28	0.29	0.30	0.32	0.33	0.34	0.36	0.37	0.39	0.40
	3	0.14	0.18	0.20	0.22	0.23	0.25	0.26	0.27	0.28	0.29	0.32	0.35	0.38	0.40	0.42	0.43	0.45	0.46	0.49	0.51	0.54	0.55	0.57
	4	0.16	0.21	0.25	0.28	0.30	0.33	0.35	0.37	0.38	0.40	0.47	0.53	0.58	0.62	0.66	0.70	0.73	0.76	0.82	0.87	0.92	0.96	1.00
20:1	5	0.17	0.24	0.29	0.34	0.38	0.41	0.45	0.48	0.51	0.53	0.66	0.76	0.85	0.93	1.00	1.07	1.13	1.20	1.31	1.42	1.51	1.60	1.69
	6	0.21	0.30	0.37	0.43	0.48	0.52	0.56	0.60	0.64	0.67	0.82	0.95	1.06	1.16	1.26	1.34	1.43	1.50	1.65	1.78	1.90	2.02	2.13
	7	0.26	0.37	0.45	0.52	0.58	0.64	0.69	0.74	0.78	0.82	1.01	1.17	1.30	1.43	1.54	1.65	1.75	1.84	2.02	2.18	2.33	2.47	2.61
12½:1	8	0.31	0.44	0.54	0.63	0.70	0.77	0.83	0.89	0.94	0.99	1.21	1.40	1.57	1.72	1.85	1.98	2.10	2.22	2.43	2.62	2.80	2.97	3.13
	9	0.37	0.52	0.64	0.74	0.83	0.91	0.98	1.05	1.11	1.17	1.44	1.66	1.85	2.03	2.19	2.35	2.49	2.62	2.87	3.10	3.32	3.52	3.71
10:1	10	0.43	0.61	0.75	0.87	0.97	1.06	1.15	1.22	1.30	1.37	1.68	1.94	2.16	2.37	2.56	2.74	2.90	3.06	3.35	3.62	3.87	4.11	4.33
	11	0.50	0.71	0.86	1.00	1.12	1.22	1.32	1.41	1.50	1.58	1.93	2.23	2.50	2.74	2.95	3.16	3.35	3.53	3.87	4.18	4.47	4.74	4.99
8:1	12.5	0.61	0.86	1.05	1.22	1.36	1.49	1.61	1.72	1.82	1.92	2.35	2.72	3.04	3.33	3.59	3.84	4.08	4.30	4.71	5.08	5.43	5.76	6.08
	15	0.81	1.14	1.40	1.62	1.81	1.98	2.14	2.29	2.43	2.56	3.13	3.62	4.05	4.43	4.79	5.12	5.43	5.72	6.27	6.77	7.24	7.68	8.09
6:1	16.7	0.96	1.36	1.67	1.92	2.15	2.36	2.54	2.72	2.88	3.04	3.72	4.30	4.81	5.27	5.69	6.08	6.45	6.80	7.45	8.04	8.60	9.12	9.62
5:1	20	1.29	1.82	2.23	2.58	2.88	3.16	3.41	3.65	3.87	4.08	5.00	5.77	6.45	7.06	7.63	8.16	8.65	9.12	9.99	10.79	11.54	12.24	12.90
4½:1	22	1.51	2.13	2.61	3.02	3.37	3.69	3.99	4.27	4.53	4.77	5.84	6.75	7.54	8.26	8.92	9.54	10.12	10.67	11.68	12.62	13.49	14.31	15.08
4:1	25	1.86	2.63	3.23	3.73	4.16	4.56	4.93	5.27	5.59	5.89	7.21	8.33	9.31	10.20	11.02	11.78	12.49	13.17	14.43	15.58	16.66	17.67	18.63
	30	2.51	3.56	4.36	5.03	5.62	6.16	6.65	7.11	7.54	7.95	9.74	11.25	12.57	13.77	14.88	15.91	16.87	17.78	19.48	21.04	22.49	23.86	25.15
3:1	33.3	2.98	4.22	5.17	5.96	6.67	7.30	7.89	8.43	8.95	9.43	11.55	13.34	14.91	16.33	17.64	18.86	20.00	21.09	23.10	24.95	26.67	28.29	29.82
	35	3.23	4.57	5.60	6.46	7.23	7.92	8.55	9.14	9.70	10.22	12.52	14.46	16.16	17.70	19.12	20.44	21.68	22.86	25.04	27.04	28.91	30.67	32.32
2½:1	40	4.00	5.66	6.93	8.00	8.95	9.80	10.59	11.32	12.00	12.65	15.50	17.89	20.01	21.91	23.67	25.30	26.84	28.29	30.99	33.48	35.79	37.96	40.01
	45	4.81	6.80	8.33	9.61	10.75	11.77	12.72	13.60	14.42	15.20	18.62	21.50	24.03	26.33	28.44	30.40	32.24	33.99	37.23	40.22	42.99	45.60	48.07
2:1	50	5.64	7.97	9.76	11.27	12.60	13.81	14.91	15.94	16.91	17.82	21.83	25.21	28.18	30.87	33.34	35.65	37.81	39.85	43.66	47.16	50.41	53.47	56.36
	55	6.48	9.16	11.22	12.96	14.48	15.87	17.14	18.32	19.43	20.48	25.09	28.97	32.39	35.48	38.32	40.97	43.45	45.80	50.18	54.20	57.94	61.45	64.78
1⅔:1	57	6.82	9.64	11.80	13.63	15.24	16.69	18.03	19.28	20.45	21.55	26.40	30.48	34.08	37.33	40.32	43.10	45.72	48.19	52.79	57.02	60.96	64.66	68.15
	60	7.32	10.35	12.68	14.64	16.37	17.93	19.37	20.71	21.96	23.15	28.35	32.74	36.60	40.10	43.31	46.30	49.11	51.77	56.71	61.25	65.48	69.45	73.21
1½:1	66.7	8.44	11.93	14.61	16.88	18.87	20.67	22.32	23.87	25.31	26.68	32.68	37.74	42.19	46.22	49.92	53.37	56.60	59.66	65.36	70.60	75.47	80.05	84.38
	70	8.98	12.70	15.55	17.96	20.08	21.99	23.75	25.39	26.93	28.39	34.77	40.15	44.89	49.17	53.11	56.78	60.23	63.48	69.54	75.12	80.30	85.17	89.78
	75	9.78	13.83	16.94	19.56	21.87	23.95	25.87	27.66	29.34	30.92	37.87	43.73	48.89	53.56	57.85	61.85	65.60	69.15	75.75	81.82	87.46	92.77	97.79
1¼:1	80	10.55	14.93	18.28	21.11	23.60	25.85	27.93	29.85	31.66	33.38	40.88	47.20	52.77	57.81	62.44	66.75	70.80	74.63	81.76	88.31	94.41	100.13	105.55
	85	11.30	15.98	19.58	22.61	25.27	27.69	29.90	31.97	33.91	35.74	43.78	50.55	56.51	61.91	66.87	71.48	75.82	79.92	87.55	94.57	101.09	107.23	113.03
	90	12.02	17.00	20.82	24.04	26.88	29.44	31.80	34.00	36.06	38.01	46.55	53.76	60.10	65.84	71.11	76.02	80.63	84.99	93.11	100.57	107.51	114.03	120.20
	95	12.71	17.97	22.01	25.41	28.41	31.12	33.62	35.94	38.12	40.18	49.21	56.82	63.53	69.59	75.17	80.36	85.23	89.84	98.42	106.30	113.64	120.54	127.06
1:1	100	13.36	18.89	23.14	26.72	29.87	32.72	35.34	37.78	40.08	42.24	51.74	59.74	66.79	73.17	79.03	84.49	89.61	94.46	103.48	111.77	119.48	126.73	133.59

