CANYON FUEL COMPANY, LLC.
SKYLINE MINE
C/007/005

WINTER QUARTERS VENTILATION FACILITY

JANUARY 2010

1 of 2

0003 **APPLICATION FOR COAL PERMIT PROCESSING** #3463

COPY

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

Permittee: Canyon Fuel Company, LLC

Mine: Skyline Mine **Permit Number:** C/007/005

Title: Winter Quarters Ventilation Facility

Description, Include reason for application and timing required to implement:

Information submitted to acquire approval to construction ventilation pad beginning in Summer 2010.

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

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

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

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

Wesley K Sorensen — Print Name

Wesley K Sorensen, General Manager 1/7/10 — Sign Name, Position, Date

Subscribed and sworn to before me this 7th day of Jan, 2010

Kathleen Atwood — Notary Public

My commission Expires: 11-12, 2011

Attest: State of Utah } ss:
County of Carbon

KATHLEEN ATWOOD
NOTARY PUBLIC-STATE OF UTAH
100 NORTH 200 WEST #13
HUNTINGTON, UT 84528
COMM. EXP. 11-12-2011

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining
File in: ☐ Confidential ☒ Shelf ☐ Expandable Refer to Record No 0003 Date 01072010 In C/0070005 2010 Incoming & Confidential For additional information		RECEIVED JAN 11 2010 DIV. OF 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

COPY

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine **Permit Number:** C/007/005
Title: Winter Quarters Ventilation Facility (1 of 2)

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

Add	Replace	Remove	DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Section 1; pages 1-30, 1-34, 1-37, 1-38, 1-39.
☐ Add	☒ Replace	☐ Remove	Section 2.1; pages 2-4c1, 2-4d
☐ Add	☒ Replace	☐ Remove	Section 2.2; pages 2-21(a), 2-21(b)
☐ Add	☒ Replace	☐ Remove	Section 2.3; pages 2-30 (j), 2-30(j1), 2-35c, 2-36, 2-36a, 2-36b, 2-38
☐ Add	☒ Replace	☐ Remove	Section 2.4; page 2-44a
☐ Add	☒ Replace	☐ Remove	Section 2.5; page 2-51g
☐ Add	☒ Replace	☐ Remove	Section 2.7; page 2-63
☐ Add	☒ Replace	☐ Remove	Section 2.8; pages 2-67, 2-68
☐ Add	☒ Replace	☐ Remove	Section 2.9; pages 2-104(j), add 2-104 (j1)
☐ Add	☒ Replace	☐ Remove	Section 2.10; page 2-111(b)
☐ Add	☒ Replace	☐ Remove	Section 2.11; page 2-120(c)
☐ Add	☒ Replace	☐ Remove	Section 2.12; pages 2-125, 2-127, 2-128
☐ Add	☒ Replace	☐ Remove	Section 2.14; page 2-161
☐ Add	☒ Replace	☐ Remove	Section 3.2; REPLACE pages 3-15, 3-23, 3-23(a), 3-31, 3-72(b); ADD pages 3-31(a), 3-31(b), 3-63(i), 3-63(j), 3-72(c)
☐ Add	☒ Replace	☐ Remove	Section 3.4; page 3-83
☐ Add	☒ Replace	☐ Remove	Section 4.1; page 4-3(a)
☐ Add	☒ Replace	☐ Remove	Section 4.3; Bond Summary, Demolition summary, Earth summary, Revegetation costs
☒ Add	☐ Replace	☐ Remove	Section 4.3; WQ Demolition, WQ Earth, WQ Revegetation
☐ Add	☒ Replace	☐ Remove	Section 4.4; pages 4-28, 4-29(a), 4-30
☐ Add	☒ Replace	☐ Remove	Section 4.6; pages 4-34(a), 4-35, 4-38(c), 4-38(d), 4-41(e)
☐ Add	☒ Replace	☐ Remove	Section 4.7; pages 4-50(a), ADD 4-58(a), ADD 4-58(b), ADD 4-58(c)
☐ Add	☒ Replace	☐ Remove	Section 4.9; page 4-62(a), ADD Fig. 4.9-B, ADD Fig. 4.9-C, ADD Fig. 4.9-D
☐ Add	☒ Replace	☐ Remove	Section 4.11; pages 4-68, 4-69, 4-71, 4-72
☐ Add	☒ Replace	☐ Remove	Section 4.12; pages 4-75, 4-78(a), 4-81
☐ Add	☒ Replace	☐ Remove	Section 4.13; pages 4-82, 4-82(a), 4-83
☐ Add	☒ Replace	☐ Remove	Section 4.14; page 4-84
☐ Add	☒ Replace	☐ Remove	Section 4.16; page 4-90
☐ Add	☒ Replace	☐ Remove	Section 4.18; page 4-103(b)

Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	Received by Oil, Gas & Mining
Five (5) redline-strikout copies of the submittal. Four copies to the Salt Lake Office, and one (1) copy to the Price Field Office.	RECEIVED JAN 11 2010 DIV. OF OIL, GAS & MINING

Form DOGM - C2 (Revised March 12, 2002)

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

COPY

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine **Permit Number:** C/007/005
Title: Winter Quarters Ventilation Facility (2 of 2)

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

Add	Replace	Remove	DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Section 4.19; page 4-110,
☒ Add	☐ Replace	☐ Remove	Section 4.20; 4-114(a)
☐ Add	☒ Replace	☐ Remove	Plates 1.6-1, 1.6-2, 1.6-3, 2.2.1-1, 2.2.7-1, 2.2.7-2, 2.2.7-3, 2.2.7-4, 2.2.7-7, 2.3.4-2, 2.3.5.1-1, 2.3.5.2-1, 2.3.6-1, 2.3.6-2, 2.7.1-1a, 2.7.1-1b, 2.8.1-1, 2.12.1-1, 3.1.8-2, 3.3-2, 4.17.3-1A, 4.17.5-1
☒ Add	☐ Replace	☐ Remove	Plates 3.2.4-3A through 3.2.4-3G, 4.4.2-3A through 4.4.2-3B
☒ Add	☐ Replace	☐ Remove	Appendix A-1, Vol.2; Clements Geophyisical report - Seismic Refraction
☒ Add	☐ Replace	☐ Remove	Appendix A-2, Vol.2; NRCS Production Estimates
☒ Add	☐ Replace	☐ Remove	Appendix A-2, Vol.2; Canyon Environmental, Soil Survey
☒ Add	☐ Replace	☐ Remove	Appenix A-2, Vol. 2; Vegetation Sampling and Sensitive Species at the Ventilation Shaft Site (revised) - Mt. Nebo Scientific
☒ Add	☐ Replace	☐ Remove	Appendix A-3, Vol.2; Wildlife Studies Summary 2006-2008, Tetra Tech
☒ Add	☐ Replace	☐ Remove	Appendix A-3, Vol.2; Winter Quarters Wildlife survey, 2009, Western Land Services, Inc.
☒ Add	☐ Replace	☐ Remove	Engineering Calculations Vol.5, Vol. 2 - Section 24; Winter Quarters Ventilation Shaft Pad Runoff and Sediment Control Design Report - EarthFax Engineering, Inc.
☒ Add	☐ Replace	☐ Remove	CONFIDENTIAL FILE; Drill log 08-1-5
☒ Add	☐ Replace	☐ Remove	CONFIDENTIAL FILE; A Cultural Resource Inventory of the Proposed Winter Quarters Ventilation Facility, In Winter Quarters Canyon, Skyline Mine, Carbon County, Utah (Located in CONFIDENTIAL INCOMING FILE 2009)
☒ Add	☐ Replace	☐ Remove	CONFIDENTIAL FILE; Cultural Resource Addendum Report of the Proposed Ventilation Facility in Winter Quarters Canyon, Skyline Mine, Carbon County, Utah - Canyon Environmental
☐ Add	☐ Replace	☐ Remove	
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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
Five (5) redline-strikout copies of the submittal. Four copies to the Salt Lake Office and one (1) copy delivered to the Price Field Office.	RECEIVED JAN 11 2010 DIV. OF OIL, GAS & MINING

114 Right-of-Entry Information

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

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

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

Private Lease	Issued to	Date of Issuance
UP&L Tract	Canyon Fuel Company, LLC	2/1/99
C&B Energy	Canyon Fuel Company, LLC	8/1/02

The legal descriptions of the above listed coal leases are:

Federal Coal Lease Serial #Utah-020305

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

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

(2) On August 3, 1978, Energy Fuels Corporation conveyed its exclusive and perpetual easement to Coastal States Energy Company (and now Canyon Fuel Company, LLC) for the purpose of constructing and maintaining a temporary coal storage and loading facility. The easement had been initially granted by Leon J. Nicolaides, et al., to Kanawha and Hocking Coal and Coke Company, Energy Fuels Corporation's predecessor in title.

(3) A Lease Agreement dated June 10, 1982 between Fotini Telonis, et al, and the Permittee grants the Permittee the right to use a 27.83 acre parcel located near Scofield, Utah, as a waste rock disposal site. The lease was amended both in August 2006 and March 2007 to increase the parcel to approximately 37.48 acres. See Appendix A in Section 3.2 for lease.

(4) A Quitclaim Deed dated May 24, 1991, from Kanawha and Hocking Coal and Coke Company to Coastal States Energy Company (and now Canyon Fuel Company, LLC) which deed conveyed to Coastal 42.57 acres of surface lands located in the Sl/2SEl/4 of Section 17, T.13S., R.7E., SLB&M.

(5) A deed dated ????, 2010, from the Allred Family Trust to Ark Land Company, conveys approximately 12.7 acres of surface lands to Ark Land Company, located in the N1/2 of Section 1, T.13S., R.6E., SLB&M,. Ark Land Company in turn will conduct an inter-company perpetual and exclusive lease with Canyon Fuel Company, LLC. - Skyline Mine. The parcel is located in Winter Quarters Canyon approximately two (2) miles west of Scofield, Utah, as the Winter Quarters Ventilation Facility (WQVF).

Power Line Addition

A parcel of land in Section 25 and 36, Township 13 South, Range 6 East, Salt Lake Base & Meridian, Carbon and Emery Counties.

Commencing at the Section Corners of 25, 25, 35, and 36, Township 13 South, Range 6 East, Salt Lake Base & Meridian, thence East along the North boundary of Section 36 for a distance of 500 feet, more or less, thence S20° 00' 00" W for a distance of 1,000 feet, more or less, herein called the point of beginning of the tract; thence N84° 20' 19" E a distance of 44.21 feet; thence N89° 08' 31" E a

Vertical Extent 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 79.12 acres.

The following information was based on projection for the next five years (1997-2002).

	Mine No. 1	Mine No. 2	Mine No. 3
Extent of Horizontal Workings	240 acres	375 acres	1,870 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 and Well pads	0.26
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
TOTAL	~~80.70~~117.07

Legal Description of Permit Area

Township 12 South, Range 7 East, SLBM

Section 32: Portion

Township 13 South, Range 6 East, SLBM

Section 1: Portion
Section 13: Portion
Section 23: Portion
Section 24: Portion
Section 25: Portion
Section 35: Portion
Section 36: Portion

Township 13 South, Range 7 East, SLBM

Section 4: Portion
Section 5: Portion
Section 17: Portion
Section 18: Portion
Section 19: Portion

Township 14 South, Range 6 East, SLBM

Section 2: Portion
Section 3: Portion

Legal Description of Adjacent Area

Township 12 South, Range 6 East, SLBM

Section 25:	Portion
Section 26:	Portion
Section 27:	Portion
Section 33:	Portion
Section 34:	All
Section 35:	All
Section 36:	Portion

Township 12 South, Range 7 East, SLBM

Section 31:	Portion

Township 13 South, Range 6 East, SLBM

Section 1:	All
Section 2:	All
Section 3:	All
Section 4:	Portion
Section 9:	Portion
Section 10:	All
Section 11:	All
Section 12:	Portion
Section 13:	Portion
Section 14:	All
Section 15:	All
Section 16:	Portion
Section 21:	Portion
Section 22:	All
Section 23:	All
Section 24:	Portion
Section 25:	Portion
Section 26:	All
Section 27:	All
Section 28:	Portion
Section 33:	Portion
Section 34:	All
Section 35:	Portion
Section 36:	Portion

Township 14 South, Range 6 East, SLBM

Section 2:	Portion
Section 3:	Portion
Section 4:	Portion
Section 10:	Portion
Section 11:	Portion

Total acres within the ADJACENT AREA: 14,738

The acreage of 14,738 acres is an AutoCad ® generated number from drawing number 1.6-1.

Winter Quarters Ventilation Facility (WQVF)

In 2010 permitting for construction of a ventilation facility in Winter Quarters Canyon was initiated. An area approximately 7.93 acres in size was permitted to construct a pad. The site is located approximately ½-mile west of the main historic Winter Quarters town site. Skyline Mine has 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.

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.

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. 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.

2.2.11 Plans for Casing and Sealing Holes

All exploration drill holes not completed as ground water monitoring wells will be plugged and abandoned using procedures specified by the BLM or the Division. Typically, exploration holes are backfilled with cement to a point at least thirty feet above the uppermost mineable coal seam. A bentonite grout is then placed on top of the cement to within 100 feet of the surface. Surface casings will be removed to at least two feet below ground surface if possible. The remainder of the hole is filled to the surface with a neat cement grout. Occasionally, the governing agency may request a survey monument be placed in the cement cap.

If the exploration hole is to be completed as a monitoring well, it will be constructed by a State licensed driller and in accordance with the requirements set forth by the State Engineer's Office for monitoring well completions. Typical well construction will be as follows. Well screen with appropriately sized apertures and steel casing will be installed in the drill hole to below the lowest mineable coal zone in water-bearing strata. The screened zone will be sand packed and sealed from overlying strata with at least 2 feet of bentonite and the overlying hole annulus will be cemented to the surface. Well casing with a locking lid will be left at the surface extending above the surface approx. 2 ft. The wellhead will be properly identified with either a brass marker or a welded-on identification.

Once a ground water monitoring well is no longer in use, it will be completely plugged with a cement or cement/bentonite slurry to the to ground surface. The wellhead and casing will be removed to at least two feet below ground surface when possible. The surface will be reclaimed to approximate original contour.

In 2009, two (2) drill holes were developed to transfer rock dust from the surface to the underground workings. Each 3.5-inch hole (3-inch I.D) is approximately 255 feet in length, and completed with steel casing. At reclamation, the abandonment procedure outlined for exploration holes (at beginning of this section).

2.2.12 Winter Quarters Ventilation Facility

The Winter Quarters Ventilation Facility will be constructed to provide adequate ventilation for mining 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 fitted with a minimum 6-inch thick cement cap, encased in an approximately 5-foot thick cement collar, vented with a minimum 2-inch diameter pipe extending a minimum of 15-feet above the cap and backfilled to the surface. 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.

groundwater in the boring and the depth to groundwater measured in well W13-2 suggests that the alluvial fill aquifer and the bedrock aquifer are separate and distinct in this area.

As illustrated by both cross-sections B-B' and C-C', the conveyor system is generally located well above the groundwater surface in Eccles Canyon. The only locations where the conveyor system approaches the groundwater surface are near its terminus at the coal loadout facility and near monitored spring S17-2. As with the coal loadout facility, the conveyor system is an above-ground structure and should not effect groundwater within the canyon floor. The only spring potentially effected by the conveyor system is in the current monitoring program, no additional groundwater monitoring is proposed.

2.3.4.4 Winter Quarters Ventilation Facility (WQVF)

Groundwater will be monitored in the vicinity of the Winter Quarters Ventilation Facility (WQFV) by one (1) deep groundwater well (08-1-5)completed below the coal seam.

No springs are located in the immediate vicinity of the WQVF site, and no subsidence is anticipated in the area that could impact the groundwater resources in the area of the Ventilation Facility.

A Seismic Refraction survey was conducted over the WQVF area to help determine the depth to bedrock (report located in Appendix A-1, Volume 2). The survey suggests weathered bedrock is approximately 10 feet below the existing ground surface in the vicinity of the decline slope. In addition, exploration hole 08-1-2, indicated a depth to competent bedrock at approximately 47 feet below the surface. No appreciable water was encountered in this hole. The decline slope will be driven bearing away from the creek at a negative 16-18 degree slope. Similarly, the proposed vertical shaft(s) is sited to be located approximately 70-feet north of the existing stream channel, encountering weathered bedrock approximately 10 feet below the surface at the approximate elevation of the stream. No problems with surface water or near surface groundwater are anticipated.

2.3.5 Uses of Water in the Aquifers

2.3.5.1 Surface Water Rights

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

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

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

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

Surface-water will be monitored in the vicinity of the Winter Quarters Ventilation Facility (WQFV) by two (2) stream sites located both up- and downstream of the site, CS-20 and CS-24, respectively. Groundwater Well 08-1-5 isscreened from 297-317 feet below the surface and will monitor the water elevation below the coal seam. Spring WQ1-1 monitors near surface groundwater. The stream sites will monitor the surface- water ensuring neither the shaft or slope is compromising the surface water system. The deep groundwater well will monitor the aquifer below the coal seam.

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

Sample Site	1st Quarter							2nd[2] / 3rd[3] / 4th Quarters												
	Lab Analysis*a	Field parameters only*1	Monthly Flow	Dissolved Oxygen	TDS,TSS, T-P	O & G		Lab Analysis*a	Qtrly Field parameters* only1	Quarterly Flow	Monthly Flow	Monthly Seasonal Flow	Quarterly Water Level Only	Dissolved Oxygen	TDS,TSS, T-P	O & G	Carbon 14	Tritium	Deuterium	Oxygen 18
Streams																				
CS-3								X								X				
CS-6**	X			X				X						X						
CS-7 (F-5)									X											
CS-8									X											
CS-9								X												
CS-10									X											
CS-11								X								X				
CS-12	X							X												
CS-13	X							X												
CS-14	X							X												
CS-16									X											
CS-17									X											
CS-18									X											
CS-19								X												
CS-20								X												
CS-21								X												
CS-22										X										
CS-23										X										
CS-24								X								X				
MD-1			X		X						X				X					
SRD-1			X								X									
F-10												X								
UP&L-10								X												
VC-6	X			X		X		X						X		X				
VC-9	X			X		X		X						X		X				
VC-10		X							X											
VC-11										X										
VC-12										X										
NL-1 through NL-42 (See Section 2.4.4)												X								

Revised 12-30-09

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

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

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

	1st Quarter						2nd[2] / 3rd[3] / 4th Quarters												
Sample Site	Lab Analysis*a	Field parameters only*1	Monthly Flow	Dissolved Oxygen	TDS,TSS, T-P	O & G	Lab Analysis*a	Qtrly Field parameters* only1	Quarterly Flow	Monthly Flow	Monthly Seasonal Flow	Quarterly Water Level Only	Dissolved Oxygen	TDS,TSS, T-P	O & G	Carbon 14	Tritium	Deuterium	Oxygen 18
Wells																			
JC-1			X					X		X				X		X	X	X	X
JC-3			X					X		X				X					
ELD-1			X							X									
W79-10-1B												X							
W79-14-2A												X							
W79-26-1												X							
W79-35-1A												X							
W79-35-1B												X							
W2-1(98-2-1)												X							
W20-4-1												X							
W20-4-2												X							
W99-4-1												X							
W99-21-1												X							
W20-28-1												X							
91-26-1												X							
91-35-1												X							
92-91-03							X												
08-1-5												X							

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

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

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

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

[3] Baseline Lab Analysis will be conducted every five (5) years beginning in 2010 in the 3rd quarter. (ie. Years 2010, 2015, 2020, etc.)

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

TABLE 2.3.7-3
MONITORING STATION IDENTIFICATION

ECCLES CANYON/MUD CREEK DRAINAGES

STREAM STATIONS - 13 Stations

CS-3	CS-6	CS-9	CS-11	CS-19	CS-20	CS-24
CS-21	VC-6	VC-9	VC-10	VC-11	VC-12	

MINE DISCHARGE STATIONS - 4 Stations
CS-12 (Mine #3) CS-14 (Mine #1) MD-1 (Composite CS-12 & CS-14)
SRD-1 (Total Mine Site Discharge to Eccles Creek/Scofield Reservoir)*

FRENCH DRAIN STATIONS - 1 Station
CS-13

HUNTINGTON CANYON

STREAM STATIONS - 12 Stations

CS-7 (F-5)	CS-8	CS-10	CS-16	CS-17	CS-18
CS-22	CS-23	UPL-10	F-10	EL-1	EL-2

WASTE ROCK DISPOSAL SITE

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

GROUNDWATER STATIONS

SPRINGS - 26 Stations

S10-1	S12-1	S13-2	S13-7	S14-4	S15-3	S17-2
S22-5	S22-11	S23-4	S24-1 Sulfur	S24-12	S26-13	S34-12
S35-8	S36-12	2-413	3-290	WQ1-39	WQ3-6	WQ3-26
WQ3-41	WQ3-43	WQ4-12	8-253	WQ1-1		

WELLS (MONITORING) - 1 Well Stations

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

WELLS, CULINARY -Referenced but not monitored
W13-1 W13-2 W17-1 W17-3 W24-1

NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES)
001 Portal Area 002 Loadout Area 003 Waste Rock Area 004 Winter Quarters JC-3 James Canyon

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

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

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

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

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

Several monitoring stations were added to the monitoring schedule with the incorporation of the North Lease Tract. CS-19 and CS-21 have been added to monitor the quantity and quality of the water in Woods Canyon Creek and CS-20 has been added to monitor the quantity and quality of the water in Winter Quarters Creek - monitoring both mining upstream and water quality upstream of the Winter Quarters Ventilation Facility (WQVF). CS-24 was added in Winter Quarters Creek below the (WQVF) to monitor any affects associated with the pad.

As part of the Skyline Mine subsidence monitoring plan, —a total of 42 new water monitoring sites have been identified in the North Lease area (Plate 2.3.6-2 Table 2.3.7-2A). Sites NL-1 through NL-42 have been selected to monitor flows on the perennial reaches of both Winter Quarters and Woods Canyon drainages one year prior to , during, and one year following longwall undermining of the perennial section of stream . The sites will be monitored monthly in June through October. If

Very little ground water was encountered while mining in the northern portion of the existing permit area prior to the addition of the North Lease. The same geologic and hydrogeologic conditions are anticipated to occur in the North Lease as occurred in the northern portion of the existing permit area (Mine 3). From 2005 through 2009 no significant water was encountered in the North Lease. Selected surface discharges of ground water and stream flows in the areas that could be impacted by mining activities have been monitored. Mining related surface impacts include subsidence and the ventilation facility in Winter Quarters Canyon (WQVF)in the North Lease area. The WQVF will be permitted to encompass approximately 7.93 acres with the disturbance being treated with a sedimentation pond. The sole purpose of the facility will be to provide ventilation to the mine. If impacts to the waters within the permit area are determined to have occurred, mitigation will be implemented immediately using BTCA as described previously.

There has been some concern that Electric Lake has been impacted by the inflows of ground water to the Skyline Mine since 1998. As presented in the Addendum to the Probable Hydrologic Consequences, July 2002 and updated in October 2002, April 2003, and June 2004, a direct connection between the water in Electric Lake and the mine inflows cannot be found. However, the water flowing into the 10 Left area of the mine and discharging from the James Canyon JC-1 well contains a slight percentage of tritium. No other significant inflows of ground water into the mine contained tritium levels that would suggest a modern component of recharge. As stated by Petersen (Appendix A, Addendum to the Probable Hydrologic Consequences, July 2002, Updated October 2002):

> "It is calculated that the maximum modern component in the fault-related system could range from approximately 6.9 to 12.4 percent. It is also apparent that since routine sampling of the 10 Left groundwater system began in May 2002, the percentage of modern recharge in the groundwater system has not increased. Based on the potential modern recharge percentage calculations presented above, it is determined that of the total inflow to the 10 Left region (approximately 3,800 gpm), a maximum of approximately 262 to 471 gpm could have originated as modern recharge. Inasmuch as Canyon Fuel has been pumping approximately 2,200 gpm from the 10 Left groundwater system into Electric Lake since September 2001, the potential net impact to the Electric Lake watershed, were it occurring, would be completely mitigated by the current pumping. Additionally, groundwater that would not otherwise be available for use without the pumping activity is being added to the watershed. Since October 2002, PacifiCorp has increased the pumping rate at JC-1 to more than 4,000 gpm. Thus, currently, the amount of groundwater being pumped into Electric Lake from JC-1 represents

of riparian habitat, the Permittee commits to using the best technology currently available (BTCA)to mitigate the damage. The repair efforts will be coordinated and agreed upon by Mine, DOGM, and USFS personnel. Repairs related to disruption of a water supply are addressed in Section 2.5.3.

2.7.7 VEGETATION OF THE SCOFIELD WASTE ROCK SITE

The Scofield Waste Rock site was expanded in 2007 into areas (approximately 5.13 acres) that were previously undisturbed by mining activities. In the 1990s the northern and eastern portions of the area were disturbed with logging activities. Soils and Vegetation information that was collected in 1981-82 was updated in 2007 with information specific to the Refuse pile expansion. The 2007 information is grouped into two (2) separate reports, the first report summarizing the preliminary qualitative vegetation data with the second compiling the remaining qualitative and quantitative data. Quantitative data was not collected during the preliminary report due to the season of data collection (late Fall 2006). The 2007 reports focused on baseline information for reclamation and identification of threatened and endangered species. No threatened or endangered species were identified. The 1981-82 information is located in Appendix Volume A-2, with the 2007 reports being located in Appendix Volume A-2, Volume 2, respectively.

Vegetation resources are protected and enhanced at the Waste Rock site through contemporaneous reclamation of the site as it is being filled. The 2007 vegetation study established a reference area for a reclamation standard and also insured no sensitive, threatened or endangered species exist at the site. For additional information on revegetation of the site, see Sections 3.2.8 - Plan for Disposal of Waste Rock, and 4.7 - Revegetation Plan of the M&RP.

2.7.8 WINTER QUARTERS VENTILATION FACILITY

The Winter Quarters Ventilation Facility (WQVF) was necessary to provide ventilation for underground mining located north of Winter Quarters Canyon. Both Soils and Vegetation information specific to the WQVF site were collected in 2008 with a second revised report drafted in 2009. Plate 2.7.1-1a was qualitatively updated in 2007. In 2008, a site-specific report focused on acquiring baseline vegetation information for reclamation and identification of threatened and endangered species for the WQVF. The revised report drafted in 2009 was necessary due to changes in the pad design that eliminated impacts to the riparian areas. The modified pad design minimizes affects to the riparian areas by keeping the disturbed area a minimum of two stream widths from the stream bank (approximately 24 feet). In general, the WQVF pad site encompasses a sagebrush and mountain brush south-facing hillside, and minimal riparian areas that have had significant detrimental affects due to heavy livestock use and noxious week infestation. Conversations with vegetation consultant Dr. Patrick Collins suggest successful revegetation of the riparian areas is very likely due to the combination of vegetation species and available water. No threatened or endangered species were identified. The vegetation report is located in Appendix A-2, Volume 2. The vegetation report focused on the riparian areas is available on request.

Huntington Creek has a diverse aquatic community with macroinvertebrate taxa representing all trophic levels. The successful cutthroat trout spawning and high number of resident trout evidence the high quality waters and habitat of Huntington Creek plus the ability of the macroinvertebrate community to support quality fisheries. Cutthroat trout, according to Utah Division of Wildlife Resources (UDWR) surveys, are increasing in numbers in Huntington Creek above Electric Lake. Trout produced in Huntington Creek provide an important part of the total number of fish in Electric Lake.

Winter Quarters Canyon Creek

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

Woods Canyon Creek

As indicated in the 1995 Environmental Assessment, Mayfly nymphs were found within the upper portions of Woods Canyon Creek in higher quantities than those found within Winter Quarters Canyon. Stonefly larvae were also found as high as the fork in the stream near the center of Section 34 (T 12 S, R 6 E). No fish were seen during the 1994 field survey although some may have been present. A survey conducted in Woods Canyon Creek in October 2002 indicated similar conditions (See Appendix Volume A-3, Volume 2).

UP Canyon - Scofield Waste Rock site

The Scofield Waste Rock site is located in UP Canyon at the confluence of two ephemeral unnamed drainages. No aquatic wildlife habitat has been noted in either drainage.

Project Impacts on Fisheries Resources

The surface facility disturbances in the portal area encroached on sections of all three upper Eccles Creek forks. In order to reduce sedimentation of these stream segments and the main stream, the tributaries and a section of Eccles Creek proper immediately below the tributary confluences were diverted into closed culverts. This modified approximately 4,200 feet of total stream habitat but did not reduce available fish habitat since fish were not found above the U.S. Forest boundary, prior to the diversion. Downstream drift of macroinvertebrates from the upper reaches of these forks still occurs as before.

At the coal loadout facilities near the mouth of the canyon (Station ECO5), approximately 600 feet of stream was moved to the north into a new channel. The new channel is 100 feet shorter but has nearly the same gradient (3 feet additional vertical drop/1,000 feet horizontal channel).

Degradation of Eccles Creek between the National Forest boundary and the coal loadout facilities should continue to be minimal since road and conveyor plans were developed and are being implemented to minimize effects on the stream.

Water being discharged from the mine is augmenting the Eccles Creek stream flow. This increased stream flow is especially beneficial during summer months when normal stream flows are low. Water temperatures are also moderated by this increased flow.

There should be little impact on Huntington Creek above Electric Lake. Impacts to date have been associated only with the construction of a new UDOT highway. Sediment control measures minimized the impact during the construction activity.

Prior to construction of the Winter Quarters Ventilation Facility (WQVF) silt fencing or similar best management practice will be installed along the entire length of the construction zone to minimize sediment and debris from entering the creek. Once construction is complete and other sediment controls are installed, these siltation structures will be removed. During the life of the VQVF pad, long term sediment control will be implemented thorough a sediment pond (UPDES discharge point 004).

At this point in time there are believed to be no other potential impacts on either Winter Quarters or Woods Canyon Creeks.

2.9.5(a) Winter Quarters Ventilation Facility (WQVF)

Considerable work studying the wildlife has been conducted in Winter Quarters Canyon, whether associated with the North Lease area of mining or exploration drilling. Various wildlife surveys have been conducted every year from 2005 through 2008, with surveys specifically conducted in the vicinity of the WQVF pad site in 2008 and 2009. To summarize the affects of the WQVF surface disturbance on wildlife, a summary report was drafted by Tetra Tech in 2009, and an additional survey by Western Land Services. Both studies are provided in Appendix A-3, Volume 2. The following briefly identifies the wildlife, their status, and the location of detailed analysis:

- Herpetofauna: 2005 Mt. Nebo report (Appendix A-3, Volume 2); Minimal effects.

- Mammals: 2009 Tetra Tech report (Appendix A-3, Volume 2); Minimal effects.

- Game Species: 2009 Tetra Tech report (Appendix A-3, Volume 2): Minimal effects.

- Goshawk, Flammulated Owl and other Wildlife report (Appendix A-3, Volume 2); Minimal effects / no owls found

- T&E Species: 2006 through 2009 Tetra Tech reports (Appendix A-3 Volume 2) None found.

- Noise:2009 Tetra Tech report; Minimal effects

- Habitat Loss: Minimal temporary habitat loss when compared to the extent similar habitat in the surrounding area. The total affected area will be limited to approximately eight (8) acres that will be returned to the pre-disturbance habitat at reclamation.

Significant portions of the area have been previously disturbed through logging, grazing, and historic mining uses. During development of the facility, daily activity will include vehicle traffic and construction activities. After construction, the use of the canyon will return to historic uses, with only an exhaust fan operation remaining. The WQVF will not be accessed on a regular basis, most inspections of the fan and associated facilities will be via underground access. The road is not operational for year-round use after construction. Access will be limited by a locked gate.

2.9.6 WILDLIFE OF THE SCOFIELD WASTE ROCK EXPANSION (~5 ac.)

The Scofield Waste Rock site expansion encompasses approximately 5.13 acres of ground previously undisturbed by mining activities. The remainder of the approximately 37.5 acre Waste Rock permit area was a pre-SMCRA, pre-disturbed site.

Because only a minimal amount of acreage is anticipated to be disturbed at one time (approximately 3 acres) - and consistent with historic use of the site, little or no effect to the resident wildlife is expected. However, a review of the existing information in conjunction with additional studies was conducted.

Impact Analysis

The Waste Rock site is adjacent to the town of Scofield, Utah, and is considered a limited value wildlife use or 'occasional use area' since the area is used minimally as a big game migratory area. Figures 2.9.1-A and 2.9.2-B illustrate the summer range, winter range, and migratory routes for both elk and Mule deer. Utah Division of Wildlife personnel Leroy Mead, visited the site in April 2007 and conversed with Utah Division of Oil, Gas, and Mining personnel in September 2007 indicating impacts to big game would be minimal.

Impacts to Herpafuna are minimal because the drainages in the area are both ephemeral and the expansion activities do not add any additional impact to the stream courses.

A raptor survey was conducted in 2007. Two red-tailed hawks were encountered within a 1/4-mile of the site, but no goshawks were observed. An apparently inactive nest located approximately 1/8-mile west-southwest of the site was observed. This nest was not noted during a similar survey conducted in 1995. Skyline Mine has committed to observing the nest in 2008 to determine any use or activity. Findings will be reported in the Annual Report.

Threatened & Endangered Species

In 2007 the site was assessed for incidental species observations for the presence of threatened, endangered and special status species, management indicator species and important habitat (including elk calving, mule deer fawning, and sage grouse breeding and nesting) and migratory bird use with the project area. Findings of the surveys support extension of the Waste Rock area. The Scofield Waste Rock site does not have the correct habitat (too high of elevation) for the threatened and endangered species listed for Carbon county, Utah.

July 1, 2005. Details of the method of the survey are outlined in Appendix A-2, "Biological 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.

~~Although minimal cliff habitat exists in the North Lease area, and the likelihood of subsiding those areas even less, Canyon Fuel Company, LLC commits to conducting an additional raptor survey in areas of cliff habitat within one year of undermining the cliff area. Additional annual surveys will be conducted if any nests are located during the baseline survey. The raptor-nest survey will be conducted via helicopter. Results of the survey will be provided in Appendix Volume A-2.~~

~~A raptor survey will be performed during 2003, however because no surface disturbance is planned in the North Lease Tract Area, critical habitat for raptors will remain unaffected by the proposed new area.~~ Raptor surveys were conducted in 2005, 2007, and 2008 in the Winter Quarters areas associated with drilling programs. Those surveys and the presence or lack of presence of raptors has not prohibited our work in the area. Those reports are located in Appendix A-3, Volume 2. A summary report addressing the affects on raptors with the addition of the Winter Quarters Ventilation Facility is also 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.

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.~~

SOILS OF THE NORTH LEASE TRACT AREA

No surface disturbance for the North Lease area was originally proposed. In 2009 the M&RP was modified to include the Winter Quarters Ventilation Facility (WQVF). Prior to the WQVF construction, a review of the soils in the area from the existing Soil Survey of Carbon County, Utah and USDA Forest Service were conducted. The soil map units in the survey are presented on Drawing No. 2.7.7-1b.

Winter Quarters Ventilation Facility Area(WQVF)
A detailed description of the soils in the WQVF area is available in Appendix A-2, Volume 2, titled,"Soils survey for the proposed Winter Quarters vent location near Scofield, Utah". The report uses United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) WEB Soil Survey (WSS) utility and associated NRCS soils reports. The vent facility will disturb approximately 1.6 acres of topsoil. Based on the soil survey 1-2 feet of suitable soil and subsoil will be separated, stored, marked with appropriate signage for protection. This material will be used during reclamation of the site. Due to the limited amount of A horizon material identified in the survey, depth of the salvaged material will be based on depth of significant rock. Attached to the soils report are the analysis of the soils collected during the survey. See Section 4.6.4.1 for additional information concerning the Topsoil/Subsoil Handling Plan.

U. P. & L. Tract

The soils for this area are classified into six groups as determined by Daniel M. Larsen, U. S. Forest Service. The following are the soil types: 1)Pando - Adel Families Complex, 2)Bundo - Lucky Star - Scout Families Complex, 3)Adel - Merino Family Complex, 4)Gateway - Adel families Complex, 5)Lucky Star - Adel Families Complex, and 6)Lucky Star - Bundo - Adel Families Complex.

Pando - Consists of deep, well drained, moderately permeable soils on mountain slopes. The soils are formed from colluvium from sandstone and shale. Slopes are 30 to 60 percent. Soils are classified as loamy-skeletal, mixed Boralfic Cryoborolls. A1 is zero to four inches of dark grayish brown loam; very dark brown moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; 10 percent gravel; slightly acid; clear smooth boundary. A2 is four to 11 inches of grayish brown cobbly loam, very dark grayish brown moist; weak medium subangler blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; 10 percent grave and 10 percent cobbles; moderately acid; gradual wavy boundary. E is 11 to 23 inches pale brown very cobbly silt loam, brown moist; weak medium subangler blocky structure; soft, friable, slightly sticky and nonplastic; few very fine and fine roots; 20 percent gravel and 30 percent cobbles; moderately acid; gradual wavy boundary. Bt is 23 to 45 inches of very pale brown extremely cobbly clay loam, yellowish brown moist; moderate medium subangler blocky structure; and, firm sticky and

Recreation

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

Eccles Canyon Road provides the only direct access from Scofield Reservoir to Huntington Canyon and is used as an access route from the Scofield Reservoir recreation area to the recreational use areas at higher elevations in the northern end of the Wasatch Plateau (U.S. Geological Survey, 1979).

Natural Gas Transmission

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

Forestry

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

Private Land - Winter Quarters Canyon

Both current (2009) and historic Land uses of private land in Winter Quarters canyon are varied and include grazing, wildlife habitat, recreation - primarily hunting big game, game birds, and small game species, forestry or timber production, and mining related activities. Addition of the ventilation facility in 2010 is consistent with the historic uses.

Plan" for the Manti-LaSal National Forest, (1986). The spruce-fir timber type contained approximately 10,000 board-feet per acre and the aspen timber type contains 5,300 board-feet per acre. Therefore, within the affected area, there were approximately 201,000 board-feet of the spruce-fir timber and 93,800 board-feet of aspen timber.

Productivity

Sheep currently graze the lease and permit areas in accordance with the sheep allotments as specified in Table 2.12.1-1.

The area proposed for disturbance in Winter Quarters Canyon for the Ventilation Facility pad was assessed for productivity by Natural Resource Conservation Service (NRCS) Area Range Management Specialist, Mr. Dean Stacy. The productivity analysis encompassed areas that will not be affected with the pad design restricted to the south-facing slope with the disturbance being no closer than approximately 25-30 feet from the creek. His productivity assessment identified that due to previous and current uses (grazing and logging), the area ranks low on the Potential Natural Community Scale. Only the south facing slope (Mountain Big Sagebrush) was as productive as anticipated (approximately 1,300 lb/ac). Both the Willow and Aspen communities were under-productive with production estimates of approximately 800 lb/ac. (See NRCS report in Appendix A-2, Vol. 2).

Recreation

Recreational use of the area affected by mine surface operations and facilities is limited primarily to sight seeing, fishing, hunting, snowmobiling and cross country skiing.

Eccles Canyon presently supports and is capable of supporting a self-reproducing population of cutthroat trout from South Fork to the mouth of the canyon. The only time a fishery potential exists above South Fork near the mine portal area is in the springtime when runoff volumes are highest (Winget, 1979). Similarly, the Winter Quarters Ventilation Facility (WQVF) has minimal (if any) impact on the fishery due to the limited flow in the creek, and channel morphology in the pad area that is dominated by riffles with an absence of pools and cut banks critical to fish habitat. A 25-30 buffer zone exisits between the WQVF pad and Winter Quarters Creek providing adequate habitat.

Highway (SR-264) through Eccles Canyon provides the only access route between recreational facilities in the north end of the Wasatch Plateau and the Scofield Reservoir recreation area. The U.S. Forest Service states that Electric Lake has added a considerable amount of recreational traffic to Eccles Canyon and that 1977 vehicle counts from June to the middle of October were approximately 22,000, which averages 160 vehicles per day. This number is increasing with the completion

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)		Units (AU)	Grazing Animal Unit Month	Potential Animal (AUM)	
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 Breakout	Spruce-Fir	.96	0.0	0.00			
	Subtotal		1.22	-	18.0		1.00
6.WQ Vent Pad	Sagebrush	1.6		53.8		1.80	
	Subtotal	1.6		53.8		1.80	
TOTAL		74.8673.26		618.3564.5			21.4519.65

ADDITION TO		TEXT		
Table 2.12.2-1	Page 2-128	Section 2.12	Page 2-128	Date 12-30-09

2.14 PRIME FARMLAND INVESTIGATION

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

A similar finding was made by the Natural Resources Conservation Service for the North Lease Tract (See Appendix Volume A-2). As shown in the Exhibit, "no prime farmland or farmland of statewide importance occurs on the recently acquired North Lease". Therefore, a negative determination for prime farmland classification of the Skyline project area is requested.

Leland Sassor of the Natural Resource Conservation Service (NRCS) was contacted in December 2008 concerning a Prime Farmland Determination in the location of the proposed Winter Quarters Ventilation Facility. Provided the information, he researched the area and confirmed (verbally) later that no Prime Farmland is identified in the area of the pad location. This is consistent with earlier determinations.

3.2 COMPONENTS OF OPERATION

3.2.1 Ponds, Impoundments, and Dams

Four (4) sedimentation ponds are included in the design of the Skyline Mine plan (Map 3.2.1-2b, 3.2.1-4, and 4.16.1-1B), and 3.2.4-3D. Each retention pond was originally designed to provide adequate volume for sediment containment and also adequate volume for a theoretical 24-hour detention of run-off resultant of a 24-hour, 10-year rainstorm. The minesite sedimentation pond also contains additional volume to adequately treat mine water discharge. An engineer's certification to meet requirements of R645-301-743-110 and R645-301-514 is located on all necessary designs and calculations for the ponds in the appropriate appendices and inspection reports. A copy of this certification will be retained at the minesite. Quarterly inspections are also retained at the minesite. All Inspections will meet the requirements of R645-515-200. The location and design characteristics for each of these three ponds are described in the following:

The sediment level will be determined by cross sectioning the sediment level through B-B' on Map 3.2.1-2B and through A-A on Map 3.2.1-4 at no greater than 3 year intervals. During sediment clean out the pond may be drained of all water that will meet permit requirements. Water not meeting discharge requirements will be hauled to the other sediment pond. Mine water discharge during clean out of the mine site sediment pond shall by-pass the pond but shall still meet UPDES Discharge Permit requirements. Sediments will be disposed of as outlined in Section 4.16.

Mine Site Sediment Pond

A detention pond is located at the mine site adjacent to the crushing and truck loading station. It will detain surface run-off from the 33.79 acres disturbed mine site area plus 2.69 acres of undisturbed area, all of which reports to the sedimentation pond shown on Map 3.2.1-1. Precipitation from a 10-year, 24-hour rainstorm is expected to be 2.43 inches. After event that immediately follows the 10-year, 24-hour event. In this scenario, the discharge from the spillway was calculated to be 6.60 cfs at a velocity of 1.3 fps. The pond will also contain runoff from a 100-year, 6-hour precipitation event. This discharge is considered non-erosive, requiring no erosion protection to the embankment.

State Regulation R645-301-746.340 indicates a sediment pond at a refuse site needs to be designed and operated so that at least 90 percent of the water stored during the designed precipitation event will be removed within a 10-day period following the event. In the event that a 10-year, 24-hour precipitation event (1.99 inches) occurs and the level of the water is above the decant pipe after 10 days, the pond will be drained to the level of the decant pipe.

Volume 5, Section 14 provides calculations and designs for drainage control ditches for the Waste Rock site. Analysis of Sedimentation Pond Capacity Following Waste Rock Expansion - April 2007, (Volume 5, Section 15a of MRP) provides a demonstration that the disturbed area ditches are adequately sized to accommodate the pile expansion.

The required volume for annual sediment storage has been estimated at 10,330 cubic feet (See Analysis of Sedimentation Pond Capacity Following Waste Rock Expansion - April 2007, Section 15, Volume 5a and Map 3.2.8-4). The 100 percent sediment 'clean-out' marker is the 8-inch decant pipe located in the pond. The landowner representative has requested a pond be left as a stock watering pond at reclamation (see Section 4.12).

Winter Quarters Ventilation Facility Pond

A sediment pond will be located at the east end of the Winter Quarters Ventilation Facility site. The pond is designed to treat the approximately 3.57 acres; 1.06 acres of disturbed area from the facility and 2.5 acres of undisturbed area above the site, respectively. Precipitation from a 10-year, 24-hour storm event has been calculated at 2.08 inches. The required volume to provide the retention of the runoff from the designed 10-year, 24-hour storm is calculated at 3,880 cubic feet. (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).

The primary and emergency spillways were designed using a 10-year, 24-hour and 25-year, 6-hour rainstorm events. Peak Stage during the 10-year, 24-hour event was determined to fill the pond to the elevation of the primary spillway (8075.05 feet). A 25-year, 6-hour event immediately following the 10-year, 24-hour event would discharge at a rate of 1.15 cfs with a velocity of 3.67 fps.

The emergency spillway will not normally discharge during the design runoff events. However, assuming the primary spillway was not functioning and the pond was assumed full to the emergency spillway crest (8075.55 ft) prior to the occurrence of a 25-year, 6-hour storm event, the emergency spillway is calculated to discharge 0.84 cfs with a velocity of 3.35 fps at the crest. This velocity is considered non-erosive.

The required volume for annual sediment storage has been estimated at 1,108 cubic feet. The 60 percent sediment volume is at an elevation of 8071.7 feet. The 100 percent sediment 'clean-out' marker is at an elevation of 8072.2 feet which corresponds to the elevation of the 6-inch diameter decant pipe.

3.2.2 Overburden and Topsoil Handling

A comprehensive discussion pertaining to this operational component of the mine plan is presented in Section 4.6 - TOPSOIL AND SUBSOIL HANDLING PLAN.

3.2.3 Coal Processing

Maps 3.2.3-1 and 3.2.3-1A are flow diagrams of the entire coal handling system. Designated capacities represent maximum design capabilities necessary to handle surges in the system. The average throughput, a substantially lower figure, is reflected in the annual production schedule.

Run of Mine (R.O.M.) coal is brought out of the mines by conveyor belts and it is temporarily stored in an 8,000 ton capacity concrete silo or the open coal storage area. As the coal is needed, it is transported by conveyor belts to a crushing system and then to the overland conveyor that transports it to the railroad loadout facility. Coal transported to the railroad loadout facility may go directly into the storage silos or may be placed in the RLO open coal storage area. Some coal is still shipped by truck direct from the truck loadout area. In the event of an emergency situation coal can be transported from the truck loadout area to the railroad loadout facility.

Stoker Coal

A stoker coal circuit is located on the coal storage silos at the train loadout area. A stoker loadout storage tank is located on sedimentation pond has been provided for the treatment of runoff water from the disturbed areas. A diversion channel is used to intercept runoff from the undisturbed hillside and route this water around the facilities into Eccles Creek. Due to space limitations in this area, it was necessary to divert the creek from its existing channel. This diversion was accomplished in such a manner as to mitigate any damage to the surrounding environment.

Access Road Improvements

Approximately 2.5 miles of improvements were necessary to the existing access road paralleling Eccles Creek. Improvements to this road resulted in a paved width of 34 feet designed to criteria set forth by the UDOT which has been designated Utah State Highway No. SR-264.

The road improvements generally follow the alignment of the previously existing road. Grading and maintenance operations along the previously existing road had re-channeled Eccles Creek in some areas for considerable distances. The improvements to the access road also resulted in improvements to Eccles Creek since the past practice of pushing dirt from grading operations into the creek was eliminated. The new public road was constructed to bypass the mine portals and facility area.

Embankments

Construction areas were generally overlain with 10 to 15 feet of colluvial materials. Geotechnical investigations indicated that this material is stable for cut slopes of one foot horizontal to one foot vertical (1h:1v) and at a depth not to exceed 10 feet (Volume A-3). Fill slopes are stable at 1.5 feet horizontal to 1 foot vertical (1.5h:1v).

Winter Quarters Ventilation Facility

The Winter Quarters Ventilation Facility (WQVF) is required for ventilation of the underground workings to continue mining north of Winter Quarter Canyon. The approximate 7.93 acre permitted area consists of a 20-foot diameter vertical shaft mounted with an exhaust fan, a 8-foot diameter escape shaft, and a decline slope/portal which provides both intake air and an emergency escapeway for the mine. Other auxiliary features of the site include a substation providing power to the fan, a mobile field office for emergency evacuation, a topsoil pile protecting the topsoil for reclamation, and a sediment pond designed to treat the disturbed area stormwater runoff prior to discharging to Winter Quarters Creek.

The WQVF pad construction will be initiated by building an access road to the pad. The first construction phase on the pad will focus on creating sufficient space to accommodate the electrical substation. Following the substation will be the extension of the pad to provide access and sufficient space to start the construction of the Declined Slope. The Declined Slope portal structure will be approximately20 feet wide by 12 feet tall, driven at a 16-18 degree slope for an approximate distance of 900 feet where it will intersect the underground mine workings. Any material not stored underground or in the pad, will be shipped to the Waste Rock site.

The 28-ft vertical shaft will be approximately 300 feet deep and constructed using one of two methods - either sunken from the surface using conventional methods or constructed from underground using a raise-bore method. Conventional sinking will generate approximately 6,800 cubic yards of material that will be stored on the surface within the WQVF pad or will be hauled to the Scofield Waste Rock site. Material generated using the Raised bore drilling method will be stored underground with a limited amount of material from the from the shaft collar to be stored on the surface.

Sediment control during construction will be treated with a combination of silt fencing, straw bales, gravel filters, and other hard structures used as energy dissipaters until the sediment pond is constructed.. In conjunction with the WQVF pad a sediment pond will be constructed to treat runoff from the disturbed area prior to being discharged to Winter Quarters Creek.

~~Winter Quarters Creek will be diverted under the WQVF site through a large diameter culvert. The culvert is designed to handle the runoff from a 100-year, 24-hour precipitation event. The inlet of~~

~~the culvert will be fitted with a 'trash rack' designed to prevent the opening of the culvert to~~

Disturbed area ditches are temporary and designed to convey runoff from a 10-year, 24-hour storm event. The Undisturbed 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).

3.2.11(b) Winter Quarters Ventilation Facility

The Winter Quarters Ventilation Facility (WQVF) was required to improve ventilation for underground mining north of Winter Quarters Canyon. The WQVF is located on a south facing slope in Winter Quarters Canyon approximately two (2) miles west of Scofield, Utah, and approximately 1/2-mile east of the United States Forest Service (USFS) boundary.

Access to the WQVF pad site is via an existing road up Winter Quarters Canyon. A road extending approximately 500 feet from the existing road will be constructed to access the pad site. Canyon Fuel Company, LLC. owns approximately 12.7 acres that encompasses the WQVF site. As a provision in a seperate lease with the landowner, Canyon Fuel Company - Skyline Mine has agreed to improve the existing road with upgrades of additional gravel and drainage, while keeping with the general footprint of the existing road.

Power is being provided to the WQVF site by Rocky Mountain Power. Similar to the power arrangement at the Eccles Canyon Mine site, Rocky Mountain Power policy dictated the separation of responsibility would be at the connection to the electrical sub-station. The power line corridor, line construction, and maintenance of the power line up to the sub-station remain the responsibility of Rocky Mountain Power.

As construction is initiated, topsoil and brush will be collectively salvaged, separated and stored for reclamation purposes. Any large trees will be segregated as well for placement on the topsoil pile or other interim habitat enhancement.

Initial construction will include an access road from the existing road to access the WQVF pad site to create a pad for an electrical substation to provide power for further site construction. Initial drainage control will be established through concentrating runoff to ditches along the access road as it is being developed. Sediment control along the road will be treated through a combination of armoring of the ditch with rock, gravel filtering, and energy dissipaters. Areas of drainage not reporting to a specific temporary ditch and representing sheet flow from the site will be treated with silt fencing. Silt fencing will line the toe of the construction site serving as a barrier between the construction site and the creek.

Once power is established at the site, further pad construction will continue with extending the substation bench west to the location of the Declined Slope Portal for those activities to begin. Material generated from boring of the slope will be used to create the remainder of the WQVF pad. Construction of the Declined Slope is scheduled to begin in Spring 2011 with the Vertical Shaft construction to begin in Spring 2012. Once pad construction is complete, the WQVF pad and topsoil storage area will be fenced to prevent humans or animals from accessing the facility.

All disturbed area drainage from the WQVF pad will report to the sedimentation pond, undisturbed ditches will route undisturbed drainage around the site, and a combination of rock armoring, vegetation, gravel filters or silt fencing will treat run-off from the access road.

LLC. Exhibit B shows the letter from UDOT giving permission to use its portion of the pad and indicating that the post-mining land use as a snow storage pad. The post-mining land use for the Canyon Fuel Co., LLC, portion of the pad will also be a snow storage pad. The configuration of the pad is such that all of the drainage will be directed to straw bales and/or silt fencing for treatment before entering the natural drainage (see Volume 5, Section 6 for the design). This area contains 0.64 acres and is classified as an Alternate Sediment Control Area.

No salt or other deicing chemicals will be used on the snow placed on this area. Each spring, following use of the pad, after the snow placed on the pad has melted any sediment or coal fines which have accumulated on the site will be removed.

Area 34. This area is located on road outslopes at the waste-rock disposal site as shown on Map 3.2.8-4. In order to make the road more usable for third parties, minor gravel fills were placed at the locations shown on the map. Silt fences were placed at the base of gravel fills, then later removed once the gravel fills were fully compacted. Since the fills are constructed of gravel they will not erode.

Area 35 and 36. These areas are the James Canyon road from the forest Service Mounment Peck Road to the drill pad and includes the buried pipline to Electric Lake. The James Canyon road is graveled with water bars approximately every 150 feet. Road runoff water flows to a water bar and is directed to a silt fence for sediment control. The buried pipeline disturbed area has been regraded and deep gouged. The area has been reseeded. Water bars have been constructed approximately every 150 feet. In 2005, both the drill pad topsoil pile (see plate 3.4-1) and the reseeded area was reclassified as a “Small Area Exemption” based on a demonstration of adequate vegetative cover (see Sec. 21 (a), Vol. 5 for demonstration). All silt fences were removed from these areas.

Area 37. This 0.67 acre area is the topsoil storage area for the Winter Quarters Ventilation Facility (WQVF) located in Winter Quarters Canyon as illustrated on Plate 3.2.4-3A, and -3B. The area consists of previous disturbance that includes the outslope of an existing road, remnants ofstone foundations and signs of heavy livestock grazing. During construction of the WQVF pad topsoil will be placed in the location in a controlled manner. Once all the topsoil is in place the surface of the pile will be roughened, seeded, and mulched. The pile will be contained with a berm around the entire circumference. A designed silt trap (Plate 3.2.4-3D)will allow any storm water runoff to discharge the pile area in a controlled manner.

Area 38. This 0.07 acre area addresses drainage from the outslope of the WQVF pad to the prescribed creek buffer zone, minimizing any sediment reporting to the creek. This area encompasses an area approximately six (6) feet wide by approximately 515 feet wide, with sediment control being addressed with silt fencing and vegetation. The area will initially be utilized as work space in constructing the WQVF retaining wall. During construction, silt fencing will provide the primary sediment control. Following construction of the retaining wall, the area will be roughened, seeded, and mulched. Once vegetation is sufficiently established, the silt fences will be removed.

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.

3.4 AREA AFFECTED BY EACH PHASE OF OPERATIONS

The area affected by the Skyline Mines project can be divided into two major categories:

(a) Surface acreage disturbed by construction/installation of coal handling and associated facilities or permitted areas, and

(b) Surface acreage overlying underground mine workings or adjacent areas.

PermittedAcreage

The offices, bathhouse, workshop, portal, fans, and other necessary facilities utilize a site of 42.55 acres. Approximately 0.26 acres is used for water tank and well pads. The coal loading and handling facility at the mouth of Eccles Canyon utilizes approximately 13.86 acres, of which a sedimentation pond requires 0.6 acres. The covered pipe belt conveyor, transporting material from the mine portals to loading points, disturbs approximately 14.18 acres. The waste rock disposal site utilizes approximately 15.91 acres of the 32.48 acres that are permitted. The South Fork breakout area has disturbed 0.96 acres. The James Canyon buried power line, buried pipeline, water wells pad and road include 4.85 acres. The Winter Quarters Ventilation Facility utilizes 7.93 acres. In total, the permitted area is 118.89 acres. The permitted area and bonded area for the Mine Portal area, Loadout area, Waste Rock Disposal area, Winter Quarters Ventilation Facility area, and miscellaneous areas are shown on maps 3.2.1-1, 3.2.1-3, 3.2.8-1, 3.2.4-3a , and3.2.3-3 through 3.2.3-3f, respectively.

The pre-mining phase of earth work and dirt removal commenced in the spring of 1980 and was completed in 1981. The actual construction and installation of facilities necessary for coal mining and handling began in early 1981.

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 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.

Bonding Calculations

Direct Costs		
Subtotal Demolition and Removal	$1,992,731	
Subtotal Backfilling and Grading	$962,854	
Subtotal Revegetation	$892,217	
Direct Costs	$3,847,802	
Indirect Costs		
Mob/Demob	$384,780	10.0%
Contingency	$192,390	5.0%
Engineering Redesign	$96,195	2.5%
Main Office Expense	$261,651	6.8%
Project Management Fee	$96,195	2.5%
Subtotal Indirect Costs	$1,031,211	26.8%
Total Cost 2009	$4,879,013	
Escalation factor		3
Number of years		0.013
Escalation	$188,195	
Reclamation Cost Escalated	$5,067,208	
Bond Amount (rounded to nearest $1,000) 2009 Dollars	$5,067,000	
Posted Bond September 19, 2006	$5,137,000	
Difference Between Cost Estimate and Bond	$70,000	
Percent Difference	1.38%	

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																			367595
	Administration Bld 02																			25308
	Mine No 1 Transfer Tower 03																			35853
	BC 2 Drive House 04																			8893
	BC 3 Drive House 05																			36369
	Crusher Raw Coal 06																			18741
	Truck Loadout 07																			2592
	Railcar Loadout 08																			21764
	Conveyors 8 total 09																			87798
	Water Tanks Two 10																			6084
	Pump House 11																			1233
	Well House Three 12																			4428
	Water Treatment Bld 13																			16600
	Misc Storage Bld 14																			3809
	Overland Conveyor 15																			88532
	Guard Rail 16																			18300
	Rock Dust Bld 17																			5835
	Overland Dust Collector 18																			1248
	Substation 19																			1980
	Power Line 20																			4605
	Cap Magazine 21																			33
	Fuel Storage 22																			2954
	Propane Tanks 23																			527
	Stacking Tube 24																			5516
	Reclaim Tunnel 25																			45632
	Slope Proctection Apron 26																			17532
	Concrete Lined Ditch 27																			485
	Raw Coal Silo 28																			15831
	Parking Area Middle 29																			2451
	Truck Loadout Foundation 30																			233
	Road Pad Lower 31																			3796
	Silo Rail Loadout 32																			140333
	Loadout Foundation RR 33																			5769
	Pavement Rail Loadout 34																			2540
	Steel 35																			6975
	James Canyon 36																			142752
	Culvert Backfilling 37																			6132
	Channel Construction 38																			529279
	Equipment 39																			245525
	Portal Face Door 40																			5823
	Concrete Building 41																			2158
	Winter Quarters 42																			52888
	Total																			1992731

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
	Steel																			
	Substation/Transformers 42																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0012	0.29	/CF													1000	CF	290
	Escape Shaft																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0012	0.29	/CF													88	CF	26
	Fencing																			
	Topsoil Pile	Fencing Barbed wire 3 strand	02 41 13 60 1600	1.75	/LF													1000	LF	1750
	Ventilation Pad	Chain link remove 8'-10'	02 41 13 60 1700	3.43	/LF													2900	LF	9947
	Reinforced Earth Retaining Wall *	Chain link remove 8'-10'	02 41 13 60 1700	3.43	/LF													9000	LF	30870
	Ventilation Fan																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0012	0.29	/CF													150	CF	44
	Mobile Field Office																			
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	/CF													1000	CF	300
	Structure's Demolition Cost (generator)	Steel Bld. Large	02 41 16 13 0012	0.29	/CF													1000	CF	290
	subtotal																			43517
	Concrete																			
	Substation	Concrete demolition	ConcreteDemo1	9.92	/CY													60	CY	595
	Shaft Collar and Foundations	Concrete demolition	ConcreteDemo1	9.92	/CY													20	CY	198
	Escape Shaft Pad	Concrete demolition	ConcreteDemo1	9.92	/CY													35	CY	347
	Drilling and Fan Pad	Concrete demolition	ConcreteDemo1	9.92	/CY													215	CY	2133
	Mobile Field Office Pad	Concrete demolition	ConcreteDemo1	9.92	/CY													15	CY	149
	Slope Collar	Concrete demolition	ConcreteDemo1	9.92	/CY													30	CY	298
	Misc. (corner fence posts, culverts etc.)	Concrete demolition	ConcreteDemo1	9.92	/CY													25	CY	248
	Concrete's volume demolished																1.3	520	CY	
	Loading Cost	Front end loader track 3 CY	31 23 16 42 1300	1.59	/CY													520	CY	827
	Disposal Costs	Disposal on site	02 41 16 17 4200	8.8	/CY													520	CY	4576
	subtotal																			9371
	Total																			52888

* closest materials removal description is chain link removal

	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Portal 01															60984
Water Tank 02															7692
Lower Terrace 03															128012
Middle Bench 04															176859
Upper Bench West Fork 05															80398
Southwest Fork 06															75632
Loadout Faclities 07															143364
South Fork Portal Area 08															44873
Waste Rock Disposal 09															218030
Pond Enlargement Interim 10															1204
Pond Diversion DU2 Interim 11															260
Interim Sediment Control 12															2689
Overland Conveyor 13															1076
James Canyon 14															0
Winter Quarters 15															21781
Total															962854

	Equipment Cost	Hourly Operating Costs	Equipment Overhead	Operator's Hourly Wage Rate	Hourly Cost	Number of Men or Eq.	Total Eq. & Lab. Costs	Units	Quantity	Units	Production Rate	Units	Equip. + Labor Time/Dis.	Units	Cost
Winter Quarters Ventilation Facility 15															
Backfilling and Grading															
CAT 345BL II (10-24)(2nd2006) 2005	16330	75.7	0.1	60.1	245.43	1	245.43	$/HR					12	HR	2945
D10R Semi EROPS (9-52) (2nd2007)	25825	127	0.1	60.1	361.21	1	361.21	$/HR					16	HR	5779
Pickup Crew 4x4 1 ton 340 hp (20-17) (2nd2007)	1060	14.5	0.1	0	22.58	1	22.58	$/HR					20	HR	452
CLAB					47.05	1.5	70.58	$/HR					20	HR	1412
Foreman Average, Outside					64.4	1	64.4	$/HR					20	HR	1288
Subtotal															11876
Topsoil															
D10R Semi EROPS (9-52) (2nd2007)	25825	127	0.1	60.1	361.21	1	361.21	$/HR					20	HR	7224
Pickup Crew 4x4 1 ton 340 hp (20-17) (2nd2007)	1060	14.5	0.1	0	22.58	1	22.58	$/HR					20	HR	452
CLAB					47.05	1	47.05	$/HR					20	HR	941
Foreman Average, Outside					64.4	1	64.4	$/HR					20	HR	1288
Subtotal															9905
Total															21781

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
	Vegetation Costs																			
	Skyline Mine																			
	South Facing Slopes 1H:3H or Greater																			
	Seeding	South Facing Slope Seed 1H : 3H or gentler	Skyline07051	667	/AC					39.81						AC		39.81	AC	26553
	Mulch	Hay 1" material only 029105000250	Reveg001	69.85	/MSF					39.81						AC		1734	MSF	121120
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006	8.9	/MSF					39.81						AC		1734	MSF	15433
	Equipment	Hydro Spreader (equip. & labor) B-81 80MS	Reveg002	19.8	/MSF					39.81						AC		1734	MSF	34333
	Subtotal																			197439
	North Facing Slopes																			
	Seeding	North Facing Slopes Seed	Skyline07052	691	/AC					20.33						AC		20.33	AC	14048
	Mulch	Hay 1" material only 029105000250	Reveg001	69.85	/MSF					20.33						AC		886	MSF	61887
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006	8.9	/MSF					20.33						AC		886	MSF	7885
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	19.8	/MSF					20.33						AC		886	MSF	17543
	Subtotal																			101363
	Riparian Habitat																			
	Seeding	Riparian Habitat Seed	Skyline07053	42.25	/AC					0.04						AC		0.04	AC	2
	Mulch	Hay 1" material only 029105000250	Reveg001	69.85	/MSF					0.04						AC		2	MSF	140
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006	0	/MSF					0.04						AC		2	MSF	0
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	19.8	/MSF					0.04						AC		2	MSF	40
	Subtotal																			182
	Soth to West Facing Slopes																			
	Seeding	Riparian Habitat Seed	Skyline07053	42.25	/AC					39.81						AC		39.81	AC	1682
	Mulch	Hay 1" material only 029105000250	Reveg001	69.85	/MSF					39.81						AC		1734	MSF	121120
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006	8.9	/MSF					39.81						AC		1734	MSF	15433
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	19.8	/MSF					39.81						AC		1734	MSF	34333
	Subtotal																			172568
	North to East Facing Slopes																			
	Seeding	Riparian Habitat Seed	Skyline07053	42.25	/AC					20.33						AC		20.33	AC	859
	Mulch	Hay 1" material only 029105000250	Reveg001	69.85	/MSF					20.33						AC		886	MSF	61887
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006	8.9	/MSF					20.33						AC		886	MSF	7885
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	19.8	/MSF					20.33						AC		886	MSF	17543
	Subtotal																			88174
	Waste Rock																			
	Seeding	Waste Rock Slopes Seed	Skyline07056	61.5	/AC					12.81						AC		12.81	AC	788
	Mulch	Hay 1" material only 029105000250	Reveg001	69.85	/MSF					12.81						AC		558	MSF	38976
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006	8.9	/MSF					12.81						AC		558	MSF	4966
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	19.8	/MSF					12.81						AC		558	MSF	11048
	Subtotal																			54890
	James Canyon																			
	Seeding	Waste Rock Slopes Seed	Skyline07056	61.5	/AC					4.85						AC		4.85	AC	298
	Mulch	Hay 1" material only 029105000250	Reveg001	69.85	/MSF					4.85						AC		211	MSF	14738
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006	8.9	/MSF					4.85						AC		211	MSF	1878
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	19.8	/MSF					4.85						AC		211	MSF	4178
	Subtotal																			20794
	Riparian Stem Supplement																			
	Stems	Bare root seedlings, 11" to 16" med. soil	02915 400 0562	1.31	Ea										9800	Ea		12838	EA	16818
	Subtotal																			58704
	Silt Fence Interim Vegetation																			
	Stems	Bare root seedlings, 11" to 16" med. soil	02915 400 0562	1.31	Ea	20000										LF		20000	EA	26200
	Subtotal																			26200
	Reveg Loadout Sediment Pond																			
	Seeding	Riparian Habitat Seed	Skyline07053	42.25	/AC					0.3						AC		0.3	AC	13
	Mulch	Hay 1" material only 029105000250	Reveg001	69.85	/MSF					0.3						AC		13	MSF	908
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006	8.9	/MSF					0.3						AC		13	MSF	116
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	19.8	/MSF					0.3						AC		13	MSF	257
	Subtotal																			1294
	Winter Quarters Ventilation Facility Bond																			
	REVEGETATION																			
	Winter Quarters Ventilation Facility																			
	South Facing Slopes																			
	Seeding	South Facing Slopes Seed Mix	*	180.00	/AC					2.43						AC		2.43	AC	437
	Mulch	Hay 1" material only 32 91 13 16 0350	Reveg001	56.1	/MSF					2.43						AC		106	MSF	5947
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006 3201901	2.13	/MSF					2.43						AC		106	MSF	226
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	23.15	/MSF					2.43						AC		106	MSF	2454
	Tublings																			
	Quaking Aspen	Bare root seedlings, 11" to 16" med. soil	32 93 43 10 0140	1.79	Ea					2.43						AC		400	/AC	1740
	Blue Elderberry	Bare root seedlings, 11" to 16" med. soil	32 93 43 10 0140	1.79	Ea					2.43						AC		400	/AC	1740
	Subtotal																			12544
	Revegetation																			
	25% of Initial Seeding																			178365
	Subtotal																			178365
	Total																			892217

* = cost from Maple Leaf Seed Mix Quote

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.