Table 3. Typical VM factor values reported in the literature.[a]

Condition	VM Factor
1. Bare soil conditions	
freshly disked to 6-8 inches	1.00
after one rain	0.89
loose to 12 inches smooth	0.90
loose to 12 inches rough	0.80
compacted bulldozer scraped up and down	1.30
same except root raked	1.20
compacted bulldozer scraped across slope	1.20
same except root raked across	0.90
rough irregular tracked all directions	0.90
seed and fertilizer, fresh	0.64
same after six months	0.54
seed, fertilizer, and 12 months chemical	0.38
not tilled algae crusted	0.01
tilled algae crusted	0.02
compacted fill	1.24-1.71
undisturbed except scraped	0.66-1.30
scarified only	0.76-1.31
sawdust 2 inches deep, disked in	0.61
2. Asphalt emulsion on bare soil	
1250 gallons/acre	0.02
1210 gallons/acre	0.01-0.019
605 gallons/acre	0.14-0.57
302 gallons/acre	0.28-0.60
151 gallons/acre	0.65-0.70
3. Dust binder	
605 gallons/ac Fiber Glass Roving	1.05
1210 gallons/acre	0.29-0.78
4. Other Chemicals	
1000 lb. Fiber Glass Roving with 60-150 gallons asphalt emulsion/acre	0.01-0.05
Aquatain	0.68
Aerospray 70, 10 percent cover	0.94
Curasol AE	0.30-0.48
Petroset SB	0.40-0.66
PVA	0.71-0.90
Terra Tack	0.66
Wood fiber slurry,[b] 1000 lb/acre fresh	0.05-0.73
Wood fiber slurry,[b] 1400 lb/acre fresh	0.01-0.36
Wood fiber slurry,[b] 3500 lb/acre fresh	0.009-0.10
Portland Cement and Latex 1000 lbs/ac + 8 gal/ac	0.13
1500 lbs/ac + 12 gal/ac	0.006
5. Seedings	
temporary, 0 to 60 days	0.40
temporary, after 60 days	0.05
permanent, 0 to 60 days	0.04
permanent, 2 to 12 months	0.05
permanent, after 12 months	0.01
6. Brush	0.35
7. Excelsior blanket with plastic net	0.04-0.10
8. Mulch (see Figures 3, 4, 5, 6)	

[a]Note the variation in values of VM factors reported by different researchers for the same measures.

[b]This material is commonly referred to as hydromulch.

the critical exposed area will be reduced. A construction operation scheduled in phases is especially valuable in dealing with long slopes, because stabilizing the upper portion of the slope will protect the lower area.

For each phase of construction, control measures which will serve to protect exposed areas and adjacent property, such as sediment traps, basins or ponds, and diversion ditches, should be installed before clearing and grading begin. Structures such as these do not decrease erosion but serve to catch the sediment after it has left the source area. Design drawings for such structures are readily available from local offices of the Soil Conservation Service and from other sources and are not included in this handbook. Even though much research remains to be done in order to determine the true efficiencies and optimum designs of sediment basins and traps, existing designs may be used effectively to prevent sediment from leaving rights-of-way and entering streams, lakes, or adjacent properties. The amount of sediment captured in such structures can be measured or calculated and subtracted from the total soil loss, determined by the equation, to estimate actual loss. Where areas are to be left for long periods of time, temporary measures such as vegetation, berms, down drains, and mulch covers should be installed to protect and stabilize the exposed soil surface, and then permanent control measures should be implemented as soon as is practical.

Much can be done to minimize erosion and sedimentation if problems are anticipated and provided for before development begins, and if control measures are implemented in a timely manner.

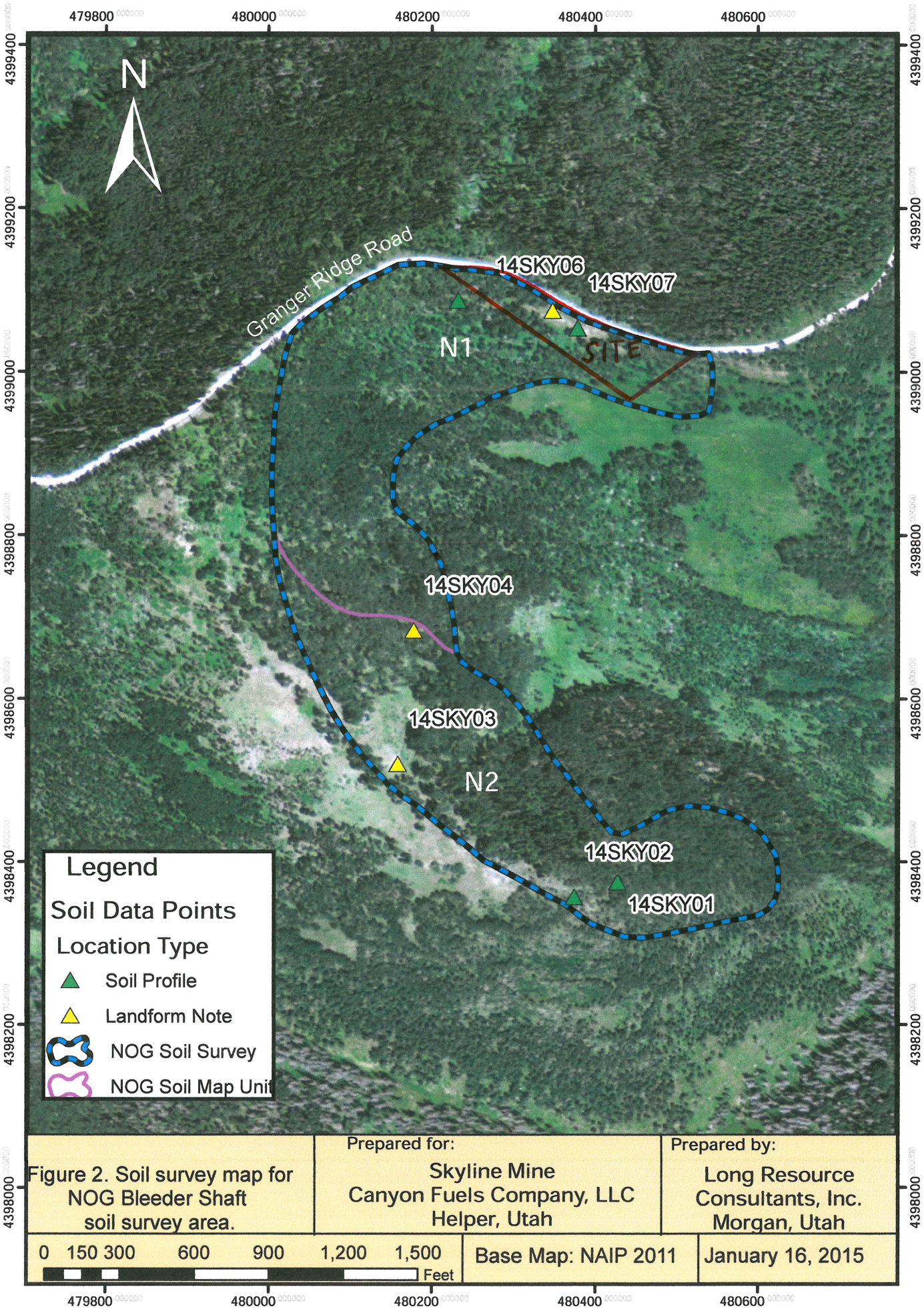


Figure 2. Soil survey map for NOG Bleeder Shaft soil survey area.

Prepared for:
Skyline Mine
Canyon Fuels Company, LLC
Helper, Utah

Prepared by:
Long Resource Consultants, Inc.
Morgan, Utah

Base Map: NAIP 2011

January 16, 2015

Inter-Mountain Labs, Inc
1673 Terra Ave, Sheridan, Wyoming, 82801
(307) 672-8945

Soil Analysis Report
Canyon Fuel Company, LLC.
HC 35 Box 380
Helper, Utah 84526

Project ID: Skyline Mine Topsoil
Date Received: 10/1/2014

Report ID: S1410053001
Date Reported: 10/30/2014
Work Order: S1410053

Lab ID	Sample ID	Organic Matter %	Sand %	Silt %	Clay %	Very Fine Sand %	Texture	K-factor (t.ac.h/100acft.tf.in)	Structure s	Permeability p	M
S1410053-001	14SKY01(0-15cm)	9.1	53.0	39.0	8.0	22.7	Sandy Loam	0.09	2	2	5676.4
S1410053-002	14SKY01(15-38cm)	6.4	47.0	44.0	9.0	14.2	Loam	0.21	2	3	5296.2
S1410053-003	14SKY01(38-58cm)	4.4	47.0	44.0	9.0	19.2	Loam	0.31	2	3	5751.2
S1410053-004	14SKY02(0-29cm)	10.1	59.0	33.0	8.0	3.3	Sandy Loam	0.02	2	2	3339.6
S1410053-005	14SKY05(0-14cm)	7.1	58.0	31.0	11.0	6.8	Sandy Loam	0.08	2	2	3364.2
S1410053-006	14SKY05(14-36cm)	5.3	58.0	30.0	12.0	15.0	Sandy Loam	0.15	2	2	3960.0
S1410053-007	14SKY05(36-58cm)	5.0	58.0	30.0	12.0	11.5	Sandy Loam	0.14	2	2	3652.0
S1410053-008	14SKY07(0-11cm)	7.9	62.0	32.0	6.0	8.0	Sandy Loam	0.08	2	2	3760.0
S1410053-009	14SKY07(11-28cm)	3.2	62.0	30.0	8.0	19.6	Sandy Loam	0.25	2	2	4563.2
S1410053-010	14SKY07(28-48cm)	4.0	62.0	31.0	7.0	14.2	Sandy Loam	0.20	2	2	4203.6
S1410053-011	14SKY08(0-9cm)	6.3	44.0	41.0	15.0	6.4	Loam	0.15	2	3	4029.0
S1410053-012	14SKY08(9-36cm)	3.7	34.0	51.0	15.0	18.1	Silty Loam	0.35	2	3	5873.5
S1410053-013	14SKY09(0-13cm)	8.2	58.0	33.0	9.0	12.2	Sandy Loam	0.08	2	2	4113.2
S1410053-014	14SKY09(13-30cm)	4.2	56.0	33.0	11.0	16.4	Sandy Loam	0.21	2	2	4396.6
S1410053-015	14SKY10(4-15cm)	4.7	58.0	35.0	7.0	20.4	Sandy Loam	0.24	2	2	5152.2
S1410053-016	14SKY10(15-34cm)	6.0	54.0	39.0	7.0	19.8	Sandy Loam	0.20	2	2	5468.4
S1410053-017	14SKY10(34-56cm)	4.5	62.0	32.0	6.0	25.5	Sandy Loam	0.26	2	2	5405.0
S1410053-018	14SKY10(56-80cm)	35.0	82.0	14.0	4.0	12.7	Loamy Sand	-0.40	2	2	2563.2
S1410053-019	14SKY10(80-130cm)	1.6	90.0	10.0	0.1	7.6	Sand	0.03	1	1	1758.2
S1410053-020	14SKY10(130-160cm)	1.0	92.0	8.0	0.1	9.2	Sand	0.03	1	1	1718.3
S1410053-021	14SKY12(0-20cm)	8.0	46.0	39.0	15.0	17.5	Loam	0.13	2	3	4802.5
S1410053-022	14SKY12(20-50cm)	4.6	46.0	37.0	17.0	18.5	Loam	0.23	2	3	4606.5
S1410053-023	14SKY12(50-84cm)	2.9	48.0	36.0	16.0	18.7	Loam	0.29	2	3	4594.8
S1410053-024	14SKY13(18-36cm)	1.9	74.0	23.0	3.0	13.5	Loamy Sand	0.21	2	2	3540.5
S1410053-025	14SKY13(36-55cm)	1.1	75.0	22.0	3.0	12.5	Loamy Sand	0.21	2	2	3346.5
S1410053-026	14SKY14(0-23cm)	2.9	64.0	28.0	8.0	21.3	Sandy Loam	0.26	2	2	4535.6
S1410053-027	14SKY14(23-51cm)	1.6	66.0	28.0	6.0	18.1	Sandy Loam	0.28	2	2	4333.4

These Results apply only to the samples tested.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

PROJECT NOG Bleeder PAGE 1 OF 1
COMPUTED TAJ DATE 2/24/2015
CHECKED RBW DATE 3/2/2015

$A = R \times K \times LS \times VM$

R = 19 × 0.68 (8 months, Figure 7) × 1.65 (10-year, Figure 9) = 21.3
K = 0.08 (0-11cm) K = 0.24 (11-28cm) K = 0.20 (28-48cm)

R from Israelsen et. Al, Figure 7 and 9.
K from Inter Mountain Labs Soil Analysis Report in Long Resource Report.
LS from Israelsen et. Al, Table 2, Combined L and S values.
VM from Israelsen et. Al, Table 3.

UW-1 (only 25% reports to pad)
L = 200 ft S = 0.35 LS = 14.46 K = 0.08 (Top 11cm) VM = 0.35 (Brush)
A = 21.3 × 0.08 × 14.46 × 0.35 = 8.6 ton/ac-yr

Sediment Load = 8.6 ton/ac-yr (15,958 sf / 43,560 sf/ac)(1 CY / 1.4 ton/CY) = 2.3 CY/yr

DW-1
L = 50 ft S = 0.50 LS = 12.60 K = (11cm × 0.08 + 17cm × 0.24 + 20cm × 0.20 / 11cm + 17cm + 20cm) = 0.19
VM = 0.38 (Seeded after 12 months)
A = 21.3 × 0.19 × 12.60 × 0.38 = 19.4 ton/ac-yr

Sediment Load = 19.4 ton/ac-yr (8,579 sf / 43,560 sf/ac)(1 CY / 1.4 ton/CY) = 2.7 CY/yr

DW-5
L = 100 ft S = 0.50 LS = 17.82 K = 0.20 (Bottom 20 cm)
VM = (85% × 0.38 (Seeded after 12 months) + 15% × 1.48 (Compacted fill))
VM = 0.55
A = 21.3 × 0.20 × 17.82 × 0.55 = 41.8 ton/ac-yr

Sediment Load = 41.8 ton/ac-yr (16,418 sf / 43,560 sf/ac)(1 CY / 1.4 ton/CY) = 11.3 CY/yr

Order 2 Soil Survey

of the

North of Graben (NOG) Bleeder Shaft Area

at the

Skyline Mine

Located West of Scofield, Utah

Prepared for

Canyon Fuels Company

by

Long Resource Consultants, Inc.
Morgan, Utah

January 16, 2015

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A Soil Profile Descriptions
B Soil Profile Location Photographs
C Soil Profile Box Photographs
D Laboratory Analysis

Section One

Purpose of Soil Survey

The purpose of this report is to summarize the results of an Order 2 soil inventory conducted for Canyon Fuels Company at a proposed bleeder shaft location near the Skyline mine in Carbon County, Utah.