4.4.5 Acid and Toxic-Forming Materials

Extensive testing of soil material near the coal seams failed to identify the presence of any materials capable of causing acidity or toxicity problems. (Refer to Hydrology Section of Volume A-1 for test results. These test, however, were conducted using different procedures than those currently requested by the Division. More recent tests on waste material removed from the mine have given mixed signals, particularly on acid forming potential. (Recent test data from representative samples are attached as an exhibit to this section.)

Material placed at the waste disposal site will be compositely sampled on a quarterly basis during periods of deposition at the site within a minimum of 1 sample per 2000 tons hauled, unless it has already been sampled at the temporary minesite gob pile. Composite samples will also be taken during recontouring prior to final reclamation at the waste rock disposal site and on the waste material to be left at the loadout facility site. Analyses of potential toxic or acid forming materials will follow the parameter list and will use the methods outlined on Table 6 of the Division's approved Soil and Overburden Handling Guidelines. Operational test data will be submitted to the Division annually. However, should acidity or toxicity problems be defined either during operation or reclamation, the Division will be notified immediately and mutually acceptable remedial action will be taken.

Waste material temporarily stored in the mine site gob pile will be tested for each accumulation of approximately 2,000 tons if it is going to remain at the temporary site longer than three months. The location in the stockpile from which the sample is taken will be identified. Sample will be a composite sample from throughout the pile. Materials found to be toxic will be removed to the permanent disposal site within 30 days or as soon thereafter as weather conditions permit. Drainage from the temporary storage site reports to the sedimentation pond where the discharge is tested in accordance with UPDES Discharge Permit conditions.

Waste material generated from the Winter Quarters Ventilation Facility (WQVF) Declined Slope will be used to create the facility pad itself. Material will be placed in lifts and compacted and reinforced with a retaining wall. In the event there is an excess of material that cannot be stored on site, whether from the Declined Slope or Vertical Shaft construction, this material will be transported to the Scofield Waste Rock site. Material sent to the Scofield Waste Rock site will be analyzed for toxicity approximately every 2,000 tons of material sent to the site. Waste Rock generated from construction of the Vertical shaft using the raised-bore drilling technique will likely be placed underground.

The majority of the topsoil in the portal yard stockpile was originally removed from National Forest lands and will be returned to National Forest 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 1.5-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 subsoil will be salvaged simultaneously and stored in the designated 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). 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 waste rock disposal site, and the fourth 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 that area. Two topsoil piles are located at the South Fork breakout area (see Map 3.2.11-1), and one at the waste rock disposal site.

4.6.3 Topsoil Protection

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

TABLE 4.6-4

TOPSOIL REDISTRIBUTION

	Acreage	Planned Depth Inches	Cubic Yds	
Loadout Area				
South Slopes	10.52	18	25,458	(Private)
North Slopes	3.30	12	5,324	(Private)
Riparian	.04	18	97	(Private)
Sub-Total	13.86		30,879	
Portal Yard Area				
South Slopes	20.03	18	48,473	(USFS)
North Slopes	16.37	12	26,410	(USFS)
Sub-Total	36.40		74,883*	
Water Tank and Well Pads	.19	12	306	(USFS)
	.07	12	113	(Private)
Sub-Total	.26		419	
Waste Rock Disposal Site	7.68	12***	10,147***	(Private)
			2,198***	(Private)
			12,345***	(Private)
South Fork Breakout Area				
South Slope	.30	30	1,210	(USFS)
North Slope	.66	12	1,065	(USFS)
Sub-Total	.96		2,275*	
Winter Quarters Ventilation Facility				
North Slope	1.611	12	3872	(Private)
1	1			
Sub-Total	1.60		3,872	

CHANGE TO		TEXT		
Table 4.6-4	Page 4-38(c)	Table 4.6-4	Page 4-38(c)	Date 08/10/9

Revised: 12-30-09-

TABLE 4.6-4 (Continued)

TOPSOIL REDISTRIBUTION

	Acreage	Planned Depth Inches	Cubic Yds	
Overland Conveyor Route	.39	12	629	(Private)
			47,838	(Private)
			77,464	(USFS)
GRAND TOTAL	58.51		125,302121,430**	

*Both of these areas are located on National Forest lands and 78,281 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 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.

South Fork of Eccles Canyon continues for some distance on Forest lands beyond the mouth of the side canyon in which the portals are located. However, access to this road is controlled by a gate at the mouth of the South Fork of Eccles Canyon. As described previously, the mine intends to rip and seed the road from the gate at the mouth of the canyon to the lower end of the truck turnout. The portion of the road where topsoil is stored at the mouth of the portal canyon will be reclaimed by pocking or gouging, mulching, and seeding. No further reclamation activities are planned on the pre-existing road south of the topsoil stockpile area.

The truck turnout is approximately 0.06 acres. The road from the truck turnout to the mouth of the South Fork of Eccles has approximately 1 acre of surface area. Therefore, approximately 1.06 acres of road between the south end of the truck turnout will be reclaimed; the truck turnout by ripping the subsoil to relieve compaction, respreading the upper 12-inches of soil previously moved aside, mulching, deep gouging, and seeding, and ripping and reseeding the remainder of the South Fork road from the truck turnout to the road's northern terminus.

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.

4.7.9 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.

Table 4.7-8A

Interim Revegetation Seed Mixture for the Winter Quarters Ventilation Facility.

Species [a)]	Rate [b)] (# PLS/Ac)	Seeds/ft²
Elymus lanceolatus	4.00	14.14
Elymus smithii	5.00	14.46
Elymus trachycaulus	4.00	14.69
Hedysarum boreale	10.00	7.71
Poa pratensis	0.30	14.99
TOTAL	**23.30**	**66.00**

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

[b)] Rates based on broadcast seeding methods.

Table 4.7-8B

Final Revegetation Seed Mixture for the Riparian Community at the Winter Quarters Ventilation Facility.

Species [a)]	Rate [b)] (# PLS/Ac)	Seeds/ft²
FORBS		
Aquilegia caerulea	1.00	8.45
Geranium viscosissimum	7.00	8.36
GRASSES (or Grass-likes)		
Agrostis stolonifera	0.05	7.35
Carex microptera	0.40	7.78
Carex nebrascensis	0.50	6.13
Elymus trachycaulus	2.00	7.35
Juncus arcticus	0.03	7.51
Poa pratensis	0.10	5.00
		0.00
TOTAL	**11.08**	**57.91**

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

b) Rates based on broadcast seeding methods.

c) Willows from containerized, bareroot or local cuttings will be planted in a :staggered or clumped" fashion at a average rate of one plant per 10 linear feet of streambank..

Table 4.7-8C

Final Revegetation Seed Mixture for the Sagebrush/Grass Community at the Winter Quarters Ventilation Facility.

Species [a]	Rate [b] (# PLS/Ac)	Seeds/ft²
SHRUBS		
Amelanchier utahensis	6.00	3.55
Artemisia tridentata var. vaseyana	0.10	5.74
Ceratoides lanata	4.00	5.05
Purshia tridentata	15.00	5.17
Symphoricarpos oreophilus	3.00	5.17
FORBS		
Achillea millefolium	0.03	1.91
Hedysarum boreale	5.00	3.86
Linum lewisii	0.70	4.47
Lupinus sericeus	8.00	4.51
Penstemon rydbergii	1.50	4.54
Viguiera multiflora	0.20	4.84
GRASSES		
Bromus carinatus	1.50	3.44
Elymus spicatus	1.50	4.82
Elymus trachycaulus	1.00	3.67
Poa pratensis	0.10	5.00
Poa secunda	0.20	4.25
TOTAL	**47.83**	**69.98**

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

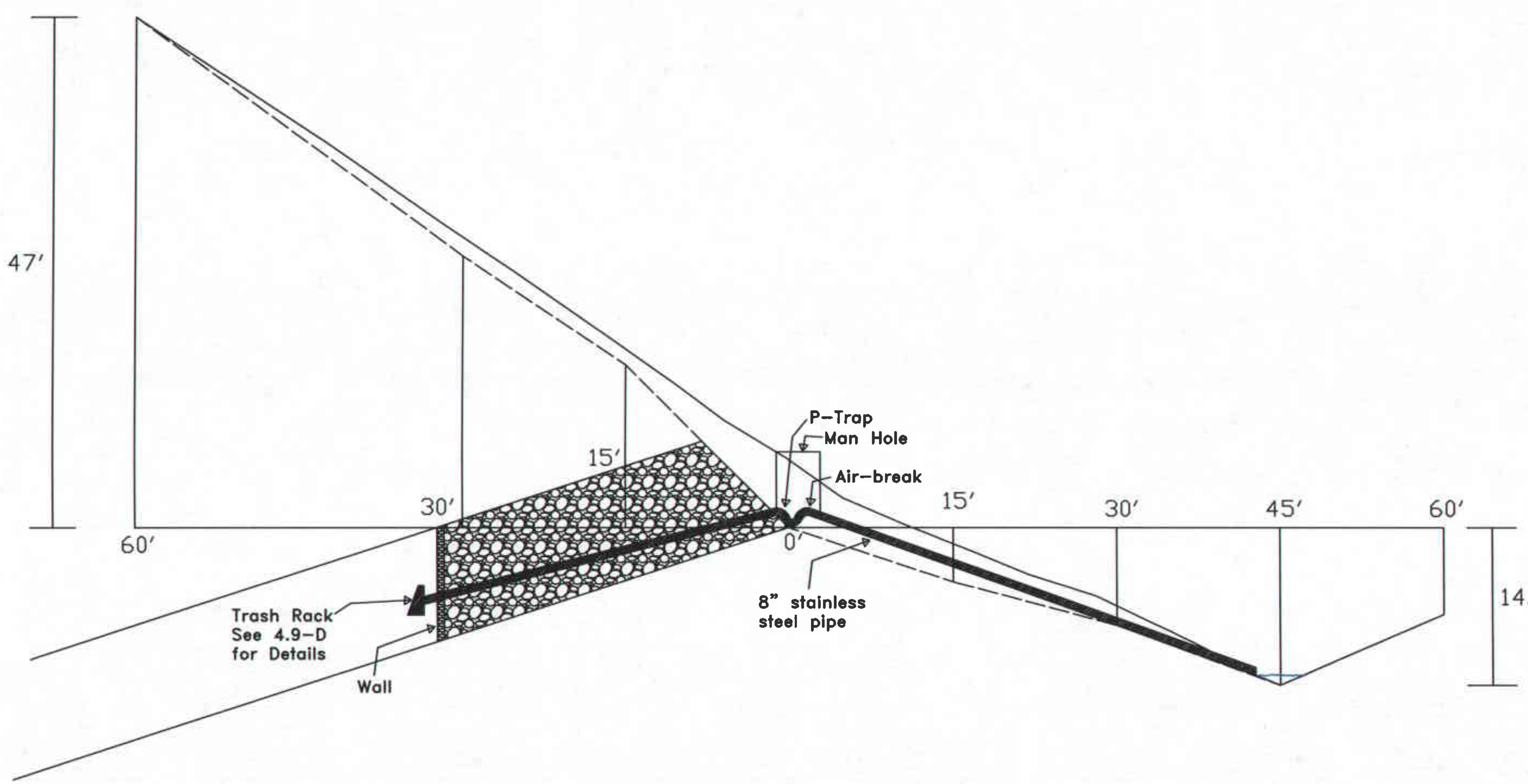
b) Rates based on broadcast seeding methods.

Shafts

Skyline Mine initiated permitting the Winter Quarters Ventilation Shaft in 2010. Reclamation will be in compliance with State regulation R645-301-551 and consistent with MSHA, CFR 75.1711-1. The shaft or other opening to the surface from an underground mine will be, sealed, and will be effectively be capped or backfilled, or otherwise properly managed, as required by the Division. The cap will consist of a minimum 6-inch thick concrete cap or equivalent. The cap will be equipped with a vent pipe at least 2-inches in diameter and extend for a distance of at least 15 feet above the surface of the shaft. 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.

Mine Entries

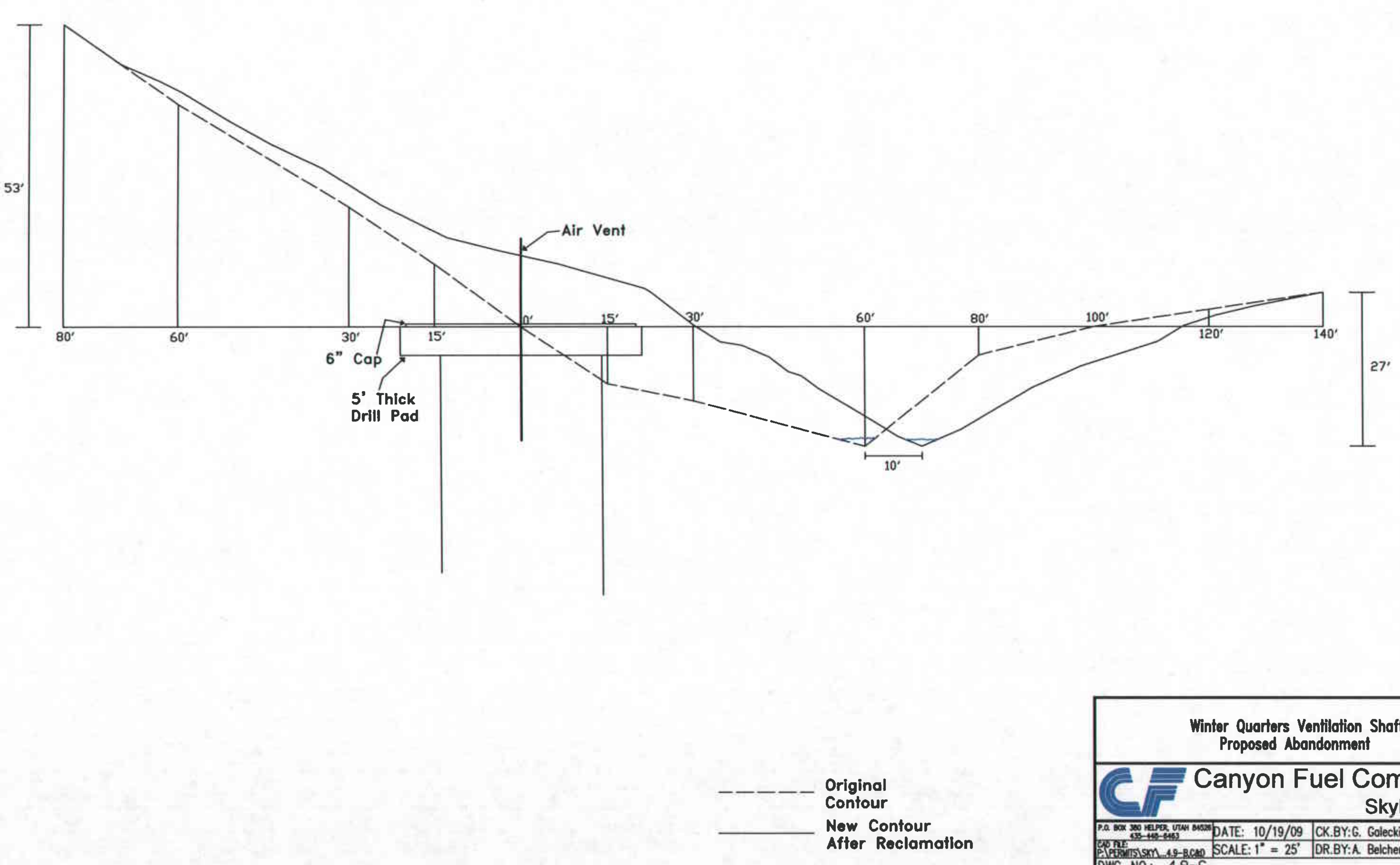
In compliance with 30 CFR 75.1711-2, seals will be installed in all entries as soon as mining is completed and the mine is to be abandoned. (See Figure 4.9-A for typical portal seal.) The seals will be located at least 25 feet inside the portal entry. The opening will be sealed with solid, substantial, incombustible material, such as concrete blocks, bricks or tile, or shall be completely filled with incombustible material. Figure 4.9-B, -C, and -D illustrate the Winter Quarters Ventilation Slope and Shaft abandonment(s).
A gravity discharge from the Winter Quarters Ventilation Facility is possible at reclamation. To accommodate this discharge, an 8-inch (minimum) stainless steel pipe will extend from inby the seal down to the creek. On the inby side of the pipe a trash-rack will be fitted onto the pipe to eliminate any clogging of the pipe (See Figure 4.9-D). The pipe will be buried and daylight at creek level at a location where the creek is well-armored to accommodate the flow.



Winter Quarters Ventilation Slope
Proposed Abandonment

Canyon Fuel Company LLC
Skyline Mines

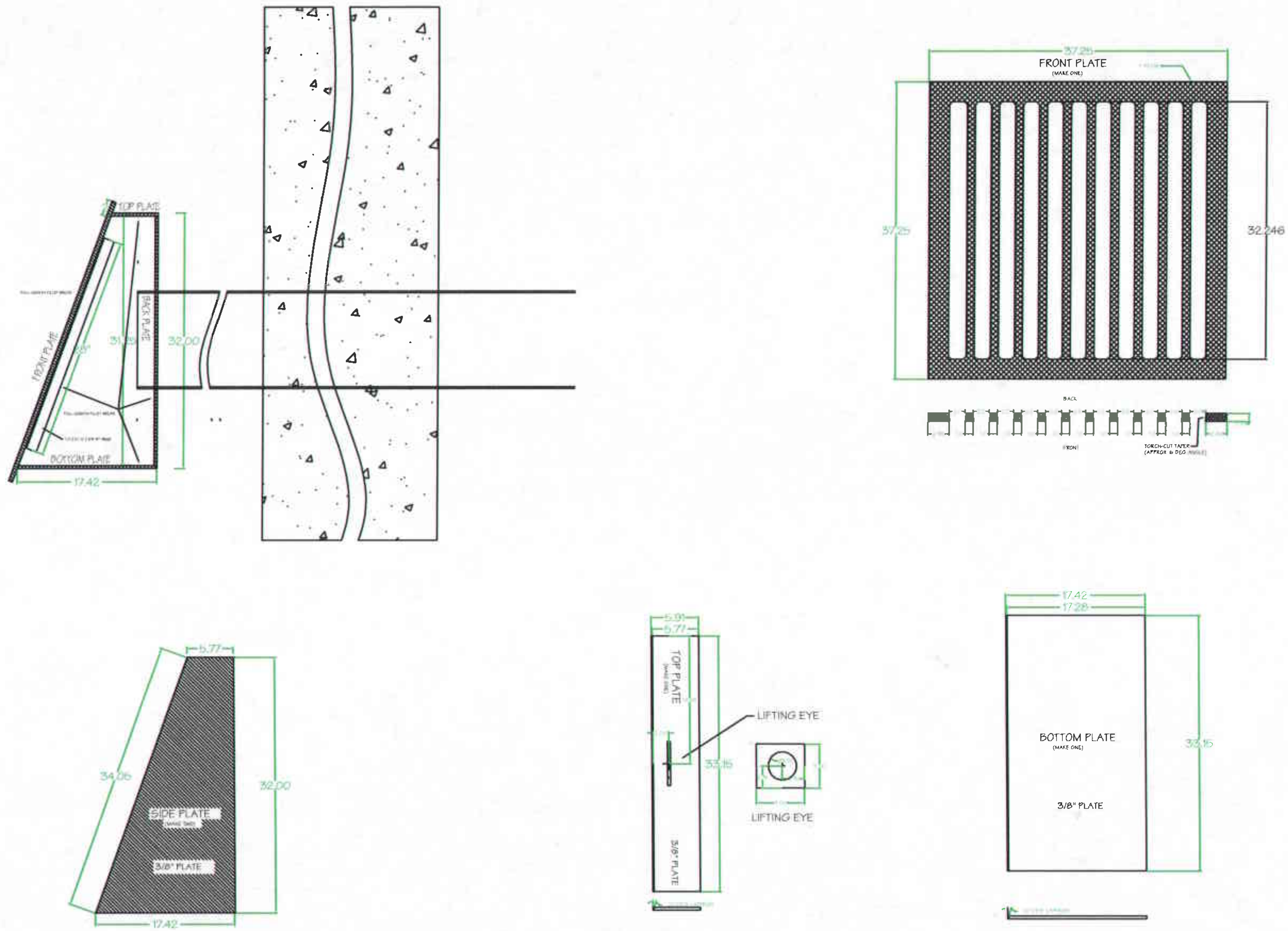
P.O. BOX 380 HELPER, UTAH 84526 435-448-8463	DATE: 10/19/09	CK.BY: G. Galecki	REVISION:
CAD FILE: P:\PERMITS\SKY\...4.9-B.CAD	SCALE: 1" = 15'	DR.BY: A. Belcher	0
DWG. NO.: 4.9-B			10/19/09



Winter Quarters Ventilation Shaft
Proposed Abandonment

Canyon Fuel Company L
Skyline Min

P.O. BOX 380 HELPER, UTAH 84526 435-448-6463	DATE: 10/19/09	CK.BY: G. Galecki	REVISI
CAD FILE: P:\PERMITS\SKY\...4.9-B.CAD	SCALE: 1" = 25'	DR.BY: A. Belcher	0
DWG. NO.: 4.9-C			10/19/



Winter Quarters Ventilation Shaft
Proposed Abandonment

Canyon Fuel Company
Skyline Mine

P.O. BOX 380 HELPER, UTAH 84526 435-448-6463	DATE: 10/19/09	CK.BY: G. Galecki	REVISI
CAD FILE: P:\PERMITS\SKY\...4.9-B.CAD	SCALE: 1" = 20'	DR.BY: G. Kenzy	0
DWG. NO.: 4.9-D			10/19/

in Pleasant Valley Canyon or by pumping water up the canyon from Scofield Reservoir.

Culinary water usage at the mine site qualifies as a public water supply and will be treated to meet State of Utah primary and secondary water standards.

4.11.2 Monitoring Program

In order to concentrate on areas of immediate impact, surface water stations located in Eccles Canyon were sampled more frequently than those on Huntington Creek during the initial phases of mining. (See Sections 2.3 and 2.4.)

As mining progresses toward the Huntington Creek area, sampling in this drainage has increased to more closely monitor mining impacts. The monitoring schedules in Section 2.3 reflect this intensified monitoring activity.

Surface water monitoring will continue according to the monitoring schedule, presented in Section 2.3.7 and 2.4.4, throughout the mining and reclamation operations. Postmining data collection will continue at each of the stations until the reclamation effort is determined successful by the regulatory authority. Quarterly ~~The August~~ samplings will continue to be analyzed according to Table 2.3.7-1 during the postmining period. The remaining samples are per Table 2.3.7-2.

Water quality data collected from surface and ground water monitoring stations will be submitted quarterly to the regulatory authority. These reports will normally be submitted electronically within 90 days of the completion of the quarterly monitoring program. ~~An annual summary will also be prepared and submitted within 90 days after the end of the calendar year.~~

In addition to the above outlined monitoring program, UPDES discharge permit monitoring is conducted in accordance with the stipulated permit conditions.

4.11.3 Water Quality Control

The ground water that is intercepted and brought to the surface as a result of mining operations normally has a lower dissolved solids content than would exist if the water was to continue its downward movement through the existing shale layers, picking up increased amounts of salt with distance through the rock formations. Generally, mine water is expected to occur when pockets of perched water are interrupted and drained. ~~The permittee believes that the limited amount of total dissolved solids (TDS) expected justifies the exclusion of complex and expensive water treatment facilities for reduction of TDS.~~ Although suspended sediment and oil and grease may increase at the mine mouth area, these constituents will be removed by retention and sediment pond skimmers prior to any potential discharge to adjacent streams. As a result, operation of the Skyline Mines is expected to have an overall beneficial impact on water quality in the region.

4.11.4 Water Quantity - Impacts

The Blackhawk Formation, extending over the entire Skyline property, consists of interbedded layers of sandstone and shale separated by various mineable and nonmineable coal seams. The sandstone beds are generally massive while the shale layers are generally bentonitic, tending to swell when wet and decompose into an impervious clay. Investigations at springs on the project area have indicated that the shale beds prevent significant downward percolation of water through the Blackhawk Formation, with much of the water entering the upper layers and surfacing a short distance away as a spring. In addition, due to the ability of the shale material to swell and decompose into an impervious clay, fractures in the Blackhawk Formation do not act as conduits but instead as barriers to potential infiltrating water.

As a result of these observations, it has been concluded that the mining activity in the Skyline Mines will have minimum adverse

4.11.5 Mine Facilities Drainage Area

The original drainage plan for the mine surface facilities was designed by Kaiser Engineers for the Permittee. Streams crossing the mine site are collected outside of the disturbed area and diverted into corrugated metal pipe (CMP) culvert of adequate size for the 100 year, 24-hour precipitation event. The CMP culverts are located to transfer the upstream flow under the minesite to Eccles Creek below the minesite. Diversion channels were constructed above the disturbed area to collect the runoff from the undisturbed areas and direct it to Eccles Creek.

4.11.6 Load-out Site Drainage

The original drainage plan for the load-out site was designed by Kaiser Engineers for the Permittee. The creek in Eccles Canyon was diverted from its natural state to gain space. Diversion channels were constructed south of the disturbed area to collect runoff from the undisturbed areas and direct it to Eccles Creek. The disturbed area surface runoff is collected and diverted to the sedimentation pond located adjacent to the storage silos.

4.11.7 Portal Locations

The mine portals have been designed to ensure that water will not be gravity discharged from the mine. The portals will have a minimum negative (in mine) slope of four percent to prevent any gravity discharge.

4.11.8 Underground Water Treatment

The mine water encountered at the working face is collected in the face area and pumped to collection points located within each mine. These collection points (or abandoned areas of the mine) ~~The impoundments~~ allow some time for suspended solids to settle. Underground water is permitted to be pumped from the Mine directly to Eccles Creek when discharge parameters are met. ~~The water is pumped from the mine into the portal area sediment pond which is the principle treatment facility. Mechanical devices have been~~

~~installed at collection points to screen grease and oil which might be preset in the water before it is pumped out of the mine.~~ All of the mine workings are located down dip from the entries which precludes gravity discharge. Upon abandonment of mining activities, the entries will be sealed as indicated in Section 4.9.

4.11.9 Winter Quarters Ventilation Facility (WQVF)

The ventilation facility design includes the locations of the declined slope, exhaust shaft, emergency escapeway shaft, sediment pond, and drainage plan for both the disturbed and undisturbed drainage. The pad is located a minimum of approximately 30 feet north of Winter Quarters Creek and approximately 20 feet higher in elevation to minimize water entering the mine. The mine openings (shafts/slope) are locate up dip of the mine workings, eliminating concern of any gravity discharge during the operation of the mine. Initially, 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 approximately 460 feet below the lowest portal in Eccles Canyon (Trespass Portal 8580 ft.). Due to the elevation change, a gravity discharge from the mine at reclamation is likely. In the absence of building bulkheads within the mine at various locations to prohibit gravity discharge, Winter Quarters has the potential to receive an additional 500-600 gallons of water with an estimated Total Dissolved Solids (TDS) concentration in the range of 500-700 mg/l. It is anticipated the untreated water quality will comply with performance standards of R645-301, R645-302, and any additional UPDES permit requirements (refer to Section 4.9 and Figure 4.9D for discharge pipe details). Because the majority of this groundwater would not naturally be discharged to the surface in the immediate area, no significant depletion will occur in the amount of water reaching the surrounding creeks and springs since these water sources (creeks and streams) are located stratigraphically above the in-mine water source. Any groundwater intercepted and discharged into Winter Quarters Creek would be consistent with the groundwater gradient information submitted in the PHC - generally to the north-northeast (PHC Volumes July 2002 and October 2002).

Revised: 12-30-09

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	Adequate Area	Compatible
Conveyor and Pipeline	Private	Grazing/ Wildlife Habitat	Grazing/ Wildlife Habitat	Wildlife Habitat	Adequate	Compatible
Main Access State Road		Forest Access and Service Road	State Road	None	Adequate	Compatible
Loadout	Private	Grazing, Picnic and Stock Pens*	Grazing/ Wildlife Habitat	Wildlife	Adequate	Compatible
Waste Rock Disposal	Private	Grazing/ Wildlife Habitat	Grazing/ Wildlife Habitat	Wildlife Habitat	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 Ventilation Facility	Private	Grazing Mining Wildlife	Grazing 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 mine support roads will be reclaimed in the permit area. Culverts and blacktop surfacing material will be removed. Reclamation would then include recontouring, ripping, adding cross drains, water bars, topsoil and seed.