The soil survey area is approximately 3.8 miles west northwest of Scofield, Utah. This soil survey was prepared so that the Skyline mine could: 1) identify suitable sources of topsoil and subsoil; 2) determine potential depths and quantities of topsoil and subsoil; 3) identify potential impacts of construction activities on the soil resource; and 4) develop a reclamation plan for the proposed construction area.

"Canyon Fuel Company, LLC, plans to construct a ventilation facility adjacent to the Granger Ridge road located approximately four (4) miles north-northwest of the primary mine site. The site is necessary to provide exhaust ventilation to complete mining in the Skyline North of Graben district (NOG). The site will include a 5-foot diameter vertical shaft, exhaust fan, and a diesel-powered emergency generator to be used during start-up of the fan. The disturbance for the pad includes a short access road, a 50-foot by 80-foot pad, and a topsoil pile. The footprint of the disturbance will be approximately 1.5 acres, with a permitted area of approximately 4.2 acres (Galecki 2015)."

Project Area

The NOG Bleeder Shaft soil survey area is near the north end of the Wasatch Plateau west of Scofield, Utah on Granger Ridge near the top of Woods Canyon. The NOG soil survey is accessed by driving approximately 6.8 miles north along the Granger Ridge road from the SR 264 highway summit, Figure 1. The soil survey area is located in portions of Sections 26, 34, and 35 in Township 12 South, Range 6 East, Salt Lake base meridian (Utah AGRC 2014b). The soil survey area is on the Scofield, Utah 7.5 minute USGS quadrangle (Utah AGRC 2014c). Elevation ranges from approximately 9,000 feet (2,744 meters) to nearly 9,300 feet (2,836 meters) on the mountain sideslope (Utah AGRC 2014c).

Because there were multiple proposed locations and the precise location of the NOG Bleeder Shaft was still under consideration during the time the soil survey field work was conducted, a much larger area was evaluated and sampled. The final pad and access road location will be within the soil survey area.

The NOG Bleeder Shaft soil survey area encompasses three proposed project areas:

- NOG Bleeder Shaft construction pad;
- *Access Road* from Granger Ridge Road to NOG Bleeder Shaft construction pad; and
- *Topsoil Stockpile(s)* adjacent to the access road and construction pad.

The soil survey area encompasses approximately 51 acres.

Vegetation

Composition of the subalpine ecological communities are directly related to aspect. North slopes are dominated by Englemann spruce, subalpine fir, Douglas fir, and quaking aspen. South slopes are dominated by quaking aspen, mountain big sagebrush, grasses, and high mountain shrubs. The aspen ecological type is dominant in the soil survey area.

Climate

An official U.S. Weather Bureau station is located near the Skyline Mine, Table 1. The Skyline mine surface facilities are approximately 4 miles south southeast of the soil survey area at 8,710 foot elevation. The weather station name is Scofield - Skyland Mine, Utah. The period of available records is July 1, 1984 through February 28, 2013 (WRCC 2014). The moisture regime is ustic and udic, characterized by deep winter snowfall and summer thunderstorms. Soil temperature regime is cryic, characterized by very cold winters and moderate summers (USDA Manti 2014 and USDA NRCS 2014a).

Table 1. Summary of weather data for the Scofield - Skyland Mine, Utah weather station.

	Ave Max Temp (F)	Ave Min Temp (F)	Ave Total Precip (in)	Ave. Total Snowfall (in)	Ave Total Snow Depth (in)
January	32.9	11.2	2.84	44.8	18
February	33.3	12.0	2.85	44.8	19
March	39.7	17.7	2.49	32.5	10
April	46.9	23.8	2.57	23.8	3
May	56.5	31.0	1.82	7.2	0
June	68.1	38.8	1.13	0.5	0
July	75.9	46.3	1.44	0.0	0
August	73.9	44.8	1.53	0.0	0
September	65.0	37.0	1.79	0.6	0
October	52.7	28.0	2.23	10.0	1
November	39.3	17.8	2.46	31.6	4
December	32.2	10.6	2.63	40.9	12
Annual	51.4	26.6	25.78	236.6	6

Source: Western Regional Climate Center, November 2014.
Period of Record: July 1, 1984 to February 28, 2013.

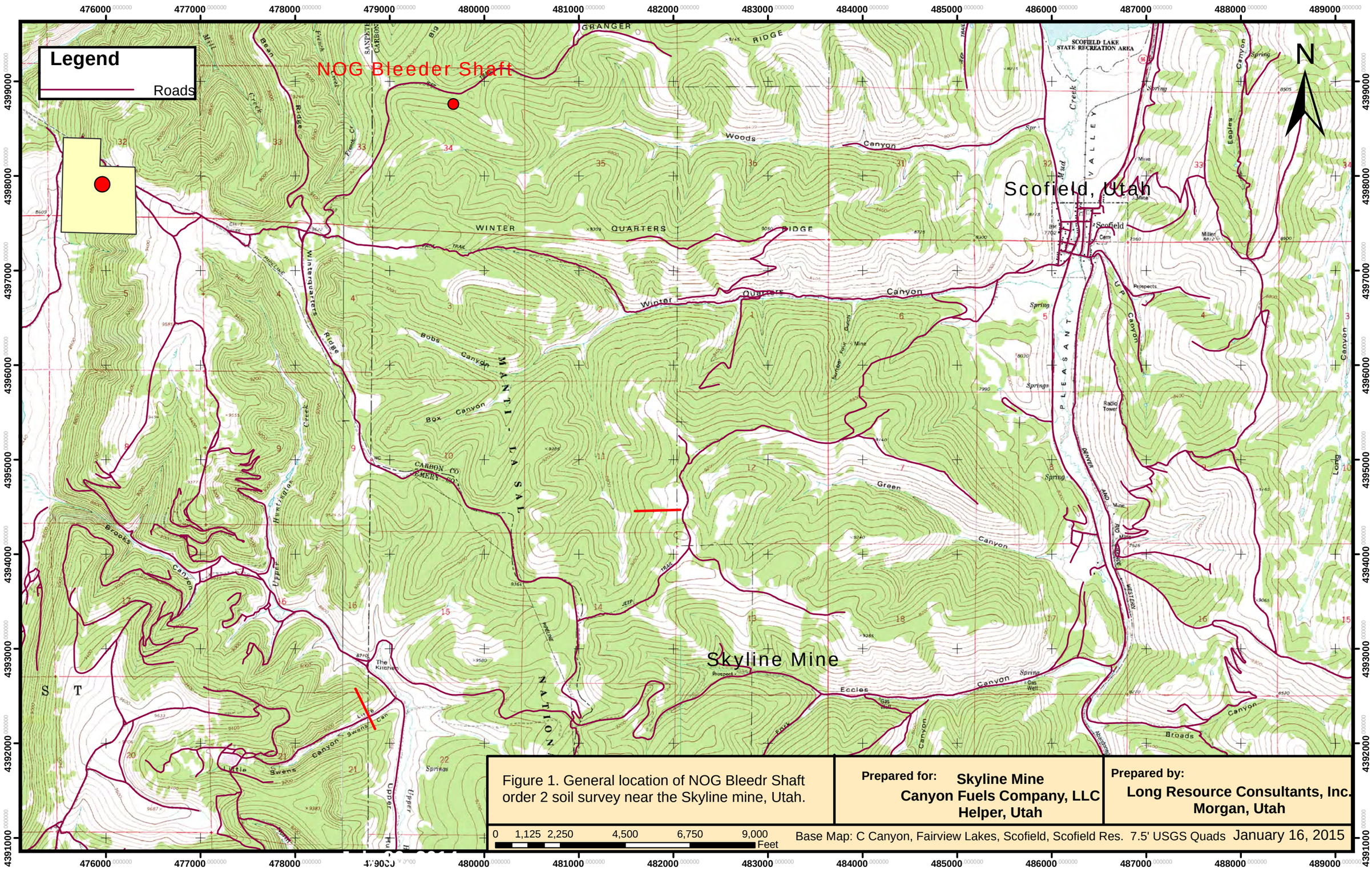

Figure 1. General location of NOG Bleedr Shaft order 2 soil survey near the Skyline mine, Utah.

Prepared for: **Skyline Mine**
Canyon Fuels Company, LLC
Helper, Utah

Prepared by:
Long Resource Consultants, Inc.
Morgan, Utah

Base Map: C Canyon, Fairview Lakes, Scofield, Scofield Res. 7.5' USGS Quads January 16, 2015

Geology

The Castlegate Formation (Kc) is the dominate geologic formation in the NOG Bleeder Shaft soil survey area (Knowles 1996). It is a member of the Upper Cretaceous Group. Castlegate Formation sandstone beds "...are chiefly gray differing from the underlying Blackhawk sandstone (Kbh) which are commonly some shade of brown (Weiss 1990)."

How this Soil Survey was Made

This soil survey was made in accordance with the guidelines for an order 2 soil survey as detailed in the *Soil Survey Manual* (USDA NRCS 1993) and *National Soil Survey Handbook* (USDA NRCS 2014b). Soils were classified using the *Keys to Soil Taxonomy, Twelfth Edition* (USDA NRCS 2014c). Haplocryolls are the dominant taxonomic Great Group.

Evaluation of Soils

Soils were examined, described, and sampled in hand dug pits (4). Miscellaneous landform notes (3) were also recorded. Soil profile descriptions and samples were collected on September 18, 2014. The soil survey map, Figure 2, details the locations of the soil profiles and miscellaneous notes that were examined, sampled, and analyzed within the NOG Bleeder Shaft soil survey area.

Soil Profile Descriptions

Soil profile descriptions were completed for each soil sample and miscellaneous landform location. Soil colors (Munsell 2012) were evaluated in the office under natural lighting using the profile box samples collected at each location. Soil *Pedon Description Forms* (USDA NRCS 1997) were completed for each soil pit using the methods detailed in the *Field Book for Describing and Sampling Soils*, version 3.0 (Schoeneberger et. al., 2012). All soil descriptions were completed by Robert E. Long, Certified Professional Soil Scientist and entered into a Pedon PC database (Soil Survey Staff 2012). Soil profile descriptions are in Appendix A. Photographs of the soil profile locations are in Appendix B.

The geomorphic setting for each soil profile location was determined based on the *Geomorphic Description System* (USDA NRCS 2008).

Soil sample locations are coded by the year that the sample was collected (2014). For example, soil sample location 14SKY05 was the fifth soil description location (08) collected at the Skyline mine (SKY) in 2014 (14).

Soil samples of each horizon were collected in new gallon size plastic freezer bags and in micromonolith profile boxes. The sealed sample bags were shipped to Inter Mountain Laboratory in Sheridan, Wyoming for analysis. Box samples were used for further examination

of soil profile characteristics and retained as a record of each soil profile. Photos of the soil profile boxes are in Appendix C.

Soil Profile Locations

The location of each soil sample location was determined with a hand-held GPS (Garmin GPSMAp 60st™) in the UTM NAD83 coordinate system. The X and Y coordinates for each soil profile location are listed as part of the profile description in Appendix A.

Digital Mapping

The soil survey map, Figure2, was produced using ARCMap software (version 10.2.1). Digital natural color aerial photography (NAIP 2011), USGS topographic maps, Public Land Survey Sections (PLSS), and a Utah transportation layer were downloaded from the Utah Automated Geographic Reference Center (Utah AGRC 2014a-d).

Analysis of Soil Samples

Soil samples (10) from 4 representative soil profiles collected from within or immediately adjacent to the NOG Bleeder Shaft soil survey area were sampled by soil horizon and submitted for chemical and physical analysis. Results of the laboratory analysis of soil samples are in Appendix D.

Soil samples were analyzed for parameters outlined by Utah Division of Oil Gas and Mining's (DOGM) *Guidelines for Management of Topsoil and Overburden* (DOGM 2008), Table 2.

Table 2. Soil analysis parameters for topsoil and overburden (Utah DOGM, 2008).

Parameter	Unit
Paste pH	s.u.
Saturation percent	%
Electrical Conductivity (ECe)	dS/m
Organic Matter Percent	%
Soluble Na, Mg, and Ca	meq/l
Sodium Adsorption Ratio	
Particle Size Analysis (report very fine sand, sand, silt, and clay)	%
CaCO3 Percent	%
Total Organic Carbon	%