Removal of Scofield Waste Disposal Site Sedimentation Pond

The livestock permittee through the owner has requested that the sedimentation pond not be reclaimed. If, over a period of time, it shows that these ponds hold natural runoff water and will be beneficial for livestock and wildlife use, they will not be removed. However, for planning and bonding purposes the sedimentation pond is to be removed and reclaimed (Map 4.16.1C). In the event the pond is not removed, Map 4.16.1B illustrates the reclamation work.

Removal of Winter Quarters Ventilation Facility (WQFV) Sedimentation Pond

The WQVF area sedimentation pond will be removed during early Phase I reclamation. Alternate sediment control measures such as silt fences, straw bales and check dams will be used until the area is vegetated and runoff meets applicable standards.

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.

4.12.7

Winter 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.

4.13 PONDS, IMPOUNDMENTS, BANKS, DAMS & EMBANKMENTS-MINE PLAN AREA

4.13.1 Sedimentation Ponds

Four sediment ponds for surface water runoff are required, one at the mine site, the second at the coal load-out site, the third at the rock disposal site, and the fourth at the Winter Quarters Ventilation Facility. Each pond is designed to provide adequate volume for sediment containment plus an adequate volume for a theoretical 24-hour detention of runoff from a 24-hour, 10 year precipitation event (Mine Site Pond Section 7, Volume 5 Loadout Site Pond Section 13, Volume 5) ,Rock Disposal Pond Section 15, Volume 5, and Winter Quarters Ventilation Facility (Volume 5 Section 24). The location and preliminary design characteristics of each of these three ponds is described in Section 3.2 - COMPONENTS OF OPERATION, subsection 3.2.1-Ponds, Impoundments and Dams. The maintenance for each pond is described in Section 3.2 - COMPONENTS OF OPERATION, subsection 3.2.6 - Procedures for Construction through Removal of Major Structures and Facilities. The reclamation timetable for removing the pond structures is presented in Section 4.2 - RECLAMATION TIMETABLE.

The design drawings for the mine site, load-out sedimentation, Waste Rock disposal, and Winter Quarter ponds are shown in Maps 3.2.1-1 and 3.2.1-2, and Maps 3.2.1-3 and 3.2.1-4, Map 4.16.1-1B, and 3.2.4-3D respectively.

The area under the sedimentation ponds will not be subsided. The ponds shall be operated in accordance with UPDES Discharge Permit conditions. Operations effecting the UPDES Discharge Permit, which are not clearly defined in the permit, shall be coordinated with the

Division of Environmental Quality. The Permittee will operate the ponds in a prudent manner and will attempt to reduce the sediment loading to the receiving waters ~~into Eccles Creek~~. Pond decanting will be utilized to minimize sediment loading into the receiving stream. When decanting operations are conducted, they will conform with applicable water quality standards including exercising the settleable solids measurement option of the UPDES Discharge Permit during periods of storm runoff or snow melt.

The portal area sedimentation pond is recessed and, therefore, has no embankments requiring geotechnical investigations. The engineering evaluation for the load-out area sedimentation pond is discussed in Section 3.2.1 and in Volume 5.

The loadout area sedimentation pond was designed and built with a combined slope of 4:1. Engineering justification for departure from the recommended 5:1 combined slope is included in the Engineering Calculations, Section 1 of Volume 5. During sediment clean out of the loadout sedimentation pond, the pond shall be drained of all the water that will meet permit requirements. Water not meeting discharge requirements may be used to water roads for dust suppression, water vegetation within the area reporting back to the sediment pond or may be hauled to the portal area sedimentation pond.

The rock disposal area sedimentation pond is recessed and, therefore, has no embankments requiring geotechnical investigation. During sediment clean out of the rock disposal sedimentation pond, the pond shall be drained of all the water that will meet permit requirements. Water not meeting discharge requirements may be used to water roads for dust suppression, water vegetation within the area reporting back to the sediment pond or may be hauled to the portal area sedimentation pond.

The Winter Quarters Ventilation Facility pond has an embankment that will be built according to designed specifications. Engineering Calculations are located in Volume 5, Section 24, and illustrated on Map 3.2.4-3h.

The four ~~three~~ sediment ponds will be inspected, at a minimum, once each calendar quarter for structural weakness, erosion, and other hazardous conditions. Any deficiencies found will be reported to DOGM. Reports are kept at the mine office and are available upon request.

4.14 PROTECTION OF PUBLIC PARKS AND HISTORIC PLACES

No public parks or registered historic places are located in areas affected by the Skyline mining operation. The Permittee agrees, however, to notify the regulatory authority and the Utah State Historic Preservation Office (SHPO) of previously unidentified cultural resources discovered in the course of mining operations. The Permittee also agrees to have any such cultural resources evaluated in terms of National Register of Historic Places eligibility criteria. Protection of eligible cultural resources will be in accordance with regulatory authority and Utah SHPO requirements.

The Winter Quarters Ventilation Facility (WQVF) is located on the westernmost edge of the Winter Quarters town site. A historical survey was conducted by Earth Touch, Inc. and is located in the Confidential File. A second report submitted by Canyon Environmental serves as an addendum to the first report due to changes in the pad design which ultimately had the potential to affect other features. The cultural resources in the Winter Quarters town site has been evaluated numerous times in terms of the National Register of Historic Places eligibility criteria and been determined to qualify. However, the affected landowners have expressed to SHPO (on numerous occasions), that they adamantly do not want the site to be listed. The vast majority of features with historical significance associated with the Winter Quarters town site are located at least ½- mile east of the ventilation facility and do not compromise the integrity of the site. A total of ten (10) dilapidated earthen and/or stone foundations may possibly be impacted by the ventilation facility. A meeting conducted with Skyline Mine, SHPO, DOGM, and Public Lands Policy Coordination Office personnel determined the most suitable protection of the Winter Quarters Canyon site was to construct an informative sign at the mouth of the canyon along SR96 in conjunction with Eccles Canyon National Scenic Byway - Energy Loop interpretive signs where the public will be provided with an awareness of the cultural activities that were historically in the area.

rock waste storage areas which result from mining coal. The economics of loading, hauling and disposing of rock waste at any point other than underground effectively prohibit the extensive use of a surface rock waste storage site.

If favorable market conditions exist, material may occasionally be recovered from the waste storage site and returned to the product stream. Surface royalties and fees will be paid for all recovered material. Material placed in the waste rock disposal site is neither toxic nor acid generating as indicated by routine sampling and analysis. The sample results are submitted to the Division annually.

The roof and floor rock for the three mineable Skyline coal seams are estimated to be 60 percent sandstone, 30 percent shale, and 10 percent claystone. The igneous dike rock varies in composition, but is essentially comprised of ferromagnesian minerals. The majority of dike rock which would require surface disposal is anticipated to be very similar to basalt and would be very durable and extremely resistant to weathering. The volumetric swell factor for the igneous and sedimentary rock is estimated to be 30 percent.

The Permittee expanded the storage capacity of the Waste Rock site in 2007. Due to changing mining conditions it is hard to provide a reasonably accurate estimate of the amount of material that will be deposited at the site. The expansion provides an estimated 300,294 yds^3 of additional storage, which should be adequate for the term of the lease.

4.16.2 Winter Quarters Ventilation Facility (WQVF)

Similar to the surface facilities at the Main Mine Site, developmental waste generated from the construction of Declined Slope and possibly from the vertical shaft will be used as fill material for the remainder of the WQVF pad. Approximately 8,000 cubic yards of material is anticipated to be generated from the Declined Slope. Approximately 4,600 cubic yards will be generated from the Vertical Shaft if the shaft is sunk from the surface using conventional methods. If the raise-bore technique is used for the construction of the shaft, very little material will be stored at the surface. Construction of the WQVF pad is a minimum 20 feet above the elevation of any existing ground or surface water. The WQVF pad will be built a minimum of two streambank widths away from Winter Quarters Creek, thus maintaining a buffer zone and minimizing the potential for stream or pad to impact each other. At reclamation, the developmental waste will be used in backfilling of the Declined Slope, the vertical shafts and attaining the Approximate Original Contours (AOC).

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).

- 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.

area has been reseeded and will not be used again until final reclamation.

During reclamation, the fill material will be removed and then the culvert lifted out of the channel. Top soil will then be placed back on the disturbed area with a track hoe and the area reseeded. Although no permanent disturbance to the channel is planned or expected, if it should occur it will be rip-rapped with a gradation of material from 4" to a maximum size of 38" (Section 18, Volume 5).

All culverts used for access to the area will be completely removed from the area during final reclamation.

This final reclamation plan outlines the minimum reclamation to be accomplished. At the time of final reclamation, a meeting will be held with the U.S. Forest Service to determine if additional reclamation work over-and-above that outlined in the plan is needed.

4.19.9 Winter Quarters Ventilation Facility

Plates 3.2.4-3A through 3.2.4-3G illustrate the construction designs. Plates 4.4.2-3A and 4.4.2-3B illustrate the final reclamation of the WQVF site. Engineering Calculations, designs, and other maps of the facility can be found in a report titled "Winter Quarters Ventilation Shaft Pad, Runoff and Sediment Control Design Report", located in Volume 5, Section 24 of the M&RP.

The reclamation of the WQVF pad will be straight-forward, being located on a south-facing slope with only very minimal impacts to the riparian corridor of Winter Quarters Creek. No topsoil in the minimal riparian areas needed to be removed during construction or reclamation of the site – only minor traffic that will be readily re-vegetated. Any concerns of excessive runoff are minimized with the undisturbed ditch on the existing road located above the site. The road drainage was improved to accommodate a 6-hour, 100-year storm event from the majority of the hillside located above the site.

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, with the landowners being responsible for the maintenance of the road.

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 -3c for detailed road illustrations and Plates 4.4.2-3A and 4.4.2-3B for reclamation details.

CLEMENT DRILLING
& GEOPHYSICAL, INC.

4114 West 9950 North
Cedar Hills, Utah 84062
Phone 801-372-3685
Fax 801-785-5748

February 17, 2009

Mr. Gregg Galecki,
Skyline Mine
HC 35 Box 380
Helper, Utah 84526

Dear Mr. Galecki,

This letter report summarizes the methodology and results of the seismic refraction testing conducted by Clement Drilling & Geophysical, Inc. at the Skyline Mine Winter Quarters site, near Scofield, Utah.

Seismic Refraction Testing

Four refraction lines were conducted at the project site in order to determine the compression wave (P-wave) velocities of the shallow subsurface material. The locations of the refraction lines are shown on Figure 1. The data were collected utilizing a Geometrics SmartSeis S12 seismograph, 8 Hz geophones and 12-pound hammer source. Each line except Line 3 consisted of two spreads approximately 220 feet long with 12 geophones placed at 20-foot intervals. Line 3 consisted on one 220-foot spread. Data collection consisted of center shot and two off end shots at each end of the seismic spreads. The auto-stacking feature of the seismograph was used to stack multiple shots at each location in order to reduce the signal to noise ratio of the data. Data from the test was recorded by and stored in the seismograph.

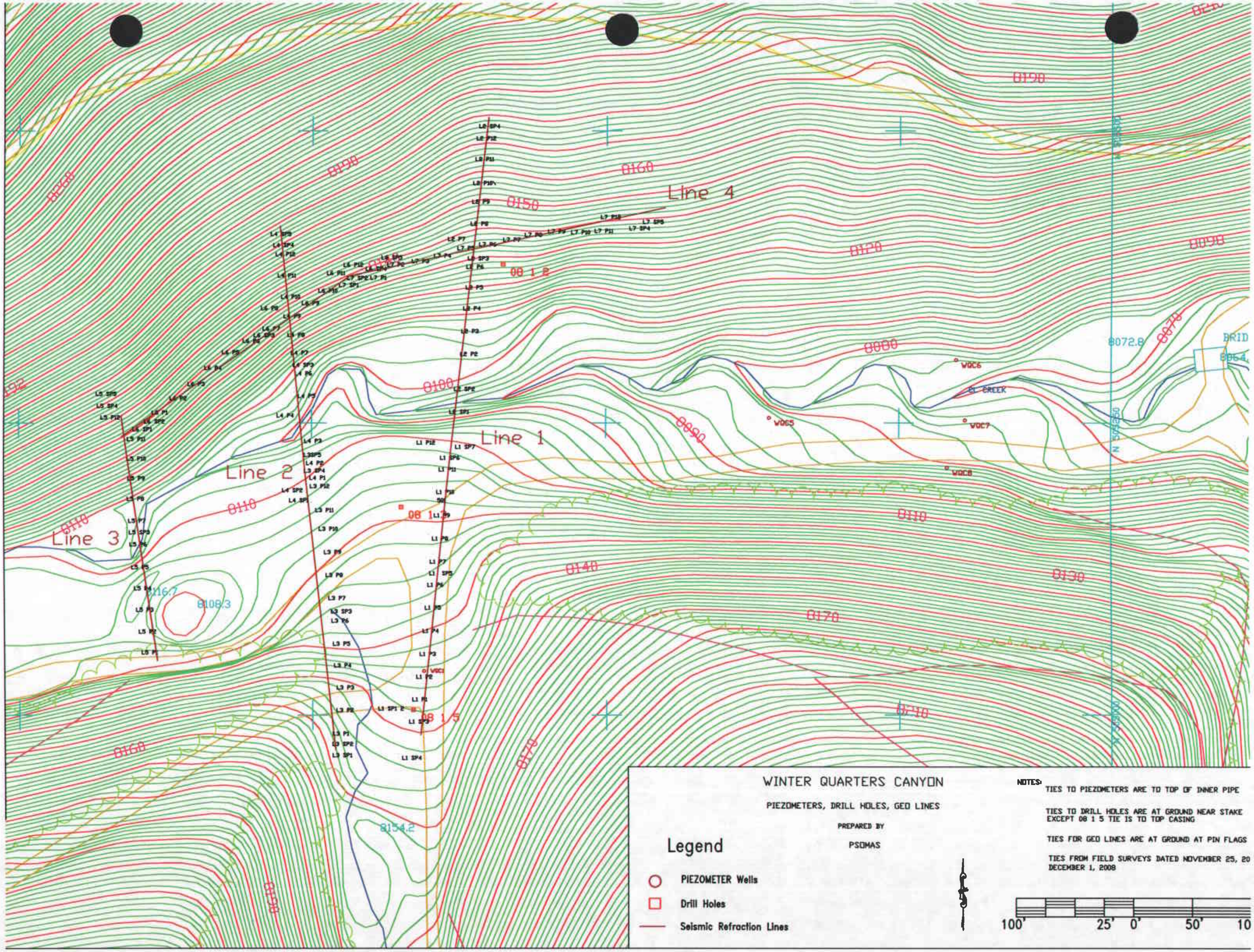
The data were processed using Rimrock Geophysics SIP software to pick the first arrivals at each geophone location and create an ASCII input file. The seismic spreads were combined into four profiles for input into the processing software. The four input files were processed using Optim's SeisOpt Pro modeling software. The refraction profiles show the calculated P-wave velocities for the subsurface materials and are presented on Figures 2, 3, 4 and 5.

Seismic Refraction Results

The profiles of the results of the seismic modeling for Lines 1, 2, 3 and 4 are presented in Figures 2, 3, 4 and 5. The typical lower seismic velocity for clastic sedimentary rocks is about 4,000 feet per second (ft/s). In the profiles this corresponds to the material shown in green. There is usually a layer of weathered bedrock with a lower velocity that overlies the more competent bedrock. This material is probably represented by the bluish-green on the profiles. All of the profiles indicate increasing velocity with depth. Lines 1 and 3 were run perpendicular to the centerline of the creek and show evidence of lateral movement of the stream channel in the past. The profiles of Lines 1, 2 and 3 correlate well where they cross Line 4. Based on the nature of refraction modeling there is limited data acquired on the ends of the seismic lines. This results in deeper units not showing up at the very ends of the profiles and may account for the 6,000 ft/s and greater material not showing up at the east end of Line 4. The material may actually have increased in depth or there may not be enough data points to accurately model that area. For this reason the attempt was made to extend the lines beyond the areas of interest.

Please feel free to contact me if you have any questions regarding the results of the geophysical testing. I appreciate the opportunity to work with you on this project.

Sincerely,
Clement Drilling & Geophysical, Inc.
Craig M. Clement
Craig M. Clement, P.G.


WINTER QUARTERS CANYON
PIEZOMETERS, DRILL HOLES, GEO LINES
PREPARED BY
PSOMAS
Legend
PIEZOMETER Wells
Drill Holes
Seismic Refraction Lines
NOTES:
TIES TO PIEZOMETERS ARE TO TOP OF INNER PIPE
TIES TO DRILL HOLES ARE AT GROUND NEAR STAKE
EXCEPT 08 1 5 TIE IS TO TOP CASING
TIES FOR GEO LINES ARE AT GROUND AT PIN FLAGS
TIES FROM FIELD SURVEYS DATED NOVEMBER 25, 20
DECEMBER 1, 2008
100'
25'
0'
50'
Line 1
Line 2
Line 3
Line 4
08 1 2
08 1 5
WQC5
WQC6
WQC7
WQC8
0108.3
0154.2
0072.8
BRID

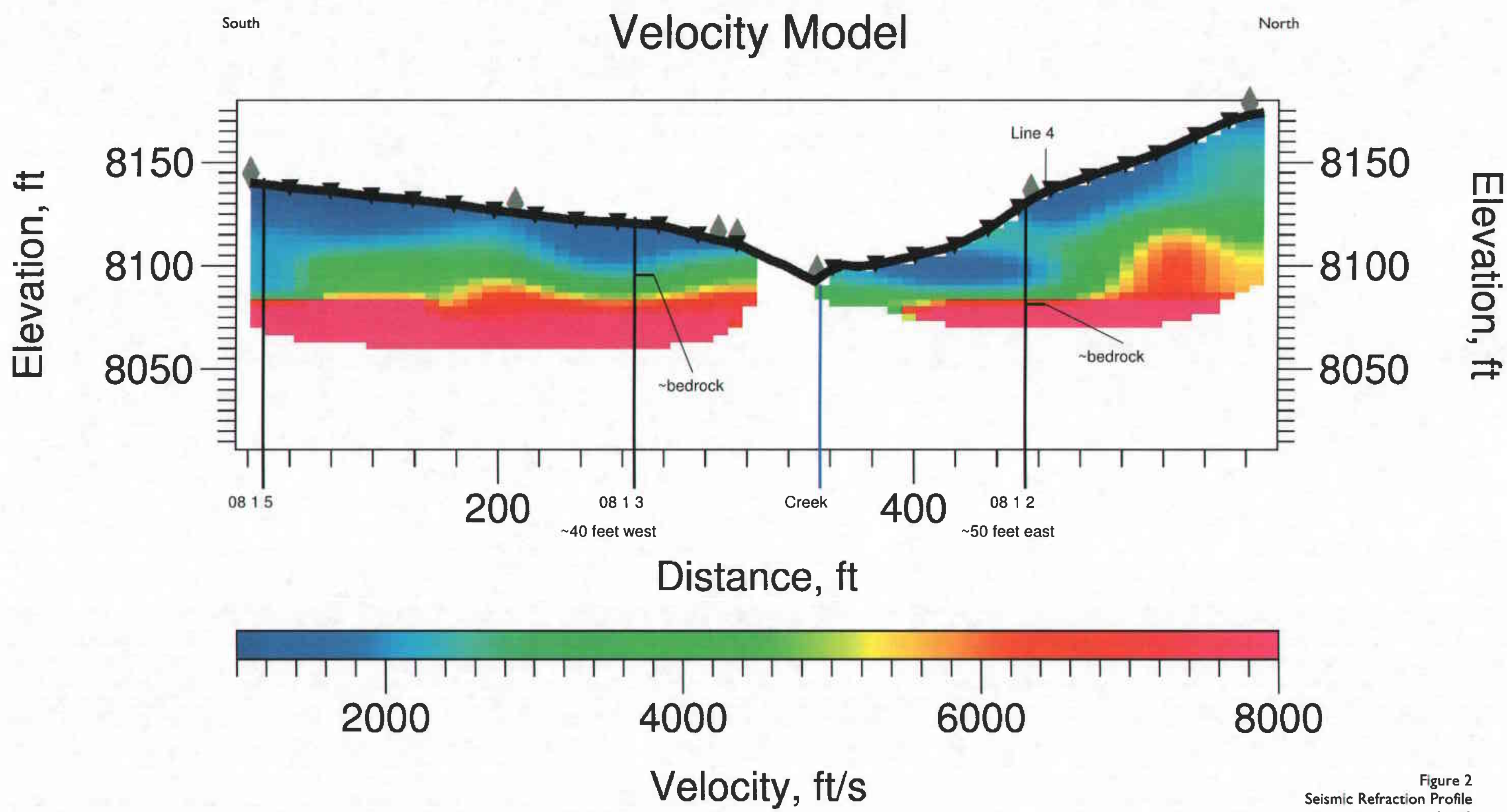


Figure 2
Seismic Refraction Profile
Line1

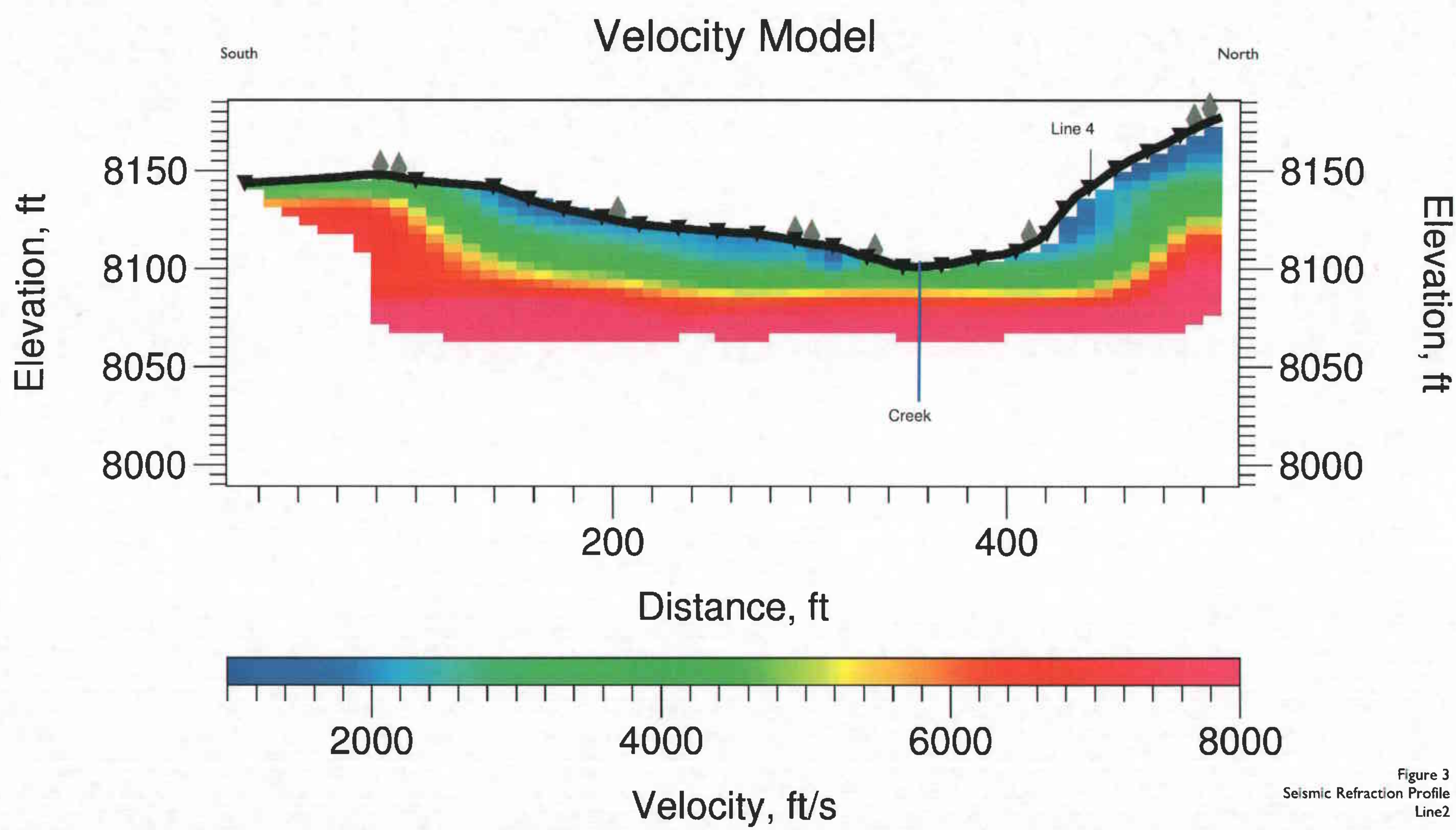


Figure 3
Seismic Refraction Profile
Line2

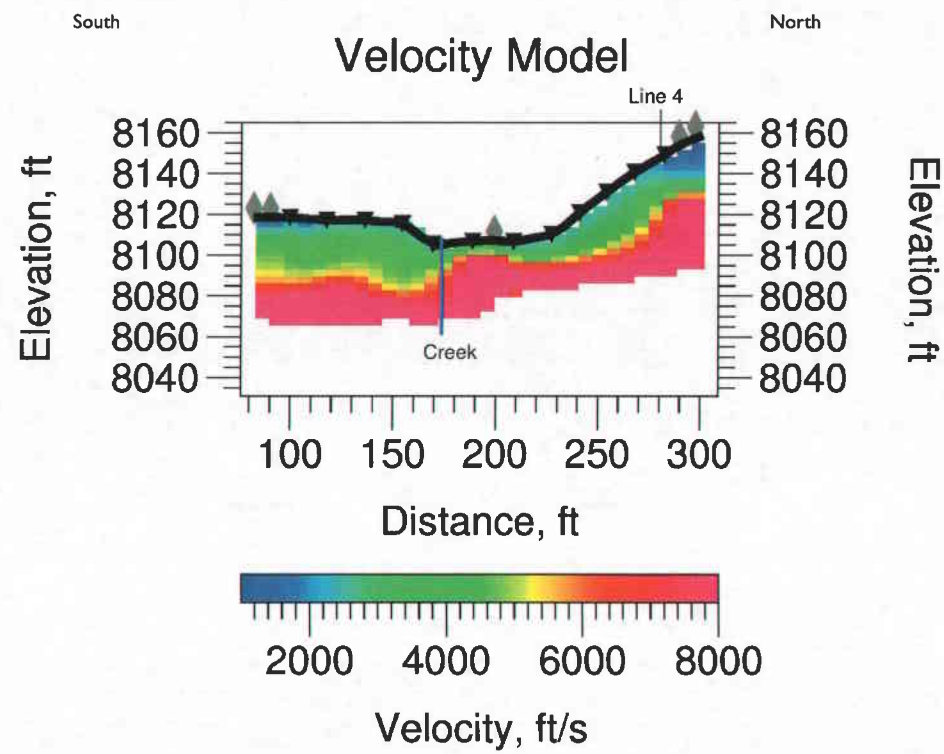


Figure 4
Seismic Refraction Profile
Line3

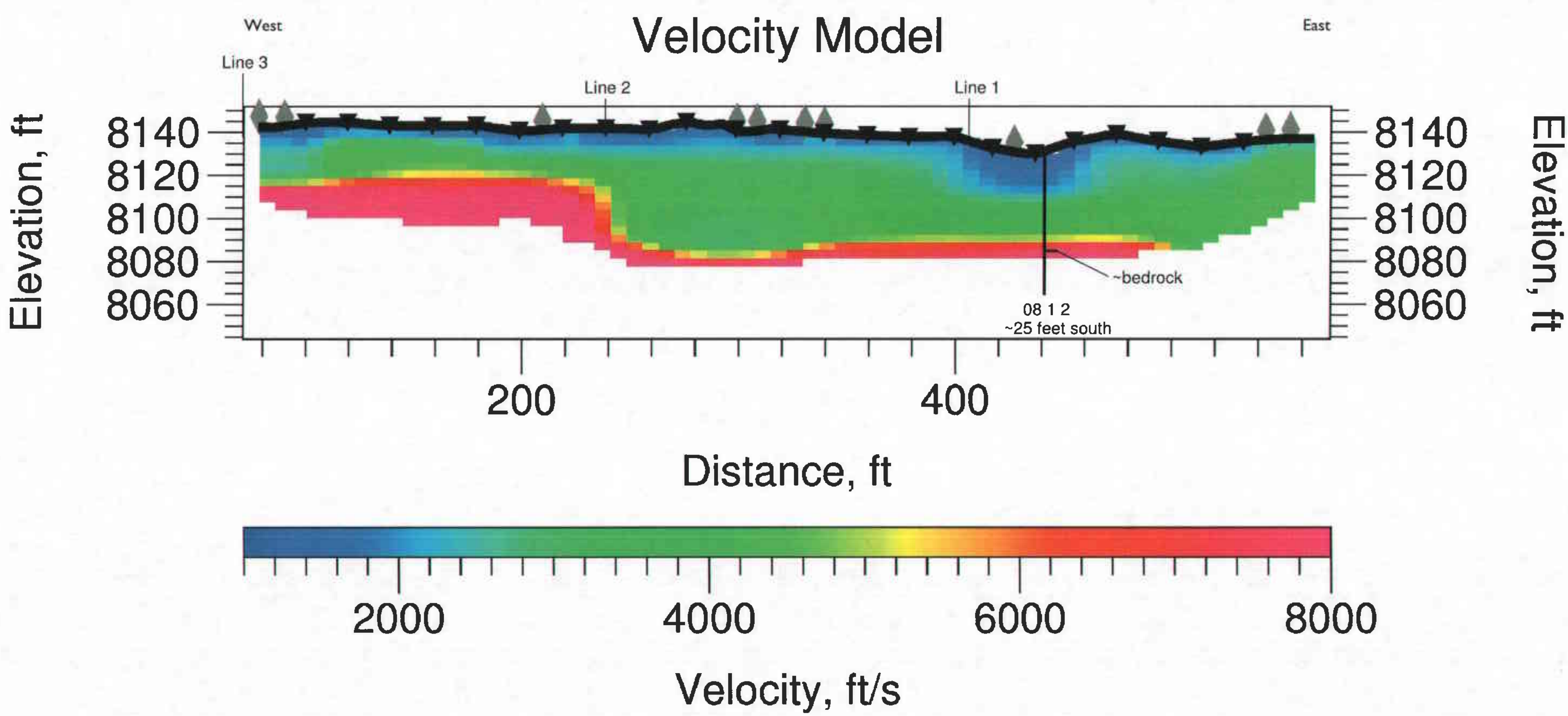


Figure 5
Seismic Refraction Profile
Line4

Canyon Fuel Company, LLC.
Skyline Mine
A Subsidiary of Arch Western Bituminous Group, LLC

Austin Belcher, Environ. Engineer
HCR 35, Box 380
Helper, UT 84526
(435) 448-2668 - Office
(435) 448-2632 - Fax

October 5, 2009

Winter Quarters Stream Photo Documentation

During the summer of 2008, the Winter Quarters stream was photo documented from the western boundary of section 5 to the western edge of the Winter Quarters Ventilation Facility. The photos labeled 23 Up through 27 Up, demonstrate the condition of the Winter Quarters stream spanning the entire Winter Quarters Ventilation Facility site, prior to construction. The other photos give an overview of the Winter Quarters stream and canyon prior to the installation of the Winter Quarters Ventilation Facility.

2 Down

2 Up

3 Down

3 Up

4 Down

4 Up

5 Down

5 Up

6 Down

6 Up

7 Down

7 Up

8 Down

8 Up

9 Down

9 Up

10 Down

10 Up

11 Down

11 Up

12 Down

12 Up

13 Down

13 Up

14 Down

14 Up

15 Down

15 Up

16 Down

16 Up

17 Down

17 Up

18 Down

18 Up

19 Down

19 Up

20 Down

20 Up

21 Down

21 Up

22 Down

22 Up

23 Down

23 Up

24 Down

24 Up

25 Down

25 Up

26 Down

26 Up

27 Down

27 Up

Overview Down

Overview Up

Up from gate

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
540 West Price River Drive
Area Office
Price, UT 84501
(435) 637-0041
FAX (435) 637-3146

June 19, 2009

Mr. Gregg Galecki
Arch Coal, Inc
Skyline Mine
P.O. Box 719
Helper, UT 84526

Re: Production estimates for proposed Winter Quarters Ventilation Shaft Pad and Slope Shaft Pad.

Mr. Galecki,

Thank you for taking the time to meet with me on June 16, 2009 in Winter Quarters Canyon. As we discussed in the field the proposed location lies within three distinct ecological sites; south facing slope is Mountain Very Steep Stony Loam (Mountain Big Sagebrush), the north facing slopes is a High Mountain Loam (Aspen) and in the valley bottom, Wet Fresh Streambank (Willow) (Figure 1). Following the field visit, as well as experience with recent climatic conditions, I have made the following determinations for vegetative production and overall, health and trend of the sites. It is noted that some of the sites have previously been disturbed with differing levels of success in the reestablishment of the Potential Natural Community (PNC). Please refer to Figures 2 & 3 to see the extent of disturbance from the previous logging activities. The only ecological site that appears to have not experienced high levels of perturbation is the Mountain big sagebrush site.

The northern portions of the proposed facilities lie within the Mountain Big Sagebrush site. This site appeared to be is very good condition at the time of the visit. Vegetation was vigorous, all appearing to exhibit reproductive capabilities and having very limited occurrences of weedy species (mainly thistle). Although there were areas with exposed soil, there was only a moderate indication of soil loss/movement despite the extremely steep slopes. Based on the conditions I observed in the field I would estimate this site is capable of producing approximately 1,300 lbs Ac^{-1}.

The willow site is still recovering from the previous logging activities and appears to have continued heavy use from livestock. Although I did not tour the surrounding locations extensively, I did not see any other watering sources in the area. Without the additional watering sources it is a given that this location will continue to see heavy use by livestock. From the previous disturbances as well as the livestock utilization of the area, the site is exhibiting an extensive colonization of weedy species (mainly stinging nettle, hounds tongue, thistle and mullen). The PNC of a site like this would normally produce over 2,000 lbs Ac^{-1}. However, at its current state I would estimate that an average throughout the proposed site would produce approximately 800 lbs Ac^{-1}.

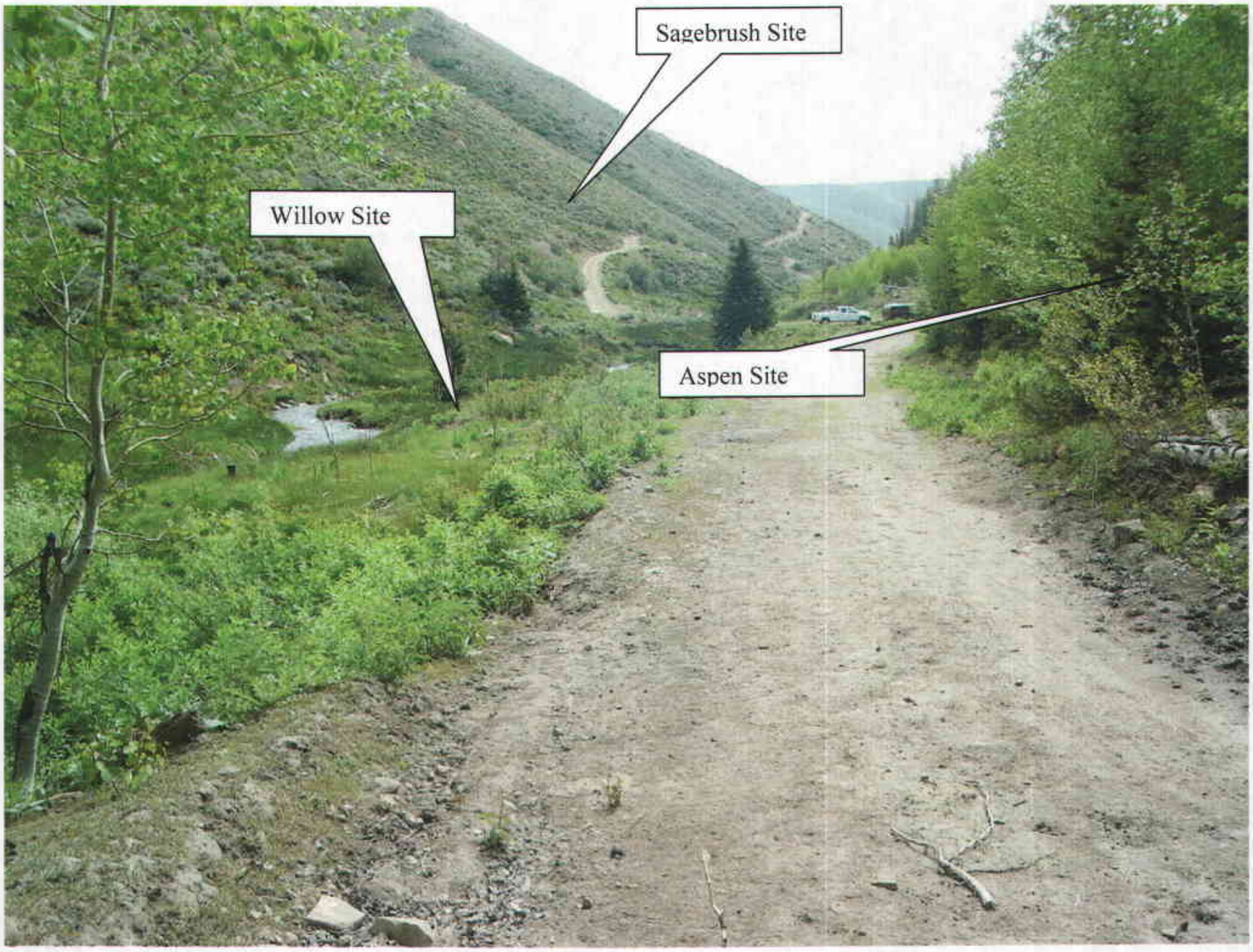


Figure 1. Visual representation of the location of the three distinct ecological sites.

The aspen site had two conditions within the proposed area of disturbance (Figure 2), one of which had previously been logged with some dead (bark beetle mortality) Douglas-Fir remaining with some older (tall straight, stemless trunks and short rounded crowns) as well as a healthy immature stand with more vigorous growth (greater age diversity), also containing some young fir trees. For this state of the aspen stand I would estimate it produces approximately 800 lbs Ac^{-1}.

Figure 2. Visual representation of aspen stand that was previously disturbed by logging activities.

The other extent of disturbance existing in the aspen stand that lies within the proposed location can be seen in Figure 3. This location appears to have been the landing area for the previous logging activities. This area is located where the proposed Sub Station is to be located. It appears this site has crossed a threshold and without considerable input will take and extended period of time to recover to its potential. For this particular site I would estimate that it produces approximately 300 lbs Ac^{-1}.

Figure 3. Visual representation of old landing area where proposed Sub Station is to be located.

In addition to the production estimates given above I have also provided a rangeland health assessment to help better qualify the overall conditions of these sites (Figures 4-6).

Sagebrush site

Departure from Expected	Code	Instructions for Evaluation Sheet, Page 2
None to Slight Slight to Moderate Moderate Moderate to Extreme Extreme to Total	N-S S-M M M-E E-T	(1) Assign 17 indicator ratings. If indicator not present, rate None to Slight. (2) In the three grids below, write the indicator number in the appropriate column for each indicator that is applicable to the attribute. (3) Assign overall rating for each attribute based on preponderance of evidence. (4) Justify each attribute rating in writing.

Indicator	Rating	Comments
1. Rills	S H S-M	
2. Water-flow Patterns	S H S-M	
3. Pedestals and/or terracettes	S H S-M	
4. Bare ground _______%	S H S-M	
5. Gullies	S H N-S	
6. Wind-scoured, blowouts, and/or deposition areas	S N-S	
7. Litter movement	S M	
8. Soil surface resistance to erosion	S H B S-M	Open spaces between sage canopy in places
9. Soil surface loss or degradation	S H B S-M	
10. Plant community composition and distribution relative to infiltration	H S-M	Sage density getting high
11. Compaction layer	S H B N-S	
12. Functional/structional groups	B S-M	
13. Plant mortality/decadence	B N-S	
14. Litter amount	H B M	
15. Annual production	B N-S	
16. Invasive plants	B N-S	
17. Reproductive capability of perennial plants	B N-S	

E-T	M-E	M	S-M	N-S
		7	1, 2, 3, 4, 5, 6, 8, 9	5, 11

Attribute Rating Justification Soil & Site Stability:

S (10 indicators): Soil & Site Stability Rating: ____________

E-T	M-E	M	S-M	N-S
		14	1, 2, 3, 4, 8, 9, 10	5, 11

Attribute Rating Justification Hydrologic Function:

H (10 indicators): Hydrologic Function Rating: ____________

E-T	M-E	M	S-M	N-S
		14	8, 9, 12, 15	11, 13, 15, 16, 17

Attribute Rating Justification Biotic Integrity:

B (9 indicators): Biotic Integrity Rating: ____________

Figure 4. Rangeland health score for the sagebrush site. Note only a slight to moderate departure from normal in the soil, hydrologic and biologic categories.

Willow Site

Departure from Expected	**Code**	**Instructions for Evaluation Sheet, Page 2**
None to Slight Slight to Moderate Moderate Moderate to Extreme Extreme to Total	N-S S-M M M-E E-T	(1) Assign 17 indicator ratings. If indicator not present, rate None to Slight. (2) In the three grids below, write the indicator number in the appropriate column for each indicator that is applicable to the attribute. (3) Assign overall rating for each attribute based on preponderance of evidence. (4) Justify each attribute rating in writing.

Indicator	Rating	Comments
1. Rills	S H S-M	
2. Water-flow Patterns	S H N-S	
3. Pedestals and/or terracettes	S H N-S	
4. Bare ground ______%	S H S-M	
5. Gullies	S H S-M	
6. Wind-scoured, blowouts, and/or deposition areas	S N-S	
7. Litter movement	S S-M	
8. Soil surface resistance to erosion	S H B M	Areas impacted by livestock
9. Soil surface loss or degradation	S H B M	"
10. Plant community composition and distribution relative to infiltration	H N-S	
11. Compaction layer	S H B N-S	
12. Functional/structional groups	B M-E	Many species absent, invasives present
13. Plant mortality/decadence	B ME	
14. Litter amount	H B M	
15. Annual production	B M	
16. Invasive plants	B M-E	
17. Reproductive capability of perennial plants	B M	Plants present OK, absence of species a concern

Attribute Rating Justification
Soil & Site Stability:

E-T	M-E	M	S-M	N-S
		17		
		15		11
		14	7	10
		13	5	6
	16	9	4	3
	12	8	1	2

S (10 indicators):
Soil & Site Stability
Rating: ____________

Attribute Rating Justification
Hydrologic Function:

E-T	M-E	M	S-M	N-S
		15		
		11		
		10	5	
		9	4	3
		8	1	2

H (10 indicators):
Hydrologic Function
Rating: ____________

Attribute Rating Justification
Biotic Integrity:

E-T	M-E	M	S-M	N-S
		17		
		15		
	16	14		
	15	9		
	12	8		11

B (9 indicators):
Biotic Integrity
Rating: ____________

Figure 5. Rangeland health score for the willow site. Note the slightly higher departures from normal especially in the hydrologic and biologic categories.

Aspen Site – Mainly old landing area.

Departure from Expected	Code	Instructions for Evaluation Sheet, Page 2
None to Slight Slight to Moderate Moderate Moderate to Extreme Extreme to Total	N-S S-M M M-E E-T	(1) Assign 17 indicator ratings. If indicator not present, rate None to Slight. (2) In the three grids below, write the indicator number in the appropriate column for each indicator that is applicable to the attribute. (3) Assign overall rating for each attribute based on preponderance of evidence. (4) Justify each attribute rating in writing.

Indicator	Rating	Comments
1. Rills	S H M	
2. Waterflow Patterns	S H M	
3. Pedestals and/or terracettes	S H M-E	
4. Bare ground ______%	S H M-E	
5. Gullies	S H M	
6. Wind-scoured, blowouts, and/or deposition areas	S S-M	
7. Litter movement	S M	
8. Soil surface resistance to erosion	S H B M-E	
9. Soil surface loss or degradation	S H B M-E	
10. Plant community composition and distribution relative to infiltration	H M-E	
11. Compaction layer	S H B M-E	
12. Functional/structional groups	B M-E	
13. Plant mortality/decadence	B M	
14. Litter amount	H B M-E	
15. Annual production	B M-E	
16. Invasive plants	B M-E	
17. Reproductive capability of perennial plants	B M	

E-T	M-E	M	S-M	N-S
	11			
	9	7		
	8	5		
	4	2		
	3	1	6	

S (10 indicators):
Soil & Site Stability
Rating: ____________

Attribute Rating Justification
Soil & Site Stability:

E-T	M-E	M	S-M	N-S
	14			
	11			
	10			
	9			
	8	5		
	4	2		
	3	1		

H (10 indicators):
Hydrologic Function
Rating: ____________

Attribute Rating Justification
Hydrologic Function:

E-T	M-E	M	S-M	N-S
	16			
	15			
	14			
	12			
	11			
	9	17		
	8	13		

B (9 indicators):
Biotic Integrity
Rating: ____________

Attribute Rating Justification
Biotic Integrity:

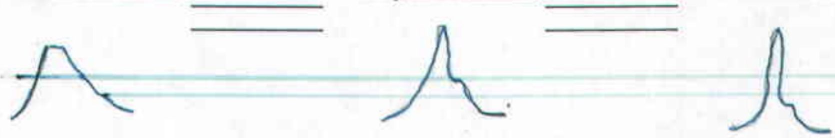


Figure 6. Rangeland health score for aspen site. Note the number of attributes in the moderate and moderate to extreme categories.

If you have any questions or comments please feel free to contact me at anytime.

Sincerely,

/s/

M. DEAN STACY
Area Range Management Specialist
Price Area Office

CC: Barry A. Hamilton, ASTC-FO
Shane Green, State Range Management Specialist
Wayne Greenhalgh, District Conservationist
File

Canyon Environmental, LLC

Canyon Environmental
326 East Stadium Avenue
Provo, UT 84604
Phone: 801.602.6883 Fax: 801.341.0005
www.canyonenvironmental.com

November 7, 2008

Gregg Galecki
Skyline Mine
HC 35 Box 380
Helper, Utah 84562

Subject: Soils survey for the proposed Winter Quarters vent location near Scofield, Utah

Dear Mr. Galecki:

Canyon Environmental has conducted a soils survey for the above mentioned site on behalf of Skyline Mine. The soil survey was conducted in order to comply with requirements set forth by the Utah Division of Oil, Gas, and Mining (DOGM).

NRCS Soils Data

The proposed vent shaft locations and surrounding areas were evaluated using the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) WEB Soil Survey (WSS) utility and associated NRCS soils reports. Soil profile locations were selected to provide site specific information regarding soils in the immediate project area (Figure 1).

According to the information provided by the NRCS, soils in the site vicinity are comprised of the Curecanti Family-Pathead Complex and the Trag-Croydon Complex. The Curecanti-Family Pathead Complex soils were identified on the north-facing slopes of the project area and the Trag-Croydon Complex soils were identified on the south-facing slopes of the project area (Figure 1). The official soil series descriptions are provided in Appendix A.

Site Reconnaissance

A site reconnaissance was initially conducted by Mr. Jensen and Mr. Gregg Galecki of Skyline Mine to identify probable locations for the placement of the proposed vent and associated soil profile locations. The site was traversed multiple times to identify probable locations and exposed soils were inspected to gather baseline data. The existing soil cuts and exposures appeared to be a result of previous logging and ranching activities in the area.

Soil Profiles

As soils investigation was conducted in the proposed project area and immediate site vicinity on October 16, 2008. Five soil profiles (SK1 – SK5) were excavated to gather representative soils data for the proposed project area. Soil profile locations area identified on Figure 1 and latitude and longitude coordinates collected using a hand-held GPS receiver are provided in the soil test profile logs. Each soil profile was excavated to a depth of one meter or to an identified C horizon. Each profile was photographed and logged using selected NRCS methods described in the *Field Book for Describing and Sampling Soils* (2002).

SK1

The soil series represented by SK1 was identified on the soils map as part of the Curecanti-family Pathead complex. Descriptions of these soils are included in Appendix A. SK1 was excavated from the north-facing slopes on the southern side of the proposed project area. The soils within SK1 most closely resemble Curecanti soils. However, the particular information derived from the soil profile tends to suggest a slight variation in soil texture and formation. This texture and formational difference is likely due to localized conditions inherent in the immediately surrounding area.

SK2 and SK4

These soil profiles were excavated from the toe-slope areas near Winter Quarters Creek. These soils appear to be distinctive from any of the identified soil series in the area. These differences are likely a result of natural and historic, man-made changes to the stream-bed. According to the information obtained from SK2 and SK3, the soils near the creek have been subjected to multiple depositional events wherein numerous sand layers have been deposited over river cobble. Additional surface soil layers appear to have been deposited from slope erosion and associated alluvial action. These soils appear to contain a mixed A horizon to a depth of approximately 30 centimeters. In soil depths greater than 30 centimeters within the creek-bed, numerous sand and sandy clay depositional layers were identified above river cobble. River cobble was encountered in both profile locations at depths ranging from 52 to 89 centimeters below the ground surface. Due to the disturbed nature of these soils, and apparent changes resulting from alluvial action and historical mining and logging, they do not appear to be representative of the NRCS soil series' identified in the project area.

According to information obtained from the NRCS, nearby soils identified at the mouth of Winter Quarters Canyon were listed as Silas-Brycam Loam series (Appendix A). Of the identified soil types in Carbon and Emery Counties, the soils from SK2 and SK4 most closely resemble the Silas series soils. These soils are generally found on alluvial deposits from canyon streams with 0-3% slopes. The parent materials are primarily comprised of sandstone and these soils generally contain alluvial sand depositional layers.

SK3 and SK5

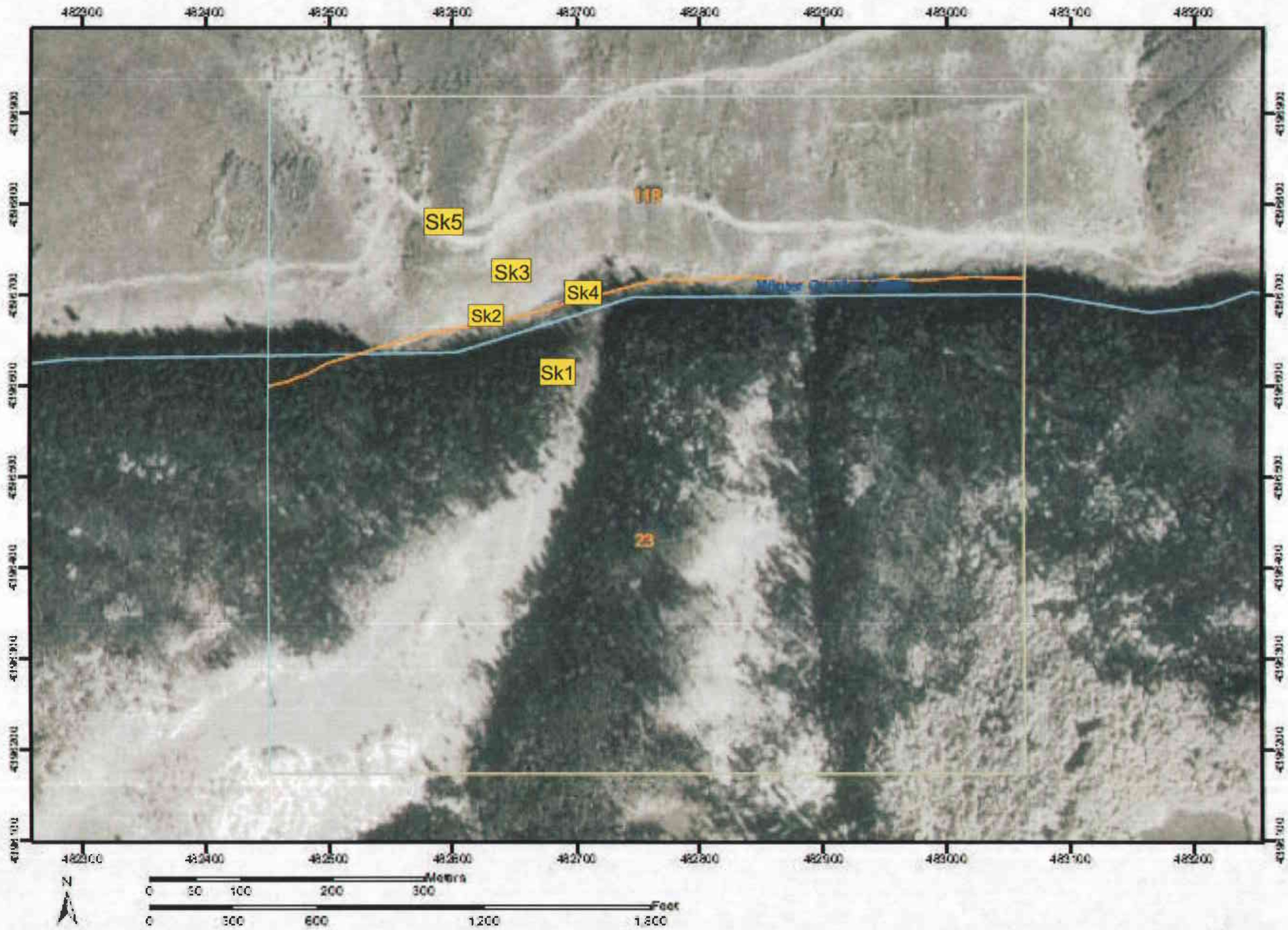
The soil series represented by SK3 and SK5 were identified on the soils map as part of the Trag-Croydon complex. Descriptions of these soils are included in Appendix A. SK3 and SK 5 were excavated from the south-facing slope of the proposed project area. SK3 was excavated from the slope above the creek and SK5 was excavated from a location near the edge of the road cut, higher in elevation that SK3 on the south-facing slope. The soils within SK3 and SK5 most closely resemble Trag series soils. These soils are generally shallow with numerous stones and cobbles. Although the soils from SK3 and SK5 appeared to contain more sand particles than the standard Trag series soils, these changes are likely due to site-specific characteristics.

The soil profiles excavated and evaluated for this soil survey appeared to represent the most common types of soils and geomorphic conditions within the proposed project area. With the noted exception of the soils located in the drainage area of Winter Quarters Creek, the soil characteristics identified in the soil profiles generally correlate to soil series information previously identified by the NRCS in the area. Due to the changing nature of the alluvial area (due to natural processes and historical changes from former mining activities) about the creek, the soils in the creek-bed do not appear to correspond to any previously documented soils in the Immediately surrounding area. However, the nearby Silas series soils (located near the mouth of Winter Quarters Canyon) correspond most closely with the soils identified in the excavated soil profiles from the creek-bed. Please review the above soil survey results and if you have any questions, contact me at 801-602-6883.

Sincerely,

Chris Jensen
Soil Scientist
Canyon Environmental

FIGURES



USDA Natural Resources Conservation Service

Web Soil Survey 2.0
National Cooperative Soil Survey

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

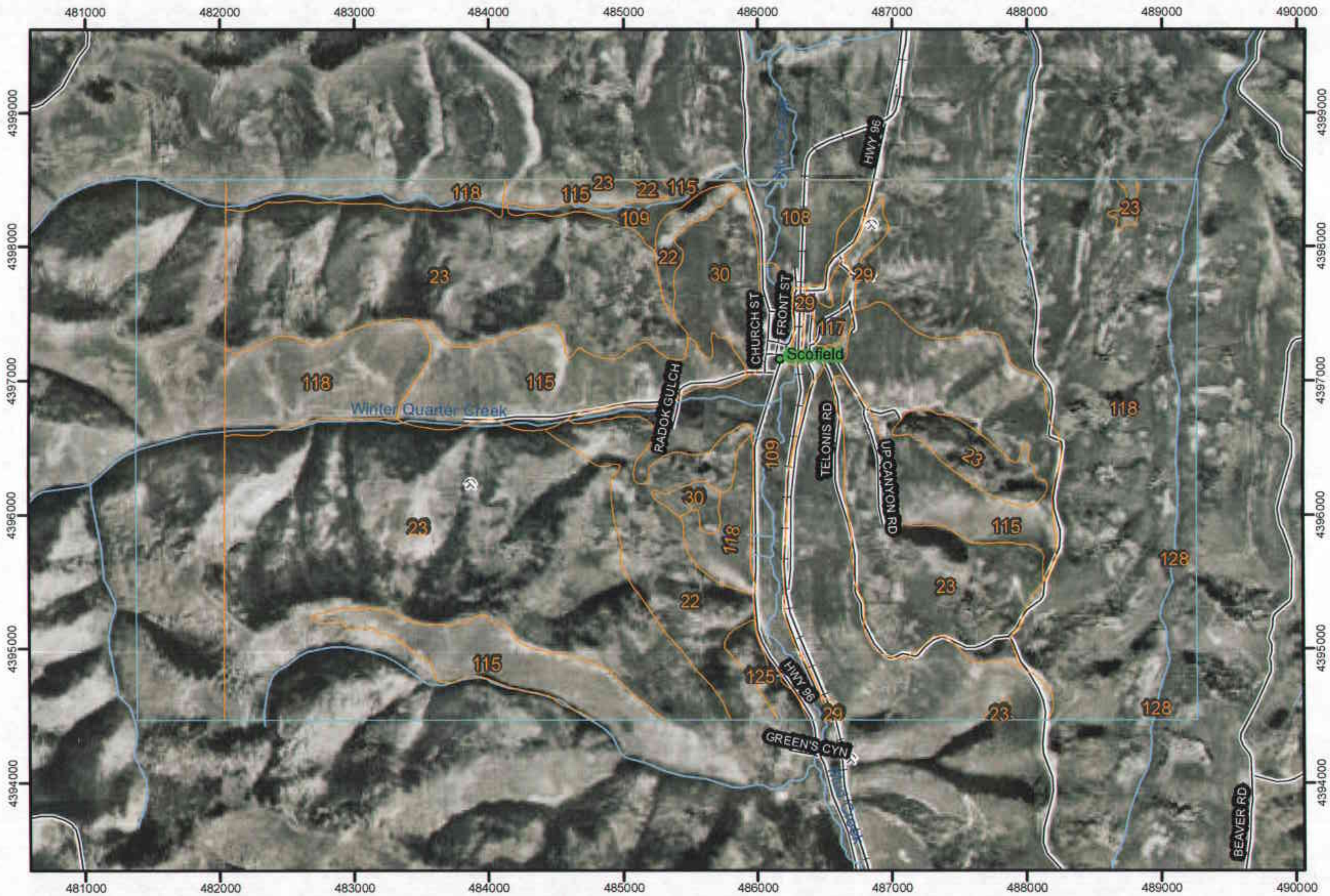
Soil Survey Area: Carbon Area, Utah, Parts of Carbon and Emery Counties
Survey Area Data: Version 4, Jul 2, 2008

Date(s) aerial images were photographed: 9/30/1997; 10/5/1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Carbon Area, Utah, Parts of Carbon and Emery Counties (UT616)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
23	Curecanti family-Pathead complex	105.7	69.2%
118	Trag-Croydon complex	47.0	30.8%
Totals for Area of Interest (AOI)		152.7	100.0%



N

0 500 1,000 2,000 3,000 Meters

0 3,000 6,000 12,000 18,000 Feet

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
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- Streams and Canals

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- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Carbon Area, Utah, Parts of Carbon and Emery Counties
Survey Area Data: Version 4, Jul 2, 2008

Soil Survey Area: Manti-Lasal National Forest, Manti Division - Parts of Sanpete and Emery Counties
Survey Area Data: Not available

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 9/30/1997; 10/5/1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Carbon Area, Utah, Parts of Carbon and Emery Counties (UT616)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
22	Croydon loam, 30 to 50 percent slopes	357.1	4.6%
23	Curecanti family-Pathead complex	2,732.5	34.9%
29	Dumps,mine	50.0	0.6%
30	Falcon-Rock outcrop complex	181.1	2.3%
108	Silas loam	124.4	1.6%
109	Silas-Brycan loams	401.1	5.1%
115	Trag stony loam, 30 to 60 percent slopes	1,374.4	17.5%
117	Trag-Beje-Senchert complex	22.7	0.3%
118	Trag-Croydon complex	1,900.7	24.2%
125	Uinta-Toze families complex	40.6	0.5%
128	Water	0.8	0.0%

Manti-Lasal National Forest, Manti Division - Parts of Sanpete and Emery Counties (UT645)
No soil data available for this soil survey area.

Totals for Area of Interest (AOI)	7,839.7	100.0%

APPENDIX A

Soil Profile Log

Site: SK1

Name	Chris Jensen	**Drainage Pattern**	Dentritic	
Date	October 16, 2008	**Drainage Class**	WD	Well Drained
Weather	Clear (70°F)	**Flooding**	None	
Location	39° 43′ 11″, 111° 12′ 07″	**Ponding**	None	
Aspect	North	**Depth to Water**	Unk.	
Gradient	8%	**Plant Cover**	SOS	Sagebrush and other shrubs with some grasses
Slope Shape	CV (concave, linear)	**Parent Material**	COL	Colluvium
Slope Position	TS (Toeslope)	**Erosion**	W, 1	0-25% erosion from water

Diagnostic Horizon	**Observation Method**	**Depth (cm)**	**Boundary**		**Color**		**Texture**	**Structure**	**Reaction (HCl)**	**%Rock Fragment and size**	**%Roots size and location**
			Distinctness	**Topography**							
A	SP	0-13	Clear	Wavy	Very Dark Grayish Brown	2.5YR3/2	SIC	GR	ST	5% G	10-20% VF-M
AC	SP	13-30	Clear	Wavy	Very Dark Grayish Brown	2.5YR3/2	SIC	GR	ST	60% G, CB	10-20% M
A (buried)	SP	30-56	Distinct	Wavy	Very Dark Grayish Brown	2.5YR3/2	SIC	GR	ST	9% G	7% VF
C	SP	56 -			Grayish Brown	10YR5/2	SIC	GR	ST	70% CB	1% VF

Depth (cm)	**Description**
0-13	Silty clay soils with small rock fragments, soils appear to have eroded from higher areas on the slope
13-30	Dark, silty clays with small rock fragments and cobbles. Appears to have eroded from the upper slope.
30-56	Buried A Horizon with fine to moderate roots. Moist soils that have been buried by slope erosion.
56-	Clays and silts with little to no roots. Large cobbles and stones indicate likely parent material.

Skyline Mine Soil Survey – Winter Quarters Canyon

SK1

Soil Profile Log

Site: SK2

Name	Chris Jensen	**Drainage Pattern**	Dentritic	
Date	October 16, 2008	**Drainage Class**	WD	Well Drained
Weather	Clear (70°F)	**Flooding**	OC	occasional
Location	39° 43' 12'', 111° 12' 06"	**Ponding**	None	
Aspect	East	**Depth to Water**	Unk.	Presumed shallow
Gradient	1%	**Plant Cover**	SOS	Sagebrush and other shrubs and grasses
Slope Shape	CV (concave, linear)	**Parent Material**	ALL	Alluvium
Slope Position	TS (Toeslope)	**Erosion**	W, 1	0-25% erosion from water

Diagnostic Horizon	**Observation Method**	**Depth (cm)**	**Boundary**		**Color**		**Texture**	**Structure**	**Reaction (HCl)**	**%Rock Fragment and size**	**%Roots size and location**
			Distinctness	**Topography**							
A	SP	0-9	Clear	Smooth	Very dark grayish brown	10YR3/2	SIL	GR	ST	20% G	10-20% VF-M
C	SP	9-13	Clear	Smooth	Brown	10YR5/3	SL	GR	ST	10% G, CB	15% M
A (buried)	SP	13-25	Distinct	Wavy	Very dark grayish brown	10YR3/2	FSL	GR	ST	5% G	15% VF-F
B (buried)	SP	25-36	Distinct	Smooth	Grayish brown	10YR5/2	LCOS	GR	ST	2% G	5% VF
C	SP	36-52	Distinct	Wavy	Light olive brown	2.5YR5/3	S	GR	ST	25% G	1% VF
River cobble	SP	52-			N/A					90% CB	None

Depth (cm)	**Description**
0-9	Granular silty loam soil with few grey and red mottles.
9-13	Sandy loam soil with some fine clay textures and lenses. Distinct change from the preceding A horizon. Appear to have resulted from alluvial deposition.
13-25	Granular sandy layer of soil that may be a former stream bed. Numerous red mottles trending toward bright orange colors.
25-36	Greyish soils comprised of granular sandy loam particles. Very little root material with red and lighter grey mottles.
36-52	Sandy soil that appears to have been deposited by alluvial action. This sandy layer rests directly atop river cobble. Very little to no roots.
52 -	River cobble

Skyline Mine Soil Survey – Winter Quarters Canyon

SK2

Soil Profile Log

Site: SK3

Name	Chris Jensen	**Drainage Pattern**	Dentritic	
Date	October 16, 2008	**Drainage Class**	WD	Well Drained
Weather	Clear (70°F)	**Flooding**	None	
Location	39° 43' 13.6", 111° 12' 05"	**Ponding**	None	
Aspect	East	**Depth to Water**	Unk.	
Gradient	35%	**Plant Cover**	SOS	Sagebrush and other shrubs and grasses
Slope Shape	CV (concave, linear)	**Parent Material**	COL	Colluvium
Slope Position	BS (backslope)	**Erosion**	W, 1	0-25% erosion from water

Diagnostic Horizon	**Observation Method**	**Depth (cm)**	**Boundary**		**Color**		**Texture**	**Structure**	**Reaction (HCl)**	**%Rock Fragment and size**	**%Roots size and location**
			Distinctness	**Topography**							
A	SP	0-18	Clear	Wavy	Brown	10YR4/3	FSL	GR	ST	10% G, CB	10-20% VF-M
C	SP	18-54	Clear	Wavy	Brown	10YR5/3	SL	GR	ST	30% G, CB	1% VF

Depth (cm)	**Description**
0-18	Granular fine sandy laom soils with small gravel and larger angular cobbles. Soils also contain extensive root material.
18-54	Sandy loam soil with small gravel and larger angular cobbles increasing with depth. This soil layer is underlain by large angular rocks and boulders resulting from hillside movements.