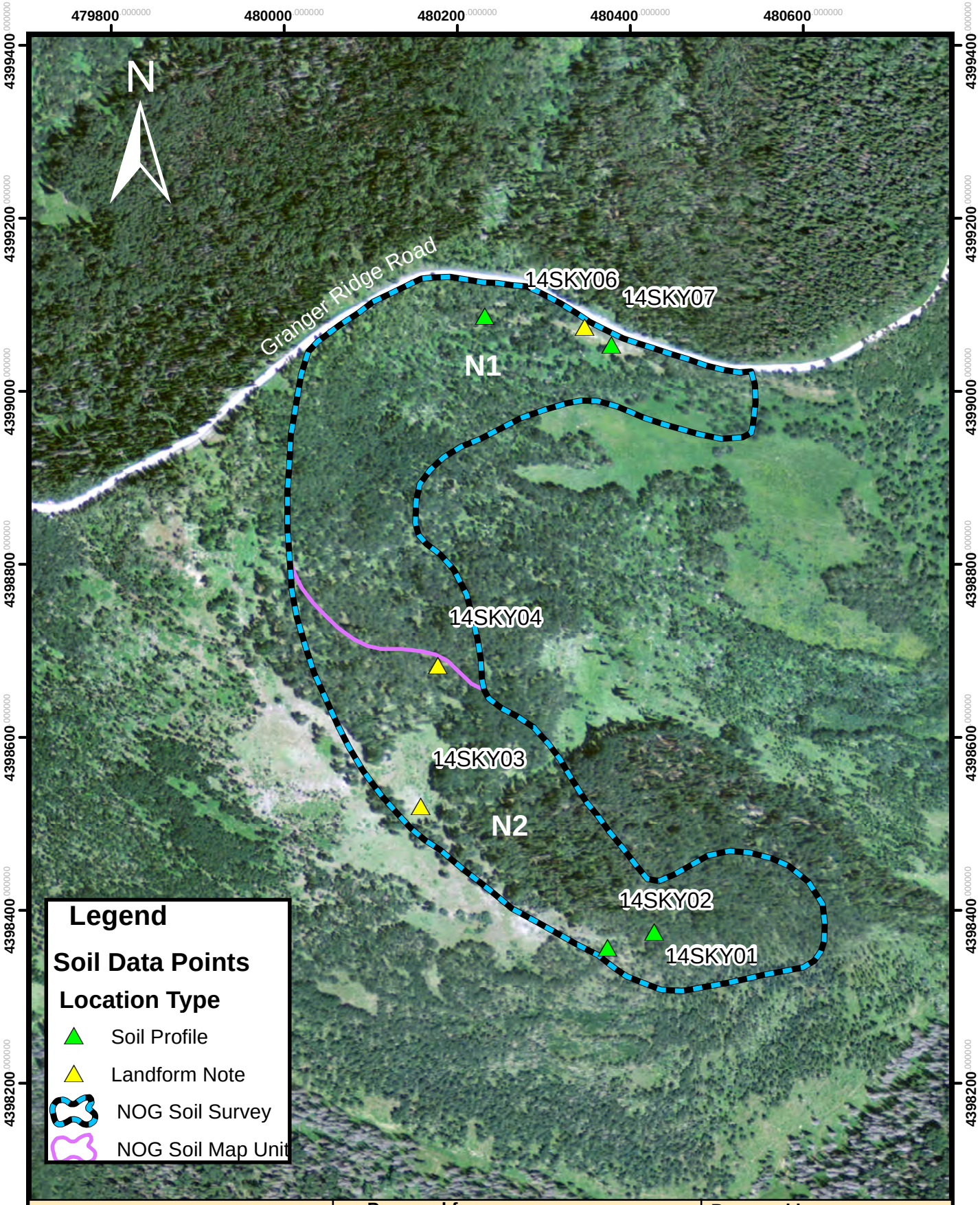

Figure 2. Soil survey map for NOG Bleeder Shaft soil survey area.

Prepared for:
Skyline Mine
Canyon Fuels Company, LLC
Helper, Utah

Prepared by:
Long Resource Consultants, Inc.
Morgan, Utah

0 150 300 600 900 1,200 1,500 Feet

Base Map: NAIP 2011

January 16, 2015

Existing Soil Survey

The NOG Bleeder Shaft soil survey is in an area previously mapped as part of the Manti-LaSal National Forest soil survey (UT645).

Manti LaSal National Forest

An order 3 soil survey has been conducted in the Manti LaSal National Forest (MLNF). Figure 3 shows the relationship of the MNLF soil map units to the NOG Bleeder Shaft soil survey. Table 3 lists the MNLF order 3 soil map units that occur within or adjacent to the NOG Bleeder Shaft soil survey (USDA - Manti 2014). Table 4 lists the taxonomic classification of each soil family as listed in the data files received from the Manti LaSal National Forest (USDA - Manti 2014).

Soils mapped by the MLNF are characterized by dark surfaces (mollic and pachic epipedons) and accumulations of illuvial clay (argillic horizons) in some soil families. The amount of soils that are shallow to bedrock (lithic contact) is of limited extent in the MLNF soil map units. The dominant physiographic setting of the MLNF map units is mountain sideslopes which is similar to the NOG Bleeder Shaft. The soil temperature regime of all the MLNF soil map unit components is cryic.

Table 3. Manti LaSal National Forest order 3 soil survey map units within the NOG Bleeder Shaft soil survey .

Map Unit[1]	Soil Map Unit[1]	Vegetation[1]	NOG Survey Acres[2]
560	Lucky Star - Skylick families, 30-60% slopes	Aspen	51.0
713	Lucky Star - Adel families, 30-60% slopes	Aspen	0.0
820	Lucky Star - Bundo - Adel families, 30-60%	Spruce, fir, aspen	0.0

1. Manti LaSal National Forest soil survey map unit symbol (USDA - Manti 2014).
2. Area calculated as plane acres within NOG soil survey area using ARCMap software (v10.2.1).

Table 4. Taxonomic classification of soil families mapped in the Manti LaSal National Forest order 3 soil survey within the NOG Bleeder Shaft soil survey.

Soil Family	Taxonomic Classification[1]
Adel	Pachic Haplocryolls fine-loamy, mixed, superactive
Bundo	Ustic Palecryalfs loamy-skeletal, mixed, superactive
Lucky Star	Typic Palecryolls loamy-skeletal, mixed, superactive
Skylick	Pachic Palecryolls fine-loamy, mixed, superactive

1. The edition of *Keys to Soil Taxonomy* was not specified in the data received from the MLNF.

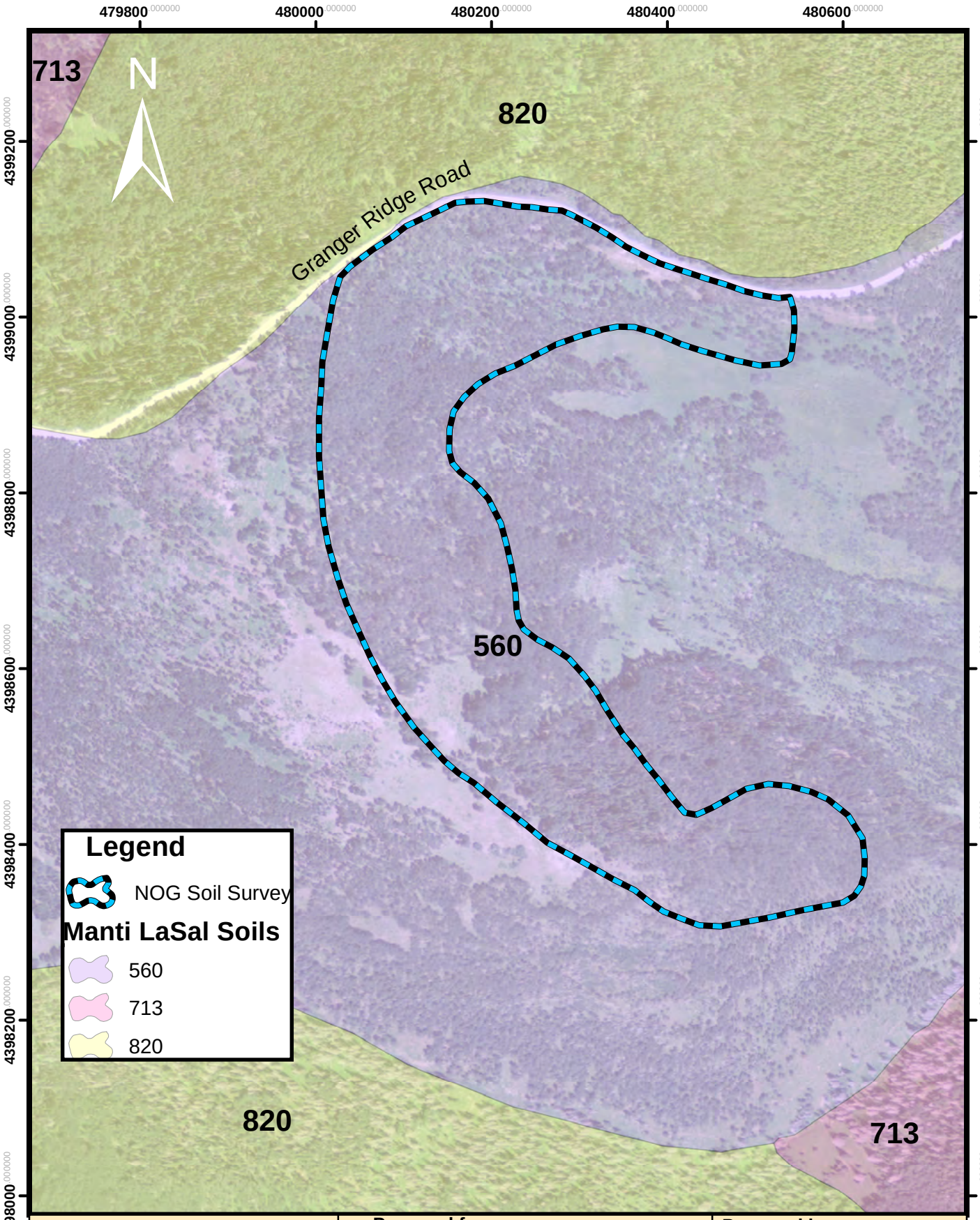

Figure 3. Manti LaSal NF soil suvey map units.

Prepared for:
Skyline Mine
Canyon Fuels Company, LLC
Helper, Utah

Prepared by:
Long Resource Consultants, Inc.
Morgan, Utah

0 150 300 600 900 1,200 1,500 Feet

Base Map: NAIP 2011

January 16, 2015

Section Two

Soil Characteristics

Soils in the NOG Bleeder Shaft soil survey area are characterized by depth to sandstone bedrock, coarse soil texture, dark soil surface color (mollic or pachic), and absence of a zone of illuvial clay accumulation (no argillic horizon). The location of each soil profile described in the NOG Bleeder Shaft soil survey is shown in Figure 2.

Cambic horizon

Soils in the NOG Bleeder Shaft soil survey area have strong cambic horizons. This indicates that some soil development has taken place. However, none of the soil profiles showed any indications of illuvial clay accumulation and there was not enough clay increase between horizons to meet the requirements for an argillic horizon based on the laboratory analysis.

Depth to Bedrock

Sandstone bedrock (lithic contact) influences the soil depth in the soil profiles in the survey area. The depth to fractured sandstone bedrock was less than 50 cm (20 inches) from the mineral soil surface in profiles 14SKY02 and 14SKY07. Fractured sandstone that may be bedrock (lithic contact) was observed at 58 cm (23 inches) in profiles 14SKY01 and 14SKY05. Field observations at 14SKY01 and 14SKY05 did not definitively identify a lithic contact, but did indicate that it may be relatively close to the 58 cm (23 inches) hole depth.

Soil pH

The soil pH ranges from 6.2 to 7.0 in the soil profiles described and sampled in the NOG Bleeder Shaft soil survey area. Soils with a pH of 6.5 to 8.2 are considered *Good* (DOGM 2008). Soils with pH from 6.0 to 6.4 are considered to be *Fair* (DOGM 2008). Although the soil pH is *Fair* in some soil profiles, based on the *Guidelines for Management of Topsoil and Overburden* (DOGM 2008), they are native soils that are supporting good grass, shrub, and tree communities.

Soil Texture

Soil textures in the NOG Bleeder Shaft soil survey area included loam and sandy loam. The percent clay ranged from 6 to 12 percent. The taxonomic particle size classes are coarse-loamy and loamy-skeletal (coarse-loamy range). Three of the four soil profiles were skeletal with greater than 35 percent rock fragments in the control section.

Soil Families

Soils in the NOG Bleeder Shaft soil survey area were classified to the taxonomic family using the *Keys to Soil Taxonomy, Twelfth Edition* (USDA NRCS 2014c). Three distinct soil families were identified in the soil survey area. The priority for soil family name selection was based on the following criteria:

1. Soil family name was previously used by either the Manti LaSal National Forest as part of the previous order 3 mapping completed in and adjacent to the NOG Bleeder Shaft soil survey area.
2. Soil family name was previously used by the NRCS on another soil survey in Utah.
3. Soil family name was previously mapped by the NRCS in a state adjacent to Utah.
4. Soil family name is from an established soil series (USDA 2015).

The soil profiles described in the NOG Bleeder Shaft soil survey are listed in Table 5.

Table 5. Taxonomic classification of soil profiles described and sampled in the NOG Bleeder Shaft soil survey area.

Profile	Family	Taxonomic Classification
14SKY01	Hobacker	Pachic Haplocryolls loamy-skeletal, mixed, superactive
14SKY02	McCadden	Lithic Haplocryolls loamy-skeletal, mixed, superactive
14SKY03	Rock Outcrop	
14SKY04	Bench	
14SKY05	Hailman	Pachic Haplocryolls coarse-loamy, mixed, superactive
14SKY06	Rock Outcrop	
14SKY07	McCadden	Lithic Haplocryolls loamy-skeletal, mixed, superactive

Potential suitability of soils (Good, Fair, or Poor) in these soil family descriptions are based on the *Guidelines for Management of Topsoil and Overburden* (DOGM 2008).

Hailman Family

Pachic Haplocryolls coarse-loamy, mixed, superactive

Representative soil profile: 14SKY05

Hailman family soils occur on concave and linear sloping to very steep mountain sideslopes. They have thick dark surfaces (pachic) and are coarse textured with less than 18 percent clay in the control section. Hailman family soils have a *Good* Available Water Capacity (AWC). These soils may have sandstone bedrock within 100 cm (40 inches) of the soil surface.

The Hailman family soils are a *Fair* source of reclamation material due to the pH of 6.4 throughout the representative soil profile. While the soil pH rates the typifying profile for Hailman family soils as *Fair,* there is a well established quaking aspen and grass community growing at the location.

Native vegetation is quaking aspen, grasses, and forbs.

The Hailman soil series was established in Wasatch County, Utah. Hailman family soils were a dominant soil in the Powerline Corridor soil survey area (Long 2014).

Hobacker Family

Pachic Haplocryolls loamy-skeletal, mixed, superactive

Representative soil profile: 14SKY01

Hobacker family soils occur on very steep convex linear mountain sideslopes. They have thick dark surfaces (pachic), are coarse textured with less than 18 percent clay and greater than 35 percent rock fragments in the control section. Hobacker family soils have *Fair* Available Water Capacity (AWC).

Native vegetation is mountain quaking aspen with scattered dead subalpine fir.

The Hobacker family soils are a *Fair* source of reclamation material to 51 cm (20 inches) based on pH (6.3 to 6.6) in the representative soil profile and the saturation percent (55.4 to 66.6).

The Hobacker soil series was established in Lincoln County, Wyoming.

McCadden Family

Lithic Haplocryolls loamy-skeletal, mixed, superactive

Representative soil profile: 14SKY07

McCadden family soils are shallow to sandstone bedrock (less than 20 inches) and occur on mountain ridges and shoulders. They have dark surfaces (mollic) and are coarse textured with less than 18 percent clay and greater than 35 percent rock fragments in the control section. McCadden family soils have *Good* to *Fair* Available Water Capacity.