Skyline Mine Soil Survey – Winter Quarters Canyon

SK3

Soil Profile Log

Site: SK4

Name	Chris Jensen	**Drainage Pattern**	Dentritic	
Date	October 16, 2008	**Drainage Class**	WD	Well Drained
Weather	Clear (70°F)	**Flooding**	OC	occasional
Location	39° 43’ 12.8’’, 111° 12’ 05.2”	**Ponding**	None	
Aspect	East	**Depth to Water**	Unk.	Presumed shallow
Gradient	1%	**Plant Cover**	SOS	Sagebrush and other shrubs and grasses
Slope Shape	CV (concave, linear)	**Parent Material**	ALL	Alluvium
Slope Position	TS (Toeslope)	**Erosion**	W, 1	0-25% erosion from water

Diagnostic Horizon	**Observation Method**	**Depth (cm)**	**Boundary**		**Color**		**Texture**	**Structure**	**Reaction (HCl)**	**%Rock Fragment and size**	**%Roots size and location**
			Distinctness	**Topography**							
A	SP	0-30	Clear	Wavy	Dark grayish brown	10YR4/2	SL	GR	ST	>1% G	35% VF-M
B	SP	30-45	Clear	Smooth	Yellowish brown	10YR5/4	FS	GR	ST	>1% G	>1% VF
C	SP	45-89	Distinct	Wavy	Grayish brown	10YR5/2	S	GR	ST	10% G, CB	None

Depth (cm)	**Description**
0-30	Granular silty loam soil extensive rooting and few oxidized inclusions.
30-45	Multiple sandy and fine sandy clay layers resulting from alluvial deposition. These layers are extremely compact with some mottles and oxidized inclusions.
45-89	Granular moist sand with little to no roots. Numerous red, oxidized inclusions were also observed. This soil layer was dissected by a rodent burrow.
89 -	River gravel and cobble

Skyline Mine Soil Survey – Winter Quarters Canyon

SK4

Soil Profile Log

Site: SK5

Name	Chris Jensen	**Drainage Pattern**	Dentritic	
Date	October 16, 2008	**Drainage Class**	WD	Well Drained
Weather	Clear (70°F)	**Flooding**	None	
Location	39° 43' 14.1'', 111° 12' 13.8"	**Ponding**	None	
Aspect	South	**Depth to Water**	Unk.	
Gradient	25%	**Plant Cover**	SOS	Sagebrush and other shrubs and grasses
Slope Shape	CV (concave, linear)	**Parent Material**	COL	Colluvium
Slope Position	BS (backslope)	**Erosion**	W, 1	0-25% erosion from water

Diagnostic Horizon	**Observation Method**	**Depth (cm)**	**Boundary**		**Color**		**Texture**	**Structure**	**Reaction (HCl)**	**%Rock Fragment and size**	**%Roots size and location**
			Distinctness	**Topography**							
A	SP	0-6	Clear	Wavy	Dark yellowish brown	10YR4/4	SCL	GR	ST	10% CB	35% VF-M
C	SP	6-20	Distinct	Wavy	Dark brown	10YR3/3	SL	GR	ST	35% CB	None

Depth (cm)	**Description**
0-6	Granular silty clay loam with small gravel and cobbles. Roots in this layer were extensive.
6-20	Angular cobbles encased in sandy loam soils with little to no rooting.

Skyline Mine Soil Survey – Winter Quarters Canyon

SK5

23—Curecanti family-Pathead complex

Map Unit Setting

- Elevation: 6,980 to 8,970 feet
- Mean annual precipitation: 16 to 20 inches
- Mean annual air temperature: 38 to 45 degrees F
- Frost-free period: 60 to 100 days

Map Unit Composition

- Curecanti and similar soils: 30 percent
- Pathead, stony, and similar soils: 25 percent
- Pathead and similar soils: 25 percent

Description of Curecanti

Setting

- Landform: Mountain slopes
- Landform position (three-dimensional): Mountainflank
- Down-slope shape: Convex
- Across-slope shape: Convex
- Parent material: Colluvium derived from sandstone and shale

Properties and qualities

- Slope: 50 to 70 percent
- Depth to restrictive feature: More than 80 inches
- Drainage class: Well drained
- Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
- Depth to water table: More than 80 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Available water capacity: Low (about 5.3 inches)

Interpretive groups

- Land capability (nonirrigated): 7e
- Ecological site: MOUNTAIN VERY STEEP LOAM (OAK) (R048AY465UT)

Typical profile

- 0 to 7 inches: Loam
- 7 to 15 inches: Very stony loam
- 15 to 20 inches: Very stony loam

- 20 to 60 inches: Very stony loam

Description of Pathead

Setting

- Landform: Canyons, mountainsides
- Landform position (three-dimensional): Mountainflank
- Down-slope shape: Linear, convex
- Across-slope shape: Linear, convex
- Parent material: Colluvium over residuum weathered from sandstone and shale

Properties and qualities

- Slope: 40 to 70 percent
- Surface area covered with cobbles, stones or boulders: 33.0 percent
- Depth to restrictive feature: 20 to 40 inches to lithic bedrock
- Drainage class: Well drained
- Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
- Depth to water table: More than 80 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Calcium carbonate, maximum content: 15 percent
- Sodium adsorption ratio, maximum: 5.0
- Available water capacity: Very low (about 2.9 inches)

Interpretive groups

- Land capability (nonirrigated): 7e
- Ecological site: MOUNTAIN WINDSWEPT RIDGE (R048AY478UT)

Typical profile

- 0 to 4 inches: Extremely bouldery fine sandy loam
- 4 to 38 inches: Very stony fine sandy loam
- 38 to 42 inches: Unweathered bedrock

Description of Pathead, Stony

Setting

- Landform: Mountain slopes
- Landform position (three-dimensional): Mountainflank
- Down-slope shape: Convex
- Across-slope shape: Convex
- Parent material: Colluvium over residuum weathered from sandstone and shale

Properties and qualities

- Slope: 50 to 70 percent
- Surface area covered with cobbles, stones or boulders: 33.0 percent
- Depth to restrictive feature: 20 to 40 inches to lithic bedrock
- Drainage class: Well drained
- Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
- Depth to water table: More than 80 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Calcium carbonate, maximum content: 15 percent
- Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
- Sodium adsorption ratio, maximum: 5.0
- Available water capacity: Very low (about 2.0 inches)

Interpretive groups

- Land capability (nonirrigated): 7e
- Ecological site: MOUNTAIN VERY STEEP LOAM (SALINA WILDRYE) (R048AY466UT)

Typical profile

- 0 to 3 inches: Extremely stony loam
- 3 to 26 inches: Very cobbly loam
- 26 to 30 inches: Unweathered bedrock

118—Trag-Croydon complex

Map Unit Setting

- Elevation: 7,580 to 9,470 feet
- Mean annual precipitation: 16 to 25 inches
- Mean annual air temperature: 34 to 40 degrees F
- Frost-free period: 40 to 80 days

Map Unit Composition

- Trag and similar soils: 50 percent
- Croydon and similar soils: 30 percent

Description of Trag

Setting

- Landform: Mountain slopes
- Landform position (three-dimensional): Mountainflank
- Down-slope shape: Convex
- Across-slope shape: Convex
- Parent material: Alluvium and/or colluvium derived from sandstone and shale

Properties and qualities

- Slope: 30 to 60 percent
- Surface area covered with cobbles, stones or boulders: 13.0 percent
- Depth to restrictive feature: More than 80 inches
- Drainage class: Well drained
- Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
- Depth to water table: More than 80 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Calcium carbonate, maximum content: 10 percent
- Available water capacity: High (about 10.2 inches)

Interpretive groups

- Land capability (nonirrigated): 7e
- Ecological site: MOUNTAIN LOAM (SALINA WILDRYE) (R048AY409UT)

Typical profile

- 0 to 10 inches: Stony loam
- 10 to 36 inches: Clay loam

- 36 to 60 inches: Clay loam

Description of Croydon

Setting

- Landform: Mountain slopes
- Landform position (three-dimensional): Mountainflank
- Down-slope shape: Convex
- Across-slope shape: Convex
- Parent material: Colluvium and/or slope alluvium over residuum weathered from sandstone and shale

Properties and qualities

- Slope: 30 to 50 percent
- Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
- Drainage class: Well drained
- Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
- Depth to water table: More than 80 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Available water capacity: Moderate (about 8.1 inches)

Interpretive groups

- Land capability (nonirrigated): 7e
- Ecological site: High Mountain Loam (Aspen) (R047XA508UT)

Typical profile

- 0 to 16 inches: Loam
- 16 to 23 inches: Loam
- 23 to 48 inches: Clay loam
- 48 to 52 inches: Weathered bedrock

109—Silas-Brycan loams

Map Unit Setting

- Elevation: 7,680 to 8,580 feet
- Mean annual precipitation: 16 to 20 inches
- Mean annual air temperature: 38 to 45 degrees F
- Frost-free period: 60 to 80 days

Map Unit Composition

- Silas and similar soils: 65 percent
- Brycan and similar soils: 20 percent
- Minor components: 7 percent

Description of Silas

Setting

- Landform: Valleys
- Down-slope shape: Linear
- Across-slope shape: Concave
- Parent material: Alluvium derived from sandstone and shale

Properties and qualities

- Slope: 0 to 3 percent
- Depth to restrictive feature: More than 80 inches
- Drainage class: Somewhat poorly drained
- Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
- Depth to water table: About 18 to 42 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Calcium carbonate, maximum content: 5 percent
- Available water capacity: High (about 9.6 inches)

Interpretive groups

- Land capability (nonirrigated): 6w
- Ecological site: Wet Fresh Meadow (Willow-Sedge) (R048AY008UT)

Typical profile

- 0 to 2 inches: Loam
- 2 to 17 inches: Loam
- 17 to 28 inches: Loam
- 28 to 43 inches: Loam

- 43 to 60 inches: Sandy clay loam

Description of Brycan

Setting

- Landform: Alluvial fans
- Down-slope shape: Concave
- Across-slope shape: Convex
- Parent material: Alluvium derived from sandstone and shale

Properties and qualities

- Slope: 3 to 8 percent
- Depth to restrictive feature: More than 80 inches
- Drainage class: Well drained
- Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
- Depth to water table: More than 80 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Calcium carbonate, maximum content: 5 percent
- Available water capacity: High (about 9.9 inches)

Interpretive groups

- Land capability (nonirrigated): 6c
- Ecological site: MOUNTAIN LOAM (SALINA WILDRYE) (R048AY409UT)

Typical profile

- 0 to 12 inches: Loam
- 12 to 32 inches: Loam
- 32 to 60 inches: Silt loam

Minor Components

Silas, poorly drained

- Percent of map unit: 5 percent
- Landform: Flood plains
- Landform position (three-dimensional): Talf, dip
- Down-slope shape: Linear
- Across-slope shape: Concave
- Ecological site: Wet Fresh Meadow (Willow-Sedge) (R048AY008UT)

Flooded soils

- Percent of map unit: 2 percent
- Landform: Flood plains
- Landform position (three-dimensional): Talf, dip
- Down-slope shape: Linear
- Across-slope shape: Concave

Inter-Mountain Laboratories, Inc.
1673 Terra Avenue, Sheridan, Wyoming 82801
(307) 672-8945

Soil Analysis Report

Canyon Fuel Company, LLC.

HCR 35, Box 380
Helper, UT 84526

Report ID: S0901102001

Date Reported: 3/2/2009
Work Order: S0901102

Project: Skyline Utah#6
Date Received: 1/9/2009

Lab ID	Sample ID	pH	Saturation	Electrical Conductivity	Field Capacity	Wilt Point	PE Calcium	PE Magnesium	PE Potassium	PE Sodium	SAR
		s.u.	%	dS/m	%	%	meq/L	meq/L	meq/L	meq/L	
S0901102-001	sk 1	7.5	59.1	1.01	35	16	8.09	2.59	1.06	0.57	0.25
S0901102-002	sk 2	7.4	45.4	0.61	26	12	1.52	0.40	1.10	0.16	0.16
S0901102-003	sk 3	6.7	50.9	0.22	26	11	0.72	0.44	0.39	0.25	0.32
S0901102-004	sk 4	7.2	62.9	0.90	29	16	4.88	1.45	2.29	0.42	0.24
S0901102-005	sk 5	6.7	41.1	0.30	28	10	1.13	0.68	0.42	0.35	0.37

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

INTER-MOUNTAIN LABS

Inter-Mountain Laboratories, Inc.
1673 Terra Avenue, Sheridan, Wyoming 82801
(307) 672-8945

Soil Analysis Report

Canyon Fuel Company, LLC.
HCR 35, Box 380
Helper, UT 84526

Report ID: S0901102001

Project: Skyline Utah#6
Date Received: 1/9/2009

Date Reported: 3/2/2009
Work Order: S0901102

Lab ID	Sample ID	Sand	Silt	Clay	Texture	Coarse Fragment	Boron	Nitrogen Nitrate	Selenium	TKN
		%	%	%		%	ppm	ppm	ppm	%
S0901102-001	sk 1	50.0	36.0	14.0	Loam	11.7	0.68	<0.1	<0.02	0.07
S0901102-002	sk 2	50.0	35.0	15.0	Loam	6.78	0.64	0.8	<0.02	<0.01
S0901102-003	sk 3	50.0	36.0	14.0	Loam	18.9	0.29	0.2	<0.02	<0.01
S0901102-004	sk 4	50.0	36.0	14.0	Loam	6.76	0.49	0.5	<0.02	0.04
S0901102-005	sk 5	50.0	35.0	15.0	Loam	2.23	0.40	7.1	<0.02	<0.01

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

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Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

Canyon Fuel Company, LLC.
HCR 35, Box 380
Helper, UT 84526

Report ID: S0901102001

Project: Skyline Utah#6
Date Received: 1/9/2009

Date Reported: 3/2/2009
Work Order: S0901102

Lab ID	Sample ID	Available Sodium meq/100g	Exchangeable Sodium meq/100g	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Total Carbon %	TOC %
S0901102-001	sk 1	0.19	0.15	0.04	1.12	46.1	44.9	4.3	3.7
S0901102-002	sk 2	0.15	0.14	0.02	0.63	10.8	10.2	2.4	2.3
S0901102-003	sk 3	0.14	0.13	0.02	0.56	7.00	6.44	2.2	2.1
S0901102-004	sk 4	0.15	0.13	0.01	0.45	19.9	19.4	2.9	2.7
S0901102-005	sk 5	0.13	0.12	0.01	0.41	7.85	7.44	2.6	2.5

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

Vegetation Sampling & Sensitive Species
at the
Ventilation Shaft Site
(Revised)

Skyline Mines
in
Winter Quarters Canyon
Carbon County, Utah

Prepared by

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for

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

December 2009

Table of Contents

Introduction

Canyon Fuel Company has plans to construct a ventilation shaft pad in Winter Quarters Canyon to support their underground coal mining operations in that area. During the engineering and design phase for the pad, a site was chosen and plans were drafted accordingly. Vegetation sampling was then conducted in the area that would have been impacted by construction of the pad. A report called *Vegetation Sampling & Sensitive Species at the Ventilation Shaft Site in Winter Quarters Canyon* was prepared by Mt. Nebo Scientific, Inc. and submitted to Canyon Fuel in July 2009. This report addressed the potential impacts to the plant communities of the area. Since that time, the site plans changed somewhat, resulting in an adjustment to the initial footprint of the pad. Consequently, this report has been written to *revise* and *update* the aforementioned report so that the permit area and impact to the vegetation associated to it are current. Although references have been made to the earlier report, and some of the data contained in that report may prove helpful, this report supercedes it.

The Winter Quarters Ventilation Shaft Site is located in Carbon County approximately 2 miles west of the town of Scofield, Utah. Average elevation of the study site was about 8,200 ft above sea level. Plant communities in the general area include riparian, sagebrush/grass, aspen, mountain brush and coniferous forests. The vegetation that would be disturbed by construction of the site is primarily a sagebrush/grass community.

This report describes the results of quantitative sampling of the plant communities that could be impacted by the proposed ventilation shaft pad. It also shows results of sampling a "reference area", or a native plant community that could be used for future revegetation success standards at the time of final reclamation.

Finally, federally listed threatened, endangered or otherwise sensitive plant and animal species that are found in Carbon County, Utah have also been addressed herein.

Methods

Methodologies used for this study were performed in accordance with the guidelines provided by the State of Utah, Division of Oil, Gas and Mining (DOGM) and other appropriate sources. The field work for the quantitative and qualitative data were recorded within the plant communities in September 2008. Followup field visits to observe modifications to the site plan were made in November 2009.

Transect and Quadrat Placement

Transect lines for sampling the vegetation were placed randomly within the boundaries of the proposed disturbed and reference areas. Once the transects were established, quadrat locations for sampling were chosen using random numbers from the transect lines with the objective to record data without preconceived bias.

Cover estimates were made using ocular methods with meter square quadrats. Species composition, cover by species, and relative frequencies were also assessed from the quadrats. Additional information recorded on the raw data sheets were notes such as: slope, exposure, grazing use, disturbance and/or other appropriate notes. Plant nomenclature follows "A Utah Flora" (Welsh et al., 2003).

Densities of woody plant species for the proposed disturbed and reference areas were estimated using the point-quarter method. 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. The number of individuals per acre was the end result of the calculations.

Sampling adequacy for cover and density was attempted by using the formula given below.

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

where,

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

With the values used for “t” and “d”above, the goal was to meet sample adequacy with 80%

confidence within a 10% deviation from the true mean.

Student's t-tests were employed to compare the total living cover and total woody species density of the proposed disturbed sagebrush/grass community with the reference area.

Color photographs of the sample areas were taken at the time of sampling and have been submitted with this report.

Threatened & Endangered Species Survey

The list of federally protected threatened, endangered & candidate plant and animal species in Carbon County, Utah was examined and the potential for impacting these species by the project were addressed.

Prior to recording quantitative data on the plant communities, a sensitive plant species survey was conducted. To initiate the study, appropriate agencies had been consulted at earlier dates (e.g. *Utah Natural Heritage Program*) and other sources were reviewed (sensitive species files at *Mt. Nebo Scientific, Inc.*) for potential plant species that are known to be rare, endemic, threatened, endangered or otherwise sensitive in the study area.

Results

Proposed Disturbed Sagebrush/Grass Community

Nearly all the impact to the vegetation by construction and maintenance of the ventilation site will occur in an upland type called the sagebrush/grass community (Map 1). As shown in Table 1, this community was dominated by mountain sagebrush *(Artemisia tridentata* var. *vaseyana*), Salina wildrye (*Elymus salinus*) and snowberry (*Symphoricarpos oreophilus*). The total living cover in this community was estimated at 48.50% (Table 2-A), of which consisted of 76.18% shrubs, 20.94% grasses and 2.88% forbs (Table 2-B). The woody species density for this community was estimated at 6,303 individuals per acre (Table 3). For a color photograph of the area refer to Photo 1.

Sagebrush/Grass Reference Area

The plant community chosen as the reference area to be used for final revegetation success standards was a similar sagebrush/grass community and was located near the proposed disturbed area (see Map 1). This community was dominated by mountain sagebrush, Salina wildrye, antelope bitterbrush *(Purshia tridentata*) and snowberry (Table 4). The total living cover of the area was estimated at 49.75% (Table 5-A). The living cover was comprised of 74.99% shrubs, 24.10% grasses and 0.91% forbs (Table 5-B). The woody species density for this reference area was composed of 4,389 individuals per acre (Table 6). For a color photograph of the area refer to Photo 2.

Riparian Areas

As explained above, an earlier report provided information about the potential impacts to the vegetation at the ventilation site when it was designed with a different footprint. That report provided detailed information about the riparian zone because it would have been greatly impacted by the early design. The new plan, however, has been designed to yield little disturbance to the riparian zones of the area. Current plans have designed a buffer zone between the stream and the proposed disturbed areas that will insure little or no disturbance to the stream or the riparian communities it supports. There is, however, one small riparian area that may or may not be slightly impacted (see Photo 3), but because of its size and the fact that it has been disturbed by over-grazing (note the "weedy" species in the photo), for all practical purposes assigning revegetation success standards to it may be illogical. Also, because the topsoil will remain intact in this area, and because it will have a constant water source where seed dispersal is facilitated to it from the riparian communities upstream, this area will be easily restored to a natural condition if it is at all impacted by the proposed activities. A riparian seed mixture will be used at the time of final reclamation in this area.

There is a lot of data available for the riparian complexes in the earlier-mentioned report, but those data are no longer essential to describe the project impacts for the current plan. The earlier report is available upon request, but this document supercedes that report. All that said, it would be easy to record some quantitative cover and density data in the next field season if DOGM should require the information for this small area.

Previously Disturbed Community

Like the riparian areas described above, earlier plans entailed disturbing areas that had already been disturbed by activities other than those proposed by current plans for the ventilation site. These areas were called “Previously Disturbed Areas” in the early report.

Although there are some areas planned for disturbance in the current plan that could be considered *previously disturbed* because “weedy” or exotic plant species are common (see upland areas on the left side of Photo 4), this disturbance was more a result of livestock overgrazing, road construction and parking, rather than logging or other major disturbance-causing activities. Moreover, these areas are localized and relatively small – too small in fact to be required by DOGM to have a similar reference area associated to them.

Because these areas are so small and their topsoil will remain in-place, standards for revegetation success will be the same as described for the sagebrush/grass community above.

Threatened & Endangered Species

There are several federally listed plant and animal species that are known to occur in Carbon County, Utah. These species are listed on Table 7 along with notes and comments about their specific habitat requirements as well as their potential to exist in the area proposed for disturbance by construction of the ventilation shaft site. There is almost no potential for the proposed activities to impact any of these species.

Summary & Discussion

An area has been proposed for construction of a ventilation shaft to support coal mine related activities in Winter Quarters Canyon. As a result, disturbance to the native vegetation in the area will be necessary. This document provides data from sampling the plant communities that have been proposed for disturbance as well as provides potential standards for revegetation success for final reclamation of the site.

Nearly all of the impacts of the project to the vegetation will be in the **Sagebrush/Grass Community**, an undisturbed and native plant community. Therefore, a **Sagebrush/Grass Reference Area** was chosen to represent revegetation success standards at the time of final reclamation. Following sampling these two areas in 2008, the data sets were compared. When statistics were applied, a Student's t-test demonstrated that there was no significant difference between the cover of the area proposed for disturbance and its reference area (Figure 1). When woody species densities were compared between these two areas, the difference was significant (Figure 2), but the goal restoration of woody species should probably be less than both of those densities. To encourage greater herbaceous forage for wildlife and domestic livestock, less woody species density would be recommended here, possibly closer to 2,500 individuals per acre.

Figure 1. A statistical comparison (Student's t-tests) of the **total living cover** between the proposed disturbed sites and the reference area at the Winter Quarters Vent site.

	$\bar{x}$	s	n	t	df	SL
Sagebrush/Grass						
Proposed Disturbed:	48.50	9.10	20			
Reference Area:	49.75	10.78	20			
t-test				-0.396	38	ns

$\bar{x}$ = mean
s = standard deviation
n = sample size
t = Student's t-value
df = degrees of freedom
n/a = not applicable
ns = non-significant

Figure 2. A statistical comparison (Student's t-tests) of the **woody species density** between the proposed disturbed and the reference area at the Winter Quarters Vent site.

	$\bar{x}$	s	n	t	df	SL
Sagebrush/Grass						
Proposed Disturbed:	6302.97	1640.38	20			
Reference Area:	4388.78	1029.30	20			
t-test				4.420	38	$p<0.01$

$\bar{x}$ = mean
s = standard deviation
n = sample size
t = Student's t-value
df = degrees of freedom
n/a = not applicable
p = probability; significance level
ns = non-significant

Summary Tables

Table 1. Cover and frequency by species at the Winter Quarters Ventilation Site (2008).

Sagebrush/Grass Community	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Amelanchier utahensis	3.25	7.29	20.00
Artemisia tridentata	23.25	12.17	95.00
Rosa woodsii	0.75	1.79	15.00
Symphoricarpos oreophilus	10.00	8.80	75.00
FORBS			
Geranium richardsonii	0.50	1.50	10.00
Machaeranthera grindelioides	0.25	1.09	5.00
Penstemon watsonii	0.75	2.38	10.00
GRASSES			
Elymus salinus	9.75	5.80	85.00

Table 2. Total mean cover (A), composition (B), standard deviations and sample sizes at the Winter Quarters Ventilation Site (2008).

Sagebrush/Grass Community	Mean Percent	Standard Deviation	Sample Size
A. TOTAL COVER			
Total Living Cover	48.50	9.10	20
Litter	11.00	4.36	20
Bareground	26.00	12.21	20
Rock	14.50	9.73	20
B. % COMPOSITION			
Trees & Shrubs	76.18	13.95	20
Forbs	2.88	5.69	20
Grasses	20.94	12.44	20

Table 3. Woody Species Density at the Winter Quarters Ventilation Site (2008).

Sagebrush/Grass Community	
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	315.15
Artemisia tridentata	3545.42
Rosa woodsii	78.79
Symphoricarpos oreophilus	2363.61
TOTAL	**6302.97**

Table 4. Cover and frequency by species at the Winter Quarters Ventilation Site (2008).

Sagebrush/Grass Reference Area	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Amelanchier utahensis	1.50	3.57	15.00
Artemisia tridentata	20.50	16.50	75.00
Mahonia repens	1.00	4.36	5.00
Purshia tridentata	9.50	13.59	50.00
Ribes cereum	0.50	2.18	5.00
Symphoricarpos oreophilus	5.25	6.61	45.00
FORBS			
Artemisia ludoviciana	0.50	2.18	5.00
GRASSES			
Elymus salinus	11.00	9.95	70.00

Table 5. Total mean cover (A), composition (B), standard deviations and sample sizes at the Winter Quarters Ventilation Site (2008).

Sagebrush/Grass Reference Area	Mean Percent	Standard Deviation	Sample Size
A. TOTAL COVER			
Total Living Cover	49.75	10.78	20
Litter	15.50	6.10	20
Bareground	17.00	8.28	20
Rock	17.75	7.98	20
B. % COMPOSITION			
Trees & Shrubs	74.99	25.06	20
Forbs	0.91	3.96	20
Grasses	24.10	24.62	20

Table 6. Woody Species Density at the Winter Quarters Ventilation Site (2008).

Sagebrush/Grass Reference Area	
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	219.44
Artemisia tridentata	1974.95
Chrysothamnus viscidiflorus	109.72
Purshia tridentata	1316.63
Rosa woodsii	54.86
Symphoricarpos oreophilus	713.18
TOTAL	**4388.78**

Table 7: Federally listed threatened, endangered & candidate species in Carbon County, Utah and notes regarding potential impacts to them as a result construction of the ventilation site

Scientific Name	Common Name	Status*	Site-Specific Notes
Gila cypha	Humpback chub	E	Humpback chub in Utah are now confined to a few white-water areas in the Colorado, Green, and White Rivers. These rivers do not occur in the study area. The drainage control measures of the site limit impacts to the downstream drainage of the Colorado River system. There should be no impacts to this species as a result of construction and operation of the vent site.
Gila elegans	Bonytail	E	The bonytail is a very rare minnow originally native to the Colorado River system. These rivers do not occur in the study area. The drainage control measures of the site limit impacts to the downstream drainage of the Colorado River system. There should be no impacts to this species as a result of construction and operation of the vent site.
Mustela nigripes	Black-footed ferret	Ex	Black-footed ferret habitat is primarily prairie grasslands. The ferret has a diet consisting of almost 90% prairie dogs. This habitat and food source does not occur in the study area. There should be no impacts to this species as a result of construction and operation of the vent site.
Phacelia argillacea	Clay phacelia	E	The habitats of clay phacelia are usually found in pinyon-juniper and mountain brush plant communities, and typically in clay soils of the Green River formation. Although the mountain brush community occurs adjacent to the study area, the geologic formations of the study area were well below the Green River formation in geologic strata. Additionally, soil types usually associated with this species were not present in the study area. There should be no impacts to this species as a result of construction and operation of the vent site.

Table 7: Federally listed threatened, endangered & candidate species in Carbon County, Utah and notes regarding potential impacts to them as a result construction of the ventilation site

Ptychocheilus lucius	Colorado pikeminnow	E	The Colorado pikeminnow is a fish that prefers medium to large rivers. With the loss of habitat they are now restricted to the upper Colorado River system. These rivers do not occur in the study area. The drainage control measures of the site limit impacts to the downstream drainage of the Colorado River system. There should be no impacts to this species as a result of construction and operation of the vent site.
Sclerocactus glaucus	Uinta Basin hookless cactus	T	*Sclerocactus glaucus* generally occurs on cobblely, gravelly, or rocky surfaces on river terrace deposits along the White and Green Rivers of Utah.. *S. glaucus* 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 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. These plant communities nor habitats associate with them occur in the study area, therefore, there should be no impacts to this species as a result of construction and operation of the vent site.
Xyrauchen texanus	Razorback sucker	E	This species prefers slow backwater habitats and impoundments in the Colorado River system. Utah Division of Wildlife Resources distribution maps of this species for Carbon County shows to occur near the Green River in extreme eastern portion of the county. These rivers do not occur in the study area. The drainage control measures of the site limit impacts to the downstream drainage of the Colorado River system. There should be no impacts to this species as a result of construction and operation of the vent site.

* Status
C = Candidate
E = Endangered
T = Threatened
Ex = Extirpated

Color Photographs of the Sample Areas

Photo 1: Proposed Disturbed Sagebrush/Grass (photo by P. Collins)

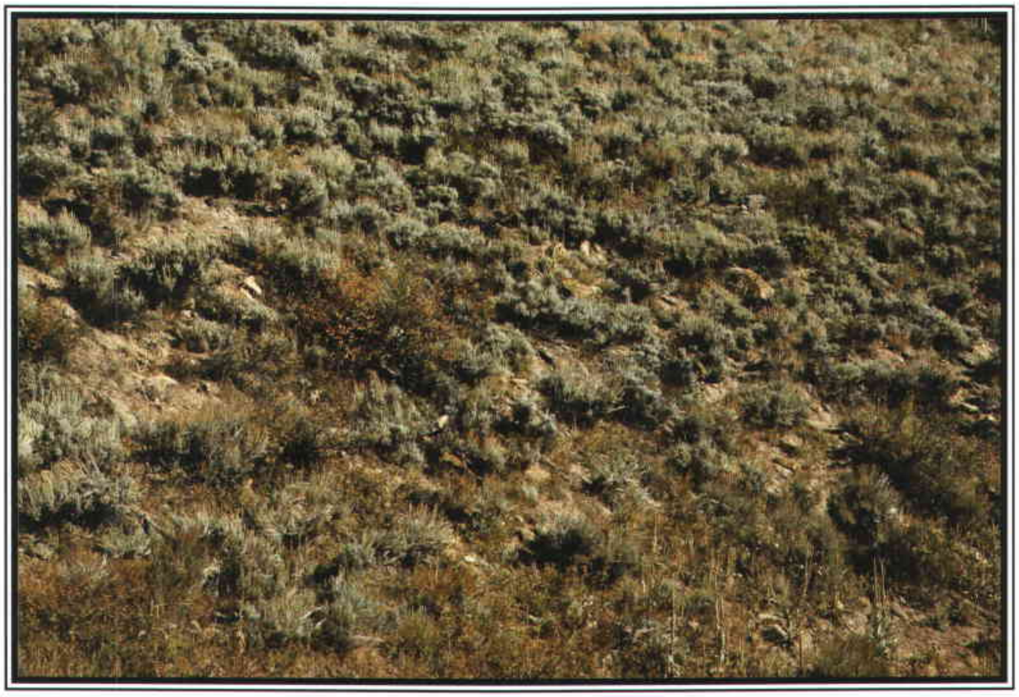


Photo 2: Sagebrush/Grass Reference Area (photo by P. Collins)

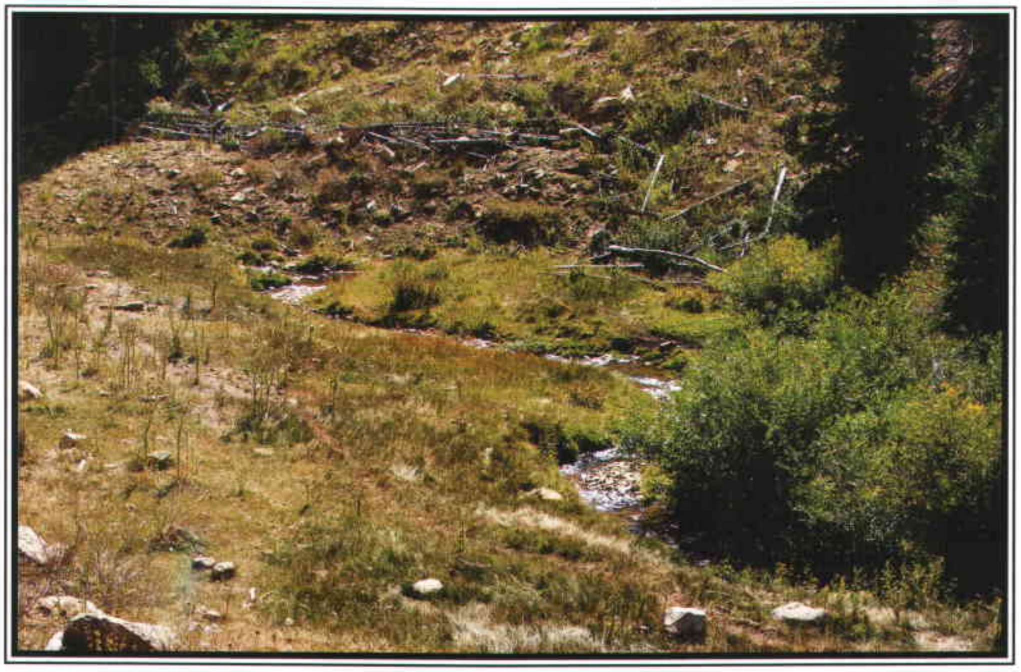
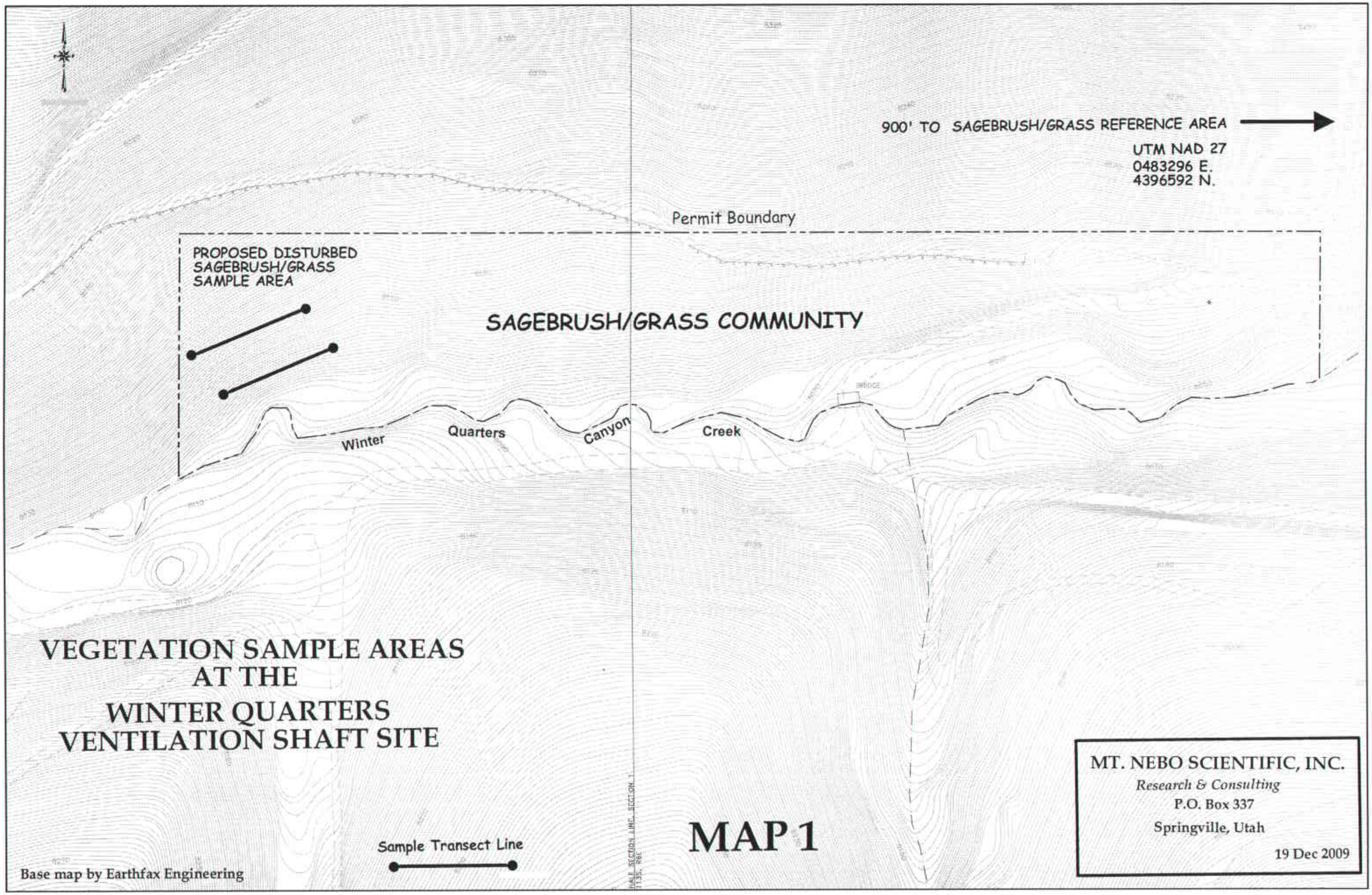


Photo 3: Proposed Disturbed Near Riparian Area (photo by G. Galecki)

Photo 4: Previously Disturbed Area (see upland areas on the left side) (photo by G. Galecki)



900' TO SAGEBRUSH/GRASS REFERENCE AREA
UTM NAD 27
0483296 E.
4396592 N.
Permit Boundary
PROPOSED DISTURBED SAGEBRUSH/GRASS SAMPLE AREA
SAGEBRUSH/GRASS COMMUNITY
Winter Quarters Canyon Creek
VEGETATION SAMPLE AREAS AT THE WINTER QUARTERS VENTILATION SHAFT SITE
Sample Transect Line
Base map by Earthfax Engineering
MAP 1
MT. NEBO SCIENTIFIC, INC.
Research & Consulting
P.O. Box 337
Springville, Utah
19 Dec 2009

Galecki, Gregg

From: Dennis Shiozawa [dennis.shiozawa@gmail.com] on behalf of Dennis K. Shiozawa [shiozawa@byu.edu]

Sent: Monday, March 16, 2009 10:09 AM

To: Galecki, Gregg

Cc: 'Patrick Collins'

Subject: WInter Quarters Canyon ventilation shaft corridor

Gregg,

Last fall I spoke to you about the planned culvert on Winter Quarters Creek near Scofield. At that time we had discussed examining macroinvertebrates within the stream corridor that would be covered during construction of the ventilation shaft. My opinion was that the macroinvertebrate communities upstream of the site were robust, as our sampling has shown for a number of years. Below the site the stream becomes depositional as it reaches the base level of the canyon. The microhabitat there will support a reduced riffle macroinvertebrate community. Within the stream reach being impacted much of the substrate is riffle habitat, likely supporting a macroinvertebrate community similar to what occurs in the Forest Service land upstream. It is my opinion that the macroinvertebrate community within the 500 foot reach of stream should be able to quickly recolonize once the culvert is removed because the upstream reaches will maintain their diverse community.

Once construction is completed and the culvert is removed I recommend that you position the stream approximately in its original channel, keeping in mind the role of discharge/alluvium from the side canyon to the south in pushing the stream to the north side of Winter Quarters Canyon. You should also replace the large woody debris in the stream since that is providing cover habitat for the resident trout. The large pile of slash near the mouth of the side canyon would provide an ample supply of logs for reconstruction of the stream channel. Downstream transport of leaves and detritus from the riparian vegetation should then allow the recolonization of the benthos by invertebrates.

My main concern within the reach being covered is the trout population. I have not surveyed fish within that reach although we have seen trout, approximately 15-20 cm in length, in pools within the construction corridor. Their density does not appear to be very high, but they are clearly established in the stream. We have found young of the year trout upstream as far as our upper-most sampling site on the U. S. Forest Service land, but have not seen larger trout in our upper sampling reaches. We have seen the larger trout when sampling at our lower macroinvertebrate station and we routinely see trout from just below the bridge, upstream to that lower sampling site. This suggests that the trout make spawning runs upstream in Winter Quarters Canyon but reside in the lower canyon. I therefore recommend that you do not block passage of the fish through the construction zone. This can be accomplished through the use of short crosswise baffles in the bottom of the culvert and by avoiding steep gradients in the slope of the pipe. It may be possible to insert boulders and rubble in the culvert so that sufficient turbulence is generated to give trout resting locations within the culvert.

As you know, I attempted to estimate the trout population density in that section last fall. Unfortunately, while the day-time weather was warm, the night temperatures were sufficient to freeze over the pools and most of the riffles. We only found approximately 20 to 30% of the stream surface open and that was in the riffles where trout would be unlikely to be found. The conditions made it impossible to conduct a population estimate. We were able to walk much of the reach where the culvert is to be placed, and a significant portion of it flows around the toe of the alluvial outwash from the side canyon. It has considerably more riffle habitat than occurs immediately upstream (the alluvial fan slows the stream above it) or downstream. This indicates that it likely holds fewer trout than either above or below the side canyon alluvial fan.

If you feel that you need to consult with someone about culvert construction, you may want to contact the BYU Civil Engineering Department to speak with Rollin Hotchkiss [rhh@byu.edu] who has students working with UDOT on culvert fish passage. In part that may depend on how long you expect the construction period to last. Assuming you have not begun work by the end of April, the trout may be able to spawn this year.

Sincerely,

Dennis

Dennis K. Shiozawa
Department of Biology
Brigham Young University
Provo, UT 84602

801-422-4972

Galecki, Gregg

From: Dennis Shiozawa [dennis.shiozawa@gmail.com] on behalf of Dennis K. Shiozawa [shiozawa@byu.edu]

Sent: Thursday, March 19, 2009 9:53 AM

To: Galecki, Gregg

Cc: 'Patrick Collins'

Subject: RE: WInter Quarters Canyon ventilation shaft corridor

Gregg,

Photo documentation would definitely be useful in reconstruction as would revegetation of the riparian.

As far as a population survey you would likely have an estimate of the number of fish that will be impacted within the section, which could give you an idea as to the amount of cover you need to make sure is put in with the reconstruction. However, man-made structures tend to be less reliable than naturally cut habitat. The stream eventually goes to an equilibrial state that is a function of variables that we don't fully understand. So I have seen a lot of restoration work that has done little to restore the stream because erosional dynamics changed the channel morphology away from what the planners thought it should be. For that reason I tend to feel that, in a system like this one, placement of large woody debris in the stream channel with a general meander frequency mimicking what it had prior to perturbation, along with riparian restoration is a better way to go. The stream will rework the channel around the woody debris during high flows and will thus refine the channel profile. You basically don't want the restored channel to be a straight cut (which your photos will help you avoid). I am sure that stream restoration advocates would differ with me on the number of constructed instream structures to install since I tend to be a minimalist on this. The stream should take the logs and incorporate them in its movement to a quasiequilibrium state. I think good photo documentation may be all you need.

So the population estimate may be of little use other than knowing how many fish are immediately impacted. It may be more useful for you to salvage fish in the construction site and place them upstream or downstream of the construction zone at the time the stream is dewatered. Do you have any plans to reduce any construction induced sediment load downstream of the pad site? It seems that the stream doesn't flow too far downstream before it gets mostly dewatered in the summer, but the reach from above the locked gate to the pad site appears to be a reasonably important habitat for trout. Also I noticed that the UDWR Price office has recently announced their interest in the status of cutthroat trout within the Scofield Reservoir drainages. It would be good to take steps to minimize impacts on the trout in the stream even though we don't know their subspecies status. I think that can be accomplished by photo documentation for reconstruction, silt control, and salvage.

Dennis

From: Galecki, Gregg [mailto:GGalecki@archcoal.com]
Sent: Wednesday, March 18, 2009 1:27 PM
To: shiozawa@byu.edu
Cc: Patrick Collins; Belcher, Austin
Subject: RE: WInter Quarters Canyon ventilation shaft corridor

Thanks for your patience on this, Dennis.

I (hopefully) have just a few more questions. The electro-fishing survey that was conducted in 2002 appears to have taken place too far upstream. If we elected to conduct a survey in the area of the proposed pad site, what do we hope to learn from the survey? Other than documenting the morphology of the creek and the fish numbers, what do we hope to learn that will be useful in reclamation? Concerning morphology, would photo documentation of the creek bed suffice?

Let me know your thoughts,

Gregg

From: Dennis Shiozawa [mailto:dennis.shiozawa@gmail.com] **On Behalf Of** Dennis K. Shiozawa
Sent: Wednesday, March 18, 2009 12:40 PM
To: Galecki, Gregg
Cc: 'Patrick Collins'
Subject: RE: WInter Quarters Canyon ventilation shaft corridor

Gregg,

I really couldn't tell how deep the pools and runs were in the area because everything was frozen over. I just noted a lot more gradient and riffle habitat than I had seen above and below that section. I think the density of the trout in the stream is low, but since we have never tried to do an estimate I can't tell you how it compares with Eccles. My guess is that it will be lower than the upper Eccles station. I could possibly tell more by walking it when the stream is open (no ice), but I can't really answer your question without such an assessment. Fish will move into riffles to feed, especially during emergences. Young of the year fish will also tend to be a little more concentrated in pockets within riffles.

Dennis

From: Galecki, Gregg [mailto:GGalecki@archcoal.com]
Sent: Tuesday, March 17, 2009 11:09 AM
To: shiozawa@byu.edu
Cc: Patrick Collins; Belcher, Austin
Subject: RE: WInter Quarters Canyon ventilation shaft corridor

Dennis,
Thanks for your detailed response. Since the portion of the creek identified as being in the construction zone (pad site) has considerably more riffle habitat than both upstream and downstream, is there a need to conduct a fish survey?

Let me know your opinion,
Gregg

From: Dennis Shiozawa [mailto:dennis.shiozawa@gmail.com] **On Behalf Of** Dennis K. Shiozawa
Sent: Monday, March 16, 2009 10:09 AM
To: Galecki, Gregg
Cc: 'Patrick Collins'
Subject: WInter Quarters Canyon ventilation shaft corridor
Gregg,

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If you feel that you need to consult with someone about culvert construction, you may want to contact the BYU Civil Engineering Department to speak with Rollin Hotchkiss [rhh@byu.edu] who has students working with UDOT on culvert fish passage. In part that may depend on how long you expect the construction period to last. Assuming you have not begun work by the end of April, the trout may be able to spawn this year.

Sincerely,

Dennis

Dennis K. Shiozawa
Department of Biology
Brigham Young University
Provo, UT 84602

801-422-4972

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Winter Quarters
Ventilation Shaft Pad
Runoff and Sediment Control Design Report

Canyon Fuel Company
Skyline Mine
Scofield, Utah

January 2010

EarthFax EarthFax Engineering, Inc.

Engineers / Scientists
www.earthfax.com

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WINTER QUARTERS VENTILATION AND MINE SLOPE PAD RUNOFF AND SEDIMENT CONTROL DESIGN REPORT, SKYLINE MINE

CHAPTER 1

INTRODUCTION

Canyon Fuel Company is planning the construction of a vertical ventilation shaft, a sloped mine portal, and an emergency escape shaft in Winter Quarters Canyon to service the Skyline Mine. The surface pad for these additional shafts will be constructed about 2 miles southwest of the town of Scofield in Carbon County, Utah (Figure 1). To prevent adverse hydrologic impacts to Winter Quarters Creek and the surrounding area, the mine will construct a runoff sediment control system including a sedimentation pond.

The purpose of this document is to present design information for the runoff and sediment controls. A sedimentation pond is being designed as a temporary impoundment intended to contain sediment and runoff discharges from the disturbed areas. 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 Company by EarthFax Engineering, Inc., and contains the following information:

- Location and background information;
- Hydrologic analyses to determine runoff and sediment discharge for design storm events;
- Sediment control and sedimentation pond sizing and design criteria;
- Slope stability analyses for sedimentation pond embankments and cut highwalls; and
- Runoff conveyance system, sedimentation pond and topsoil sediment trap construction specifications.

Engineering calculations are included as attachments to this document.

CHAPTER 2

LOCATION AND BACKGROUND INFORMATION

The general layout of the proposed Winter Quarters facility is shown on Plate 3.2.4-3A. The watershed area contributing to the sedimentation pond is approximately 3.69 acres, which includes the pad areas for the ventilation shaft, sloped mine portal, emergency escape shaft, the power substation, sedimentation pond, and part of the access road. The watershed also includes nearby undisturbed drainage areas that can not be reasonably diverted. The watershed contributing to the topsoil sediment trap is approximately 0.61 acres, and includes only the topsoil stockpile area contained within the topsoil berm. The watershed area contributing to the alternative sediment control area (ASCA) along the access road is approximately 1.01 acres, and includes the remaining section of the access road not included in the sedimentation pond area and the undisturbed area below the upper road and above the access road. Construction is planned for 2010.

The sedimentation pond has been designed to contain storm runoff and sediment discharge as specified in the Utah Administrative Code Titles R645-301-742 and 743. Thus, the pond has been designed to comply with the following criteria:

- The pond will contain the runoff from a 10-year, 24-hour storm event in addition to sediment yielded from its catchment area.
- The pond will safely convey the peak flow resulting from a 25-year, 6-hour storm event immediately following a 10-year, 24-hour storm event via an 18-inch diameter riser primary spillway. An emergency spillway will also be constructed along the eastern edge of the pond and will pass the same storm event if the primary outlet fails. Additionally, a dewatering valve will be installed above the sediment storage elevation to drain the impoundment after a storm event once water-quality criteria are met.
- All embankments surrounding the pond have been evaluated for slope stability. They have been designed with a minimum factor of safety of 1.3 against rotational shear failure when the pond is filled to capacity.

- The pond will be constructed from native or imported materials. The embankment will not be constructed from coal mine waste rock.

The topsoil sediment trap has been designed to contain storm runoff and sediment discharge as specified in the Utah Administrative Code Titles R645-301-742 and 743. Thus, the sediment trap has been designed to comply with the following criteria:

- The sediment trap will contain the runoff from a 10-year, 24-hour storm event in addition to sediment yielded from its catchment area.
- The sediment trap will be constructed from native or imported materials. The embankment will not be constructed from coal mine waste rock.

The runoff conveyance systems associated with this facility have been designed to safely convey site runoff as specified in the Utah Administrative Code Titles R645-301-742 and 743. Thus, the conveyance systems have been designed to comply with the following criteria:

- The conveyance system will safely convey the runoff from a 10-year, 24-hour storm event.
- All of the side slopes of the swale and ditches have been designed to prevent channel degradation and erosion.
- The swale, ditches, and berms will be constructed from native or imported materials and not from coal mine waste rock.
- The culvert outfall will be riprap armored to prevent erosion.

The upper road runoff conveyance system has been designed to safely convey upstream runoff as specified in the Utah Administrative Code Titles R645-301-742 and 743. Thus, the conveyance systems have been designed to comply with the following criteria:

- The ditch, catch basin, and culvert have been designed to safely convey runoff from a 100-year, 6-hour storm event.
- The ditch will be constructed from native or imported materials and not from coal mine waste rock.
- The culvert outfall will be riprap armored to prevent erosion.

The ASCA would increase the sedimentation pond by approximately 20%. To prevent cutting north further into the existing slope below the access road and possibly increase slope instability, the sedimentation pond was not designed to contain runoff and sediment from the ASCA. The ASCA system has been designed to safely convey site runoff as specified in the Utah Administrative Code Titles R645-301-742 and 743. Thus, the conveyance systems have been designed to comply with the following criteria:

- The conveyance system will safely convey the runoff from a 10-year, 24-hour storm event.
- All of the side slopes of the ditches have been designed to prevent channel degradation and erosion.
- The ditches and berm will be constructed from native or imported materials and not from coal mine waste rock.
- The culvert outfall will be riprap armored to dissipate runoff.
- Wattles (erosion control log) placed around the inlet of the ASCA catch basin will be installed according to manufacturers specifications.

CHAPTER 3
OPERATIONAL HYDROLOGY

3.1 Hydrology Introduction

Storm water discharge for the area was calculated using HydroCAD version 8.50. The curve number (CN) value used was assigned for the Winter Quarters Canyon based on sub-basin soil types and vegetation cover type. According to Natural Resources Conservation Service native soil types are categorized as Hydrologic Soil Group B. Much of the native vegetation at the site is sagebrush and grass in fair to good condition.

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). Upstream and site watershed areas and average slopes were calculated from 2-foot contour interval topographic map by Psomas Engineering (Psomas 10/15/08) using AutoCad 2008 software. All storm runoff calculations are included in Attachment A.

3.2 Drainage Area Characteristics

The drainage areas contributing to the sedimentation pond, topsoil sediment trap, upstream, and ASCA watersheds are delineated in Plate 3.2.4-3G. The area draining to the sedimentation pond includes both disturbed and undisturbed areas: disturbed watersheds DW-1 through DW-4, undisturbed watersheds UDW-2 and UDW-3, and the sedimentation pond watershed (SPW). The area draining to the topsoil sediment trap includes only the topsoil stockpile watershed (TSW). The upstream watershed includes the undisturbed watershed UDW-1. The area drainage to the ASCA includes both undisturbed and disturbed areas: disturbed watershed DW-5, undisturbed watershed UDW-4 and UDW-5.

Watershed DW-1 consists of the highwall west, north and east of the ventilation shaft and extends east to the sloped mine portal. The highwall consists of 0.5 horizontal to 1 vertical cut face with 10 foot wide benches for every 20 feet in height, the tallest part of this wall is 60 feet high. A berm above the highwall will direct runoff from the undisturbed area above the highwall into the pad swale. Watershed DW-2 consists of the west half of the ventilation shaft pad, immediately south of DW-1. This pad area is sloped toward the pad swale along the north highwall at 2%. The vertical ventilation shaft, sloped mine portal and emergency access shaft are located within this watershed. Watershed DW-3 consists of the area along the highwall east of the sloped mine portal and north of the east half of the ventilation shaft pad and access road. This highwall is sloped at 0.5 horizontal to 1 vertical with a maximum height of 25 feet. Runoff from this watershed flows south into the access road ditch. Watershed DW-4 consists of the west half of the ventilation shaft pad, immediately south of DW-3. This area of the pad is sloped toward the access road ditch at 2%. From the access road ditch runoff enters the access road catch basin, runoff is then conveyed through a culvert under the access road and into the sedimentation pond (see Plates 3.2.4-3E and 3.2.4-3F). The power substation and field office are located within this watershed.

Watershed DW-5 consists of the east half of the access road and the portion of the existing road to be improved for site access. The access road is sloped toward the ASCA ditch at 2% to 5%, the access road is sloped toward a vertical curve in the middle of this watershed at 0 to 8.4%. The highwall above the access road is sloped at 0.5 horizontal to 1 vertical with a maximum height of 25 feet.

Watershed UDW-1 consists of the 46.83 acre area north of the upper road uphill from the site to the top of the ridge above the site. The average slope within this watershed is 40%, with vegetation consisting of sagebrush and grass. Runoff from this watershed will flow south to the upper road ditch. The upper road ditch will convey runoff to a culvert inlet on the north side of the intersection of the site access road and the upper road. This culvert will convey runoff under the road and into the upper road catch basin. From the upper road catch basin, runoff will flow to a riprap pad 30 feet north of the Winter Quarters Creek. From the riprap pad runoff will flow into Winter Quarters Creek.

Watershed UDW-2 consists of the area north of DW-1 and south of the upper road. Watershed UDW-3 consists of the area north of DW-3 and south of the upper road. Runoff from this watershed will flow into DW-3 and then into the access road ditch. The average slope within both of these watersheds is 40%, with vegetation consisting of sagebrush and grass.

Watershed UDW-4 consists of the area north of DW-5 and south of the upper road. Runoff from this watershed will flow into DW-5 and then into the ASCA ditch. The average slope within the watershed is 50%, with vegetation consisting of sagebrush and grass. Watershed UDW-5 consists of the area south of DW-5 and north of the topsoil stockpile. This area includes a portion of the existing road from immediately below the upper road culvert inlet to the topsoil stockpile.

Runoff from the UDW-4 and DW-5 watershed will flow into the ASCA ditch. From the ASCA ditch runoff enters the ASCA catch basin. Runoff is then conveyed through a culvert under the access road and into riprap located north of the existing road, to dissipate and spread runoff. From this culvert outlet, runoff from UDW-5 and the culvert will flow across the existing road, as it currently does, and into the north side of the topsoil berm. The topsoil berm will direct runoff into Winter Quarters Creek (see Plates 3.2.4-3E and 3.2.4-3F).

3.3 Runoff Volume Calculations

Results of the runoff calculations are provided in Appendix A. HydroCAD was used in conjunction with precipitation data from The National Oceanic and Atmospheric Administration Atlas 14 to calculate runoff for the site. The runoff volumes are presented in the HydroCAD worksheets. Total runoff volume discharge to the sedimentation pond resulting from the 10-year, 24-hour storm event is 4,182 cubic feet. Total runoff volume discharge to the topsoil sediment trap from the 10-year, 24-hour storm event is 445 cubic feet.

3.4 Sediment Volume Calculations

The average annual anticipated sediment yield to the sedimentation pond and ASCA was calculated using an adaptation of the Universal Soil Loss Equation that was 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

A copy of the instructions for obtaining input variables for this equation is included in Table 1 and 2 and Attachment B.

This method assumes that all the soil mobilized by erosion in the entire watershed travels down slope to the sedimentation pond and ASCA (i.e., a sediment delivery ratio of 1.0). Thus, the sediment volume predicted by this equation is conservatively high.

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 sedimentation pond and the ASCA. The maximum calculated annual sediment yield for the area draining to the sedimentation pond is 1,108 cubic feet and ASCA is 183 cubic feet.

Derivations of each factor in the sediment yield equation for each of the watershed are summarized below:

- The value for R was obtained from an isoerodent precipitation map of Utah (Israelsen et al., 1984).
- Values for K were obtained for the native soils from the online NRCS soils database.
- 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 (2 foot contour interval). Linear interpolation was used for slope values to more accurately model watersheds DW-2 and DW-4 and UDW-3. Linear interpolation was also used for length value to more accurately model watershed DW-2. These calculations are presented in Table 2 and 3 and Appendix B.
- Values for VM were taken from a table provided by Israelsen et al. (1984).

CHAPTER 4
SEDIMENT CONTROL DESIGN

4.1 Sedimentation Pond, Topsoil Sediment Trap and ASCA Capacities

The sedimentation pond has been sized to contain the runoff from a 10-year, 24-hour storm event (4,182 cubic feet, see Attachment A) and one year of predicted sediment yield (1,108 cubic feet, see Table 1), for a total capacity of at least 5,290 cubic feet. The design accommodates drainage from the facilities pad and west end of the access road. It will also accommodate runoff from nearby undisturbed areas that cannot be reasonably diverted.

The stage-capacity curve for the sedimentation pond is shown in Figure 2. As noted, the sedimentation pond will have the capacity to store sediment to an elevation of 8072.1 feet, and a total storage (sediment plus runoff) to an elevation of 8075.05 feet. Sediment will be cleaned out of the pond when it reaches an elevation of 8071.65 feet (the elevation corresponding to a volume of 60% of the calculated sediment storage volume).

An 18-inch diameter riser will be installed in the sedimentation pond to act as the primary spillway, with a top elevation of 8075.05 feet. A 6-inch diameter decant pipe will be placed at an inlet elevation of 8072.1 feet, which is the elevation of the top of the sediment storage capacity. Discharge from the primary spillway will be through an 18-inch diameter, 42-foot long pipe attached to the riser at an elevation of 8071.0 feet, with an outflow elevation of 8070.0 feet.

A secondary spillway will also be constructed on the south embankment of the sedimentation pond. This spillway, which will function only in the event of a storm larger than the design storm or in the event that the primary spillway is plugged, will consist of a 5-foot wide channel with 5 horizontal to 1 vertical sides, a 5% slope across the top of the embankment, and a 50% slope down the face of the embankment. The elevation of the secondary spillway crest will be 8075.55 feet. This is 0.5 feet above the primary spillway, and approximately 1 foot below the compacted maximum elevation of the embankment. For design details see Plates 3.2.4-3D and 3.2.4-3E.

The topsoil sediment trap has been sized to contain the runoff from a 10-year, 24-hour storm event (445 cubic feet), as indicated in Table 3 and Attachment A. The design accommodates drainage from the topsoil stockpile area. As indicated in Plate 3.2.4D, a 3-foot high silt fence will be installed within the embankment. A 4 foot wide section of the fence will be cut and sown back to allow for a spillway 6 inches below the berm height (8,056.0 feet). This design will allow containment of the 10-year, 24-hour storm event with 0.5 feet of freeboard below the spillway.

A 12-inch diameter wattle will be placed around the ASCA catch basin, causing runoff to pool and flow through the wattle and removing sediment. As flows increase during a high flow event, runoff will flow over the wattles into the ASCA catch basin. However, due to the relatively flat and long section of the ASCA ditch on either side of the ASCA catch basin, much of the sediment will still be removed. It is estimated that the average annual sediment from the ASCA will be 183 cubic feet (see Table 2). Sediment trapped by the wattle will be removed as necessary to maintain functionality. The wattle will also be replacement as necessary.

4.2 Inflow and Outflow Erosion Protection

Peak flows for the both the sedimentation pond and the topsoil sediment trap were calculated using HydroCAD version 8.50 and FlowMaster version 6.0. The results of these calculations are presented in Attachment A and summarized in Table 4. For design details, see Plates 3.2.4-3D through 3.2.4-3F.

The sedimentation pond inlet was designed to safely convey the peak flow resulting from the 10-year, 24-hour storm event. The primary spillway on the pond was designed to discharge the 25-year, 6-hour storm event assuming that the pond was full to the top of the primary spillway at the beginning of the storm.

The sedimentation pond inlet consists of an 18-inch diameter corrugated metal pipe with a design outflow peak discharge of 1.74 cfs (cubic feet per second) at a maximum velocity of 11.04 fps (feet per second). This culvert will outlet approximately 3 feet above the bottom level of the pond. To protect the soil and prevent erosion at the pond inlet a 5-foot by 5-foot riprap pad with D_{50} = 9 inches to dissipate the runoff energy. The riprap pad will be imbedded 1 foot into the pond floor and rise 2 feet above the pond floor. This will allow the runoff to free fall only a foot before the riprap pad dissipates the flow.

The topsoil sediment trap was designed to retain the runoff volume resulting from the 10-year, 24-hour storm event. The topsoil sediment trap will consist of a 6-inch high berm along the bottom of the topsoil stockpile. The peak discharge along the edge of the berm was calculated to be 0.17 cfs with a maximum velocity of 3.10 fps. Hence, no riprap is needed to protect this berm.

The sedimentation pond primary and secondary outlets were model using the 25-year, 6-hour storm event. The maximum outflow form the primary spillway during a 25-year, 6-hour storm event has been determined to be 1.09 cfs with a velocity of 3.29 fps. To protect the soil and slow flow velocity, a 5-foot wide and 5-foot long riprap pad with a D_{50} = 2 inches will placed at the outfall. The secondary spillway consists of a 5-foot wide channel with 5 horizontal to 1 vertical sides. Assuming the pond is full to the top of the primary spillway at the beginning of the event, and the primary spillway is plugged, the maximum outflow for the secondary spillway during a 25-year, 6-hour storm event was calculated to be 2.06 cfs with a maximum velocity of 4.69 fps. Although this velocity is low enough to preclude the need fro riprap, to protect the face of the embankment the secondary spillway channel will be armored with D_{50} = 2 inch riprap.

4.3 Sedimentation Pond and Topsoil Sediment Trap Details

The sedimentation pond embankment will have a crest elevation of 8076.5 feet, and a minimum crest width of 10 feet. The first 1.6 feet of topsoil in this area will be removed and stored within the topsoil stockpile area. The bottom of the sedimentation pond elevation (8071.0) is approximately 2 feet below the existing ground level. Given the site constraints, the sedimentation pond has been designed to fit within a flat area between a zone approximately 30 feet from the stream and the steep sides of the hillside. Where fill is used to construct the embankment, the side slopes will be 2 horizontal to 1 vertical. The embankment will be constructed from native clay/silt soils, and will be compacted in 1-foot lifts using standard compaction techniques. The embankment material will be free of large rocks, sod, large roots, frozen soil, and acid or toxic forming coal processing waste. The sedimentation pond embankment has been designed with a factor of safety of 2.75, as indicated in Attachment C. The north slopes where the hillside is cut into bedrock will be 1 horizontal to 1 vertical. This cut will be in bedrock and will be stable. Slope analysis for the area above the pad (0.5 horizontal to 1 vertical) yielded a factor of safety of 2.0. The sedimentation pond will be cut into similar material, see Attachment C. For design details see Plate 3.2.4-3D.

The topsoil sediment trap will have a crest elevation of 8056.0 feet at its lowest point, and no crest width. The side of the embankment will slope at 2 horizontal to 1 vertical and will be no higher than about 3 feet. A silt fence will be located within the center of the embankment where the embankment is over 2 feet high. The center of the embankment will have a 4-foot wide section were the fence is cut down 6 inches and sown back on itself to provide an outlet. $D_{50} = 4$ inch riprap will be placed below this outlet to prevent erosion of the outfall area. For design details see Plate 3.2.4-3F.

4.4 Erosion Protection for Runoff Conveyance System

The peak flow for the runoff conveyance systems were calculated using HydroCAD version 8.50 and FlowMaster version 6.0, as indicated in Attachment A and summarized in Table 4 and 5.

The runoff conveyance system for the sedimentation pond, topsoil stockpile , and ASCA will be temporary. Therefore, they were modeled using the 10-year, 24-hour storm event. As summarized in Table 4, velocities for the pad swale, access road ditch, topsoil berm, and ASCA ditches are lower then 5 fps. Therefore, no riprap lining will be required. The sedimentation pond inlet has a velocity of 11.04 fps. Therefore, a $D_{50} = 9$ inch riprap will armor the outfall of this culvert. The ASCA culvert will have an outfall velocity of 2.81 fps. However, to dissipate runoff above the existing road and prevent erosion, a 5-foot by 5-foot $D_{50} = 2$ inch riprap pad will be placed at the outfall. The access road catch basin will have a maximum of 0.6 feet of water depth. This is 3.4 feet below the top of this catch basin. The ASCA catch basin will have a maximum depth of 0.44 feet. This is 2.06 feet below the top of this catch basin.

The upper road ditch, upper road culvert inlet, and upper road culvert outlet will be permanent. Therefore, they were modeled using the 100-year, 6-hour precipitation event. The upper road ditch collects runoff from watershed UDW-1. The upper road ditch will have a maximum velocity of 4.24 fps. Therefore, no riprap lining is required. The upper road culvert inlet will consist of an 18 inch culvert with a maximum flow depth of 0.12 feet. The upper road catch basin will have a maximum of 0.4 feet of water depth. This is 3.6 feet below the top of this catch basin. The upper road culvert outlet will have a maximum flow depth of 0.10 feet with a velocity of 6.56 cfs. To prevent degradation of the outfall, a 5-foot wide by 10-foot long D_{50} = 6 riprap pad will be constructed at the outfall of the upper road culvert outlet.

4.5 Runoff Conveyance System Details

The pad swale will have a depth of 6 inches with 10 horizontal to 1 vertical sides and a slope ranging from 1.5% to 3%. The pad swale begins northwest of the ventilation shaft along the highwall and will convey runoff east to the access road ditch immediately east of the mine portal. The access road ditch will have a depth of 1 foot with 2 horizontal to 1 vertical sides and a slope ranging from 2% to 8.33%. The access road ditch will convey runoff into the access road catch basin. The access road catch basin will convey runoff into the sedimentation pond inlet culvert. The sedimentation pond inlet culvert is discussed in Section 4.2.

A ditch will be placed along the north side of the facility access road to capture runoff from the ASCA. This ditch will vary in width from 2 to 4 feet, as indicated on Plate 3.2.4-3A. The ditch will be constructed with side slopes of 2 horizontal to 1 vertical. Due to changes in slope, the depth of the ditch will vary from 6 to 12 inches in areas where the width is 2 feet and 4 feet, respectively.

The 4-foot wide ASCA ditch will convey runoff into the ASCA catch basin. The ASCA catch basin will be located at the center of the 4-foot wide ASCA ditch and will have a 12-inch diameter wattle placed around it to prevent sediment from entering the catch basin. The wattle will be installed according to recommendations from the manufacturer. The wattle will be maintained regularly to prevent sediment from building up. Accumulated sediment will be removed and the wattle will be replaced as needed. The ASCA catch basin will convey runoff into an 18-inch culvert under the access road and into a riprap pad along the north side of the existing road south of the access road. The riprap pad will dissipate flow and allow the runoff to flow along its natural path across the existing road. From the south side of the existing road runoff will flow west along the north side of the topsoil berm toward Winter Quarters Creek.

The upper road ditch will have a depth of 6 inches with 2 horizontal to 1 vertical sides and a slope range from 7% to 20%. The upper road ditch begins northwest of the ventilation shaft on the north side of the upper road and conveys runoff approximately 1,400 feet east into the upper road culvert inlet. The upper road culvert inlet will consist of an 18 inch diameter culvert located on the north side of the intersection of the upper road and the site access road. From the upper road culvert inlet runoff will be conveyed under the intersection of the upper road and the site access road to the upper road catch basin. From the upper road catch basin runoff is conveyed into the 18 inch diameter upper road culvert outlet and then into Winter Quarters Creek.

For general layout of site see Plate 3.2.4-3A. For details of above described conveyances see Plates 3.2.4-3E and 3.2.4-3F.

CHAPTER 5
RECLAMATION HYDROLOGY

Natural drainage patterns will be restored during reclamation. To assure that natural drainage is restored contours will be regraded to closely resemble predevelopment conditions. Fill from behind the wall will be used to fill be cut areas below the highwalls, and topsoil from the topsoil stockpile area will be placed back on the site. Some gouging and scarring with a dozer will occur after topsoil placement to provide areas for moisture to gather adding to slope stability and vegetation growth.

The sedimentation pond, topsoil sediment trap and ASCA will be removed along will all ditches, swales, culverts and catch basins related to these sediment treatment devises will be removed during reclamation. The upper road ditch, culvert and catch basin will remain after reclamation to prevent excess runoff from entering the site and causing erosion to take place before vegetation is established. The upper road runoff conveyance system will also be left in place to add long term stability to the upper road.

The reclamation layout and cross sections can be seen on Plates 4.4.2-3A and 4.4.2-3B, respectively.

CHAPTER 6

REFERENCES

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TABLE 1

Erosion Calculations for the Sedimentation Pond

Erosion Calculation for the Sedimentation Pond								
R (Before Correction)[a]					17			
R (After Correction)[b]					26			
K					0.1			
Contributing Watersheds	Length (ft)				Slope (%)		LS[c]	
DW-1	50				80		23.60	
DW-2	125				2.5		0.26	
DW-3	10				55		6.48	
DW-4	80				2.5		0.23	
UDW-2	200				45		21.50	
UDW-3	150				42.5		17.06	
SPW	0				0		0.00	
Contributing Watersheds	R	K	LS	VM[(d)]	A	Area (ac)	Soil Density (pcf)	Sediment Load (CF)
DW-1	26	0.1	23.60	1.30	80.03	0.181	110	263
DW-2	26	0.1	0.26	1.48	1.00	0.392	110	7
DW-3	26	0.1	6.48	1.30	21.98	0.085	110	34
DW-4	26	0.1	0.23	1.48	0.89	0.408	110	7
UDW-2	26	0.1	21.50	0.35	19.63	1.143	110	408
UDW-3	26	0.1	17.06	0.35	15.58	1.372	110	389
SPW	26	0.0	0.00	0.00	0.00	0.113	0	0
Total								1,108

(a) From Isrealsen et. Al. Mean Annual Iso-Erodent Value, see Attachment B.
(b) From Isrealsen et. Al. Figure 9 "10 Year Recurrence Interval and Figure 1 Zone III", see Attachment B.
(c) From Isrealsen et. Al. Table 2, see Attachment B.
(d) From Isrealsen et. Al. Table 3, see Attachment B.

TABLE 2

Erosion Calculations for the Alternative Sediment Control Area

Erosion Calculation for the Alternative Sediment Control Area								
R (Before Correction)[a]				17				
R (After Correction)[b]				26				
K				0.1				
Contributing Watersheds	Length (ft)				Slope (%)		LS[c]	
UDW-4	100				50		17.82	
DW-5	70				3		0.26	
Contributing Watersheds	R	K	LS	VM[(d)]	A	Area (ac)	Soil Density (pcf)	Sediment Load (CF)
UDW-4	26	0.1	17.82	0.35	16.27	0.592	110	175
DW-5	26	0.1	0.26	1.48	1.00	0.422	110	8
Total								183

(a) From Isrealsen et. Al. Mean Annual Iso-Erodent Value, see Attachment B.
(b) From Isrealsen et. Al. Figure 9 "10 Year Recurrence Interval and Figure 1 Zone III", see Attachment B.
(c) From Isrealsen et. Al. Table 2, see Attachment B.
(d) From Isrealsen et. Al. Table 3, see Attachment B.

TABLE 3

Topsoil Stockpile Calculations

Topsoil Volume Calculation			
Disturbed Area (ft^2)	Average Topsoil Depth (ft)	Topsoil Volume (CY)[a]	Topsoil Volume Available (CY)[b]
73,667	1.6	4,365	4421
Topsoil Stockpile Berm Runoff Storage Capacity			
Elevation	Surface Area (ft)	Incremental Volume (CF)[c]	Cumulative Volume (CF)
8053	0	0	0
8054	220	110	110
8055	450	335	445
8056	765	608	1053
Total			1053

(a) Topsoil Volume = Disturbed Area X Average Topsoil Depth.
(b) Based on AutoCAD Cut and Fill.
(c) Surface area at given elevations based on AutoCAD topography of site.

TABLE 4

Runoff Conveyance Riprap Size

Runoff Conveyance Riprap Size		
Runoff Conveyance	Velocity (fps)[a]	D_{50} (in)[b]
2' Wide ASCA Ditch	3.74	N/A
4' Wide ASCA Ditch	3.51	N/A
Access Road Ditch	4.53	N/A
ASCA Culvert Outfall	2.81	2[(c)]
ASCA Topsoil Berm (North Side of Berm, South of Exiting Road)	3.49	N/A
Pad Swale	1.86	N/A
Sedimentation Pond Inlet	11.04	9
Sedimentation Pond Primary Outfall	3.29	2[(c)]
Sedimentation Pond Secondary Outfall (Upper Section)	2.23	2[(c)]
Sedimentation Pond Secondary Outfall (Lower Section)	4.69	2[(c)]
Topsoil Berm	3.10	N/A
Upper Road Ditch	4.24	N/A
Upper Road Ditch Culvert Outfall	6.56	6

(a) From FlowMaster version 6.0 Worksheets, see Attachment A.
(b) From U.S. Dept. of Transportation "Use of Riprap for Bank Protection". Assuming K/d>1, therefore $V_s/V = 1$, as indicated in Attachment A.
(c) Riprap not required, but used to dissipate flow and energy.

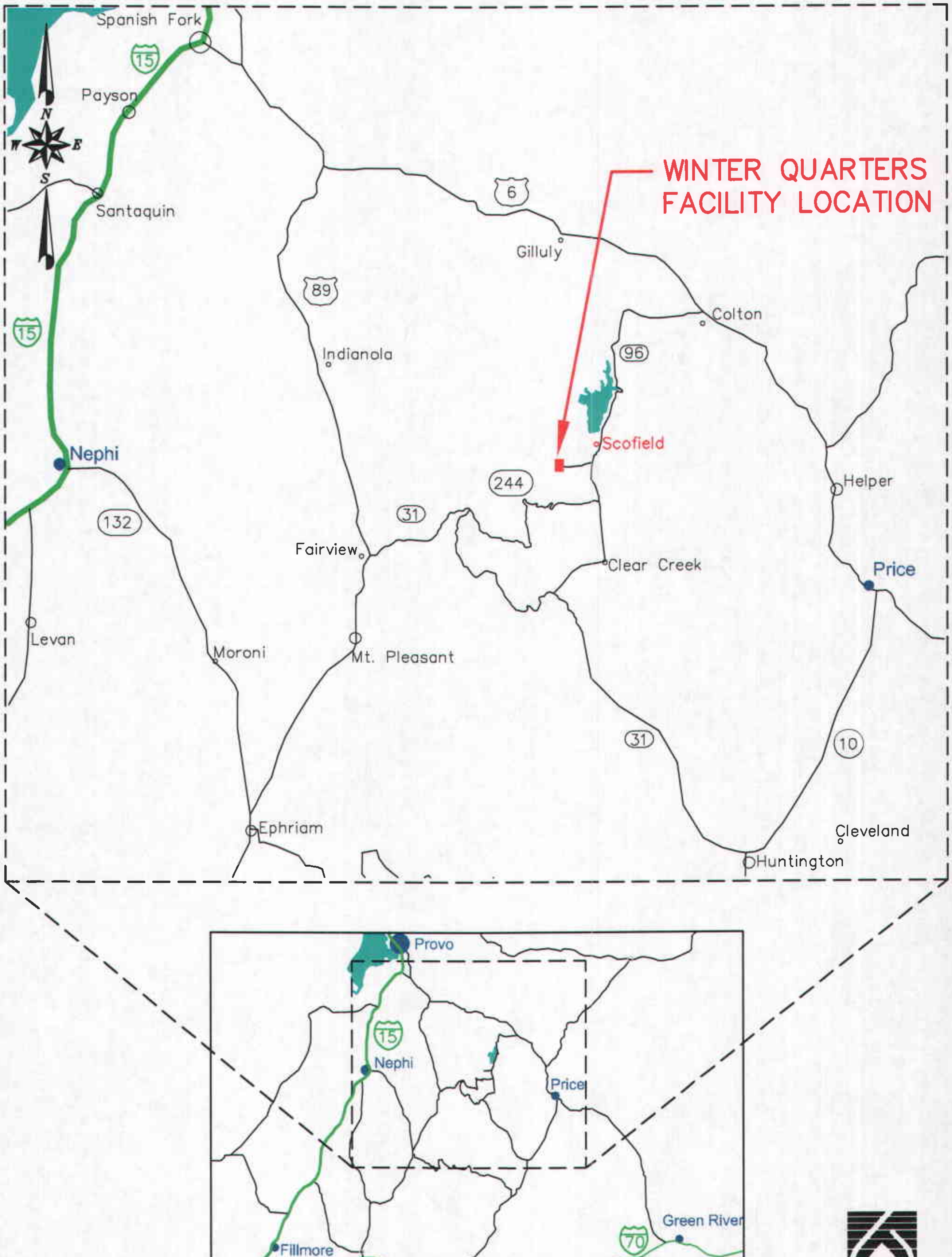
TABLE 5

Runoff Conveyance Maximum Flow Depth

Runoff Conveyance Maximum Flow Depth		
Runoff Conveyance	Depth (ft)[a]	Freeboard (ft)[a]
2' Wide ASCA Ditch	0.32	0.18
4' Wide ASCA Ditch	0.35	0.65
Access Road Ditch	0.63	0.37
Access Road Catch Basin	0.60	3.40
ASCA Catch Basin	0.44	2.06
ASCA Culvert	0.28	1.22
ASCA Topsoil Berm (North Side of Berm, South of Exiting Road)	0.36	0.14
Pad Swale	0.22	0.28
Sedimentation Pond Inlet	0.21	1.29
Sedimentation Pond Primary Outfall	0.36	1.14
Sedimentation Pond Secondary Outfall (Upper Section)	0.16	0.79
Sedimentation Pond Secondary Outfall (Lower Section)	0.08	0.87
Topsoil Berm	0.26	0.24
Upper Road Ditch	0.27	0.23
Upper Road Culvert Inlet	0.12	1.38
Upper Road Catch Basin	0.40	3.60
Upper Road Culvert Outfall	0.10	0.50

(a) From FlowMaster version 6.0 Worksheets, see Attachment A.

FIGURES



NOT TO SCALE

FIGURE 1. GENERAL LOCATION MAP

EarthFax

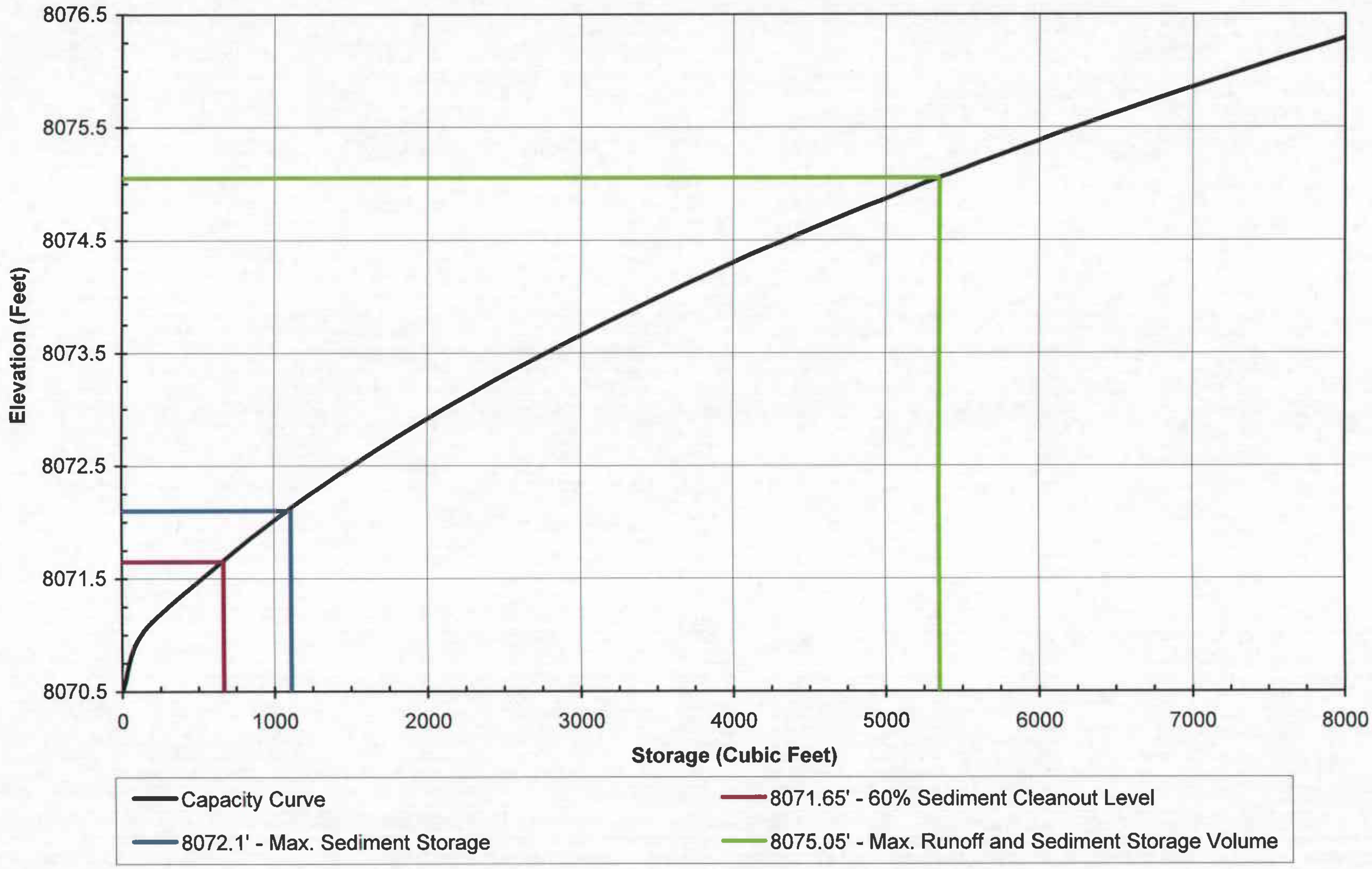


FIGURE 2. STAGE-CAPACITY CURVE FOR THE SEDIMENTATION POND

ATTACHMENT A

Operational Hydrology Calculations

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 39.72048 N 111.20086 W 8543 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Thu Dec 3 2009

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.14	0.22	0.27	0.36	0.45	0.56	0.62	0.81	1.04	1.21	1.46	1.85	2.23	2.57	3.45	4.25	5.30	6.27
2	0.18	0.28	0.35	0.47	0.58	0.70	0.78	1.00	1.28	1.50	1.81	2.29	2.76	3.18	4.30	5.28	6.59	7.80
5	0.25	0.39	0.48	0.65	0.80	0.93	1.00	1.24	1.55	1.82	2.20	2.79	3.38	3.89	5.28	6.42	8.03	9.51
10	0.31	0.48	0.59	0.80	0.99	1.14	1.20	1.44	1.79	2.08	2.51	3.20	3.88	4.45	6.05	7.31	9.13	10.81
25	0.41	0.62	0.77	1.03	1.28	1.46	1.52	1.72	2.11	2.43	2.94	3.75	4.55	5.19	7.07	8.47	10.56	12.49
50	0.49	0.74	0.92	1.24	1.54	1.74	1.79	1.99	2.37	2.69	3.26	4.18	5.07	5.75	7.84	9.33	11.63	13.73
100	0.58	0.89	1.10	1.48	1.83	2.07	2.12	2.31	2.64	2.96	3.59	4.61	5.60	6.31	8.63	10.18	12.69	14.96
200	0.69	1.05	1.30	1.76	2.17	2.45	2.49	2.66	2.98	3.23	3.92	5.05	6.13	6.88	9.41	11.02	13.73	16.15
500	0.86	1.32	1.63	2.20	2.72	3.05	3.09	3.25	3.57	3.58	4.36	5.64	6.84	7.62	10.43	12.10	15.08	17.68
1000	1.02	1.55	1.92	2.59	3.20	3.60	3.64	3.79	4.11	4.15	4.70	6.10	7.39	8.19	11.21	12.90	16.09	18.81

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

*** Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)**

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.17	0.26	0.32	0.44	0.54	0.66	0.73	0.92	1.16	1.37	1.66	2.13	2.59	2.98	4.06	4.96	6.24	7.27
2	0.22	0.34	0.42	0.56	0.69	0.83	0.91	1.15	1.43	1.70	2.05	2.65	3.21	3.69	5.05	6.17	7.76	9.07
5	0.30	0.46	0.57	0.77	0.95	1.11	1.18	1.41	1.74	2.06	2.50	3.23	3.93	4.52	6.23	7.54	9.47	11.06
10	0.38	0.57	0.71	0.96	1.19	1.35	1.41	1.64	2.00	2.35	2.86	3.70	4.50	5.17	7.16	8.57	10.78	12.56
25	0.49	0.75	0.93	1.25	1.54	1.75	1.79	1.98	2.37	2.75	3.34	4.33	5.30	6.04	8.39	9.94	12.49	14.54
50	0.59	0.90	1.11	1.50	1.86	2.09	2.12	2.30	2.67	3.05	3.71	4.83	5.91	6.70	9.33	10.95	13.77	16.04
100	0.71	1.07	1.33	1.79	2.22	2.51	2.53	2.69	3.00	3.35	4.10	5.34	6.54	7.39	10.27	11.97	15.05	17.49
200	0.84	1.29	1.59	2.15	2.66	2.99	3.00	3.12	3.43	3.67	4.50	5.85	7.18	8.07	11.23	13.00	16.34	18.94
500	1.07	1.63	2.02	2.73	3.38	3.78	3.80	3.88	4.15	4.19	5.04	6.57	8.09	8.99	12.54	14.35	18.02	20.84
1000	1.29	1.96	2.43	3.27	4.05	4.55	4.55	4.60	4.84	4.89	5.45	7.14	8.79	9.70	13.54	15.38	19.34	22.29

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.

Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

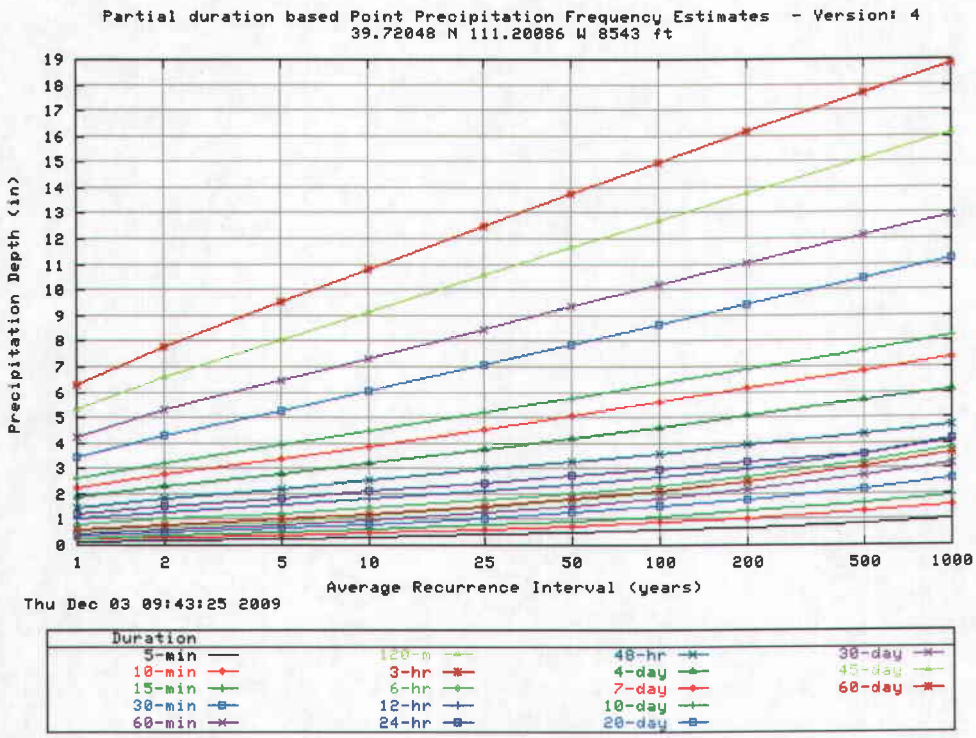
*** Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)**

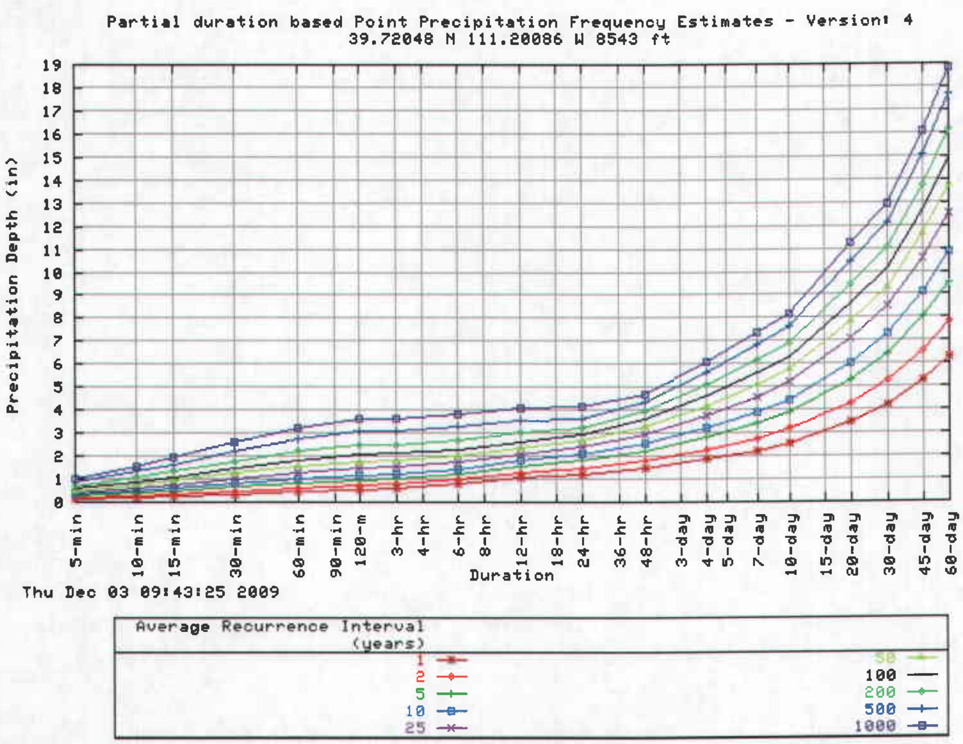
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.12	0.19	0.23	0.31	0.39	0.48	0.54	0.72	0.94	1.08	1.29	1.62	1.96	2.23	3.00	3.68	4.60	5.46
2	0.16	0.24	0.30	0.40	0.50	0.60	0.68	0.90	1.16	1.34	1.60	2.01	2.43	2.78	3.74	4.58	5.72	6.81
5	0.21	0.33	0.41	0.55	0.68	0.80	0.87	1.10	1.40	1.63	1.94	2.44	2.96	3.38	4.57	5.55	6.94	8.27
10	0.26	0.40	0.50	0.67	0.83	0.96	1.04	1.27	1.60	1.85	2.21	2.79	3.38	3.85	5.21	6.30	7.87	9.39
25	0.33	0.51	0.63	0.85	1.05	1.21	1.29	1.50	1.87	2.15	2.57	3.25	3.94	4.46	6.06	7.25	9.05	10.77
50	0.39	0.60	0.74	1.00	1.24	1.41	1.49	1.71	2.07	2.37	2.83	3.59	4.36	4.92	6.67	7.95	9.91	11.77
100	0.46	0.70	0.87	1.17	1.44	1.64	1.73	1.95	2.29	2.58	3.10	3.93	4.78	5.37	7.28	8.61	10.77	12.74
200	0.53	0.81	1.00	1.34	1.66	1.89	1.99	2.22	2.55	2.79	3.36	4.26	5.19	5.81	7.88	9.25	11.57	13.65
500	0.63	0.96	1.19	1.61	1.99	2.25	2.37	2.64	2.99	3.06	3.70	4.70	5.73	6.36	8.61	10.03	12.56	14.78
1000	0.72	1.09	1.36	1.83	2.26	2.56	2.70	3.01	3.39	3.42	3.94	5.01	6.12	6.77	9.16	10.61	13.29	15.60

* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.

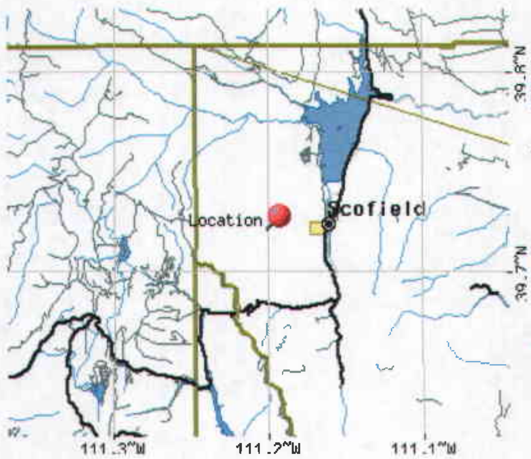
** These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Text version of tables





Maps -



These maps were produced using a direct map request from the [U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server](#).

Please read [disclaimer](#) for more information.

LEGEND

- State
- County
- Indian Resv
- Lake/Pond/Ocean
- Street
- Expressway
- Highway
- Connector
- Stream
- Military Area
- National Park
- Other Park
- City
- County

0 2 4 6 8 mi

0 2 4 6 8 10 km

Scale 1:228583

*average--true scale depends on monitor resolution

Other Maps/Photographs