Native vegetation is dominated by quaking aspen and grasses.

McCadden family soils are a *Fair* to *Good* source of reclamation material limited by pH and saturation percent. Soil pH ranges from 6.2 to 7.0. Saturation percent ranges from 44.1 to 72.0 percent. They are also limited by the shallow depth to sandstone bedrock.

The McCadden soil series was established in Utah County, Utah. McCadden family soils were a dominant soil in the Powerline Corridor soil survey area (Long 2014).

Section Three

Soils Legend

Soils in the NOG Bleeder Shaft survey area were described with two soil map units, Table 6.

Table 6. Soil map unit composition.

Map Unit	Pct	Family	Taxonomic	Typifying Profile	Vegetation
	%				
N1	Hailman - McCadden families complex, 20 to 70 percent slopes				
	70	Hailman	Pachic Haplocryolls coarse-loamy, mix, super	14SKY05	Aspen grass
	15	McCadden	Lithic Haplocryolls loamy-skeletal, mix, super	14SKY07	Aspen grass
	10	Hobacker	Lithic Haplocryolls loamy, mixed, superactive		Aspen grass
	5		Sandstone Outcrops	14SKY06	
N2	Hobacker - McCadden families complex, 15 to 80 percent slopes				
	70	Hobacker	Lithic Haplocryolls loamy, mixed, superactive	14SKY01	Aspen Conifer
	15	McCadden	Lithic Haplocryolls loamy-skeletal, mix, super	14SKY02	Aspen grass
	10	Hailman	Pachic Haplocryolls coarse-loamy, mix, super		Aspen grass
	5		Sandstone Outcrops	14SKY03	

Map Unit Descriptions

Potential suitability of soils (Good, Fair, or Poor) in these map unit descriptions are based on the *Guidelines for Management of Topsoil and Overburden* (DOGM 2008).

N1 Hailman - McCadden families complex, 20 to 70 percent slopes

The N1 soil map unit is located on steep to very steep south and east facing mountain sideslopes in Woods Canyon. This map unit is dominated by soils that are moderately deep and shallow to fractured sandstone. Map unit N1 comprises 26.7 of the NOG soil survey area.

The map unit consists of 70 percent Hailman family soils on mountain sideslopes and 15 percent McCadden family soils on mountain shoulders. Soil profile 14SKY05 is representative of Hailman family soils in map unit N1. Soil profile 14SKY07 is representative of McCadden family soils in map unit N1. Also included in this map unit are 10 percent Hobacker family soils on convex mountain sideslopes, 5 percent sandstone outcrop and other similar soils.

Native vegetation consists of quaking aspen and grasses with scattered subalpine fir.

This soil map unit is limited by steep to very steep slopes and depth to sandstone. These soils are a *Good* to *Fair* source of topsoil and subsoil for reclamation that are limited by soil pH, saturation percent, and depth to sandstone.

N2 Hobacker - McCadden families complex, 20 to 65 percent slopes

The N2 soil map unit is located on steep to very steep south and east facing mountain sideslopes in Woods Canyon. This map unit is dominated by soils that are moderately deep and shallow to fractured sandstone. Map unit N2 comprises 24.3 of the NOG soil survey area.

The map unit consists of 70 percent Hobacker family soils on convex mountain sideslopes and 15 percent McCadden family soils on mountain ridges and shoulders. Soil profile 14SKY01 is representative of Hobacker family soils in map unit N2. Soil profile 14SKY02 is representative of McCadden family soils in map unit N2. Also included in this map unit are 10 percent Hailman family soils, 5 percent sandstone outcrop and other similar soils.

Native vegetation consists of quaking aspen and grasses with scattered subalpine fir.

This soil map unit is limited by steep to very steep slopes and depth to sandstone. These soils are a *Good* to *Fair* source of topsoil and subsoil for reclamation that are limited by soil pH, saturation percent, available water capacity, and depth to sandstone.

Section Four

Topsoil and Subsoil Salvage

Areas within the NOG Bleeder Shaft soil survey that will require salvage and stockpiling of topsoil and subsoil include the *Construction Pad* and the *Access Road*.

Soil Limiting Features

Low Available Water Capacity

The coarse soil textures in the NOG Bleeder Shaft soil survey area results in *Fair* Available Water Capacity (AWC) in 40 percent of the soil horizons. AWC values were estimated using the *Soil Water Characteristics* model (Saxton 2009). This model adjusts the AWC for texture, organic matter, rock fragments and salinity. The estimated AWC values are listed in Table D-2 in Appendix D.

Table 7 lists the estimated AWC suitability for each soil profile based on criteria set forth in the *Guidelines for Management of Topsoil and Overburden* (DOGM 2008). Table 8 lists the AWC suitability by soil map unit.

Table 7. Suitability of topsoil and subsoil suitability for soil profiles.

Soil Profile	Soil Family	Topsoil AWC Suitability[1]	Subsoil AWC Suitability[1]
14SKY01	Hobacker	Good	Fair
14SKY02	McCadden	Fair	---- [2]
14SKY03	Sandstone Outcrop		
14SKY04	Bench		
14SKY05	Hailman	Good	Good
14SKY06	Sandstone Outcrop		
14SKY07	McCadden	Fair	---- [2]

1. Suitability based on criteria set forth in *Guidelines for Management of Topsoil and Overburden* (DOGM 2008).
2. Subsoil included in topsoil rating for these shallow soils.

Table 8. Suitability of topsoil and subsoil AWC by soil map units, based on the dominate soil type in each map unit.

Soil Profile	Topsoil AWC Suitability[1]	Subsoil AWC Suitability[1]
N1	Good	Good
N2	Good	Fair

1. Suitability based on criteria set forth in *Guidelines for Management of Topsoil and Overburden* (DOGM 2008).
2. Subsoil included in topsoil rating for these shallow soils.
NA Not Applicable

Shallow Soils

Shallow soils are a limiting soil feature in soil map units N1 and N2 which have major components that are shallow (McCadden family). The estimated average topsoil salvage depth for each of these map units is 14 inches or greater. Use of substitute soil is not anticipated to be necessary for either soil map unit.

Topsoil and Subsoil Salvage Depths

Topsoil and subsoil salvage should be expected to vary within the soil map units. Salvage operations should be monitored to avoid mixing of topsoil and subsoil. Table 9 lists the estimated average topsoil and subsoil salvage depths for each soil map unit. Actual salvage depths should be expected to vary in the field and should be monitored during construction.

Topsoil and subsoil stockpiles should be protected from wind and water erosion.

Table 9. Estimated average topsoil and subsoil salvage depths based on weighted averages.

Map Unit	Map Unit Name	Estimated Average Topsoil Salvage Depth[1]	Estimated Average Subsoil Salvage Depth[1]	Estimated Average Total Salvage Depth[1]
		inches	inches	inches
N1	Hailman - McCadden families complex, 20-70% slopes	19	2[2]	21
N2	Hobacker - McCadden families complex, 15-80% slopes	14	6	20

1. Estimated salvage depths are based on weighted averages that take into account the contribution of each soil map unit component based on its percent occurrence in the map unit.
2. Subsoil salvage depths less than 6 inches should be salvaged with the topsoil.

Replacement of Topsoil and Subsoil

Topsoil and subsoil should be replaced in the reverse order of how they were removed. Subsoil replaced first followed by replacement of the topsoil. Reduction of soil compaction in either or both the topsoil and subsoil may be required prior to seeding.

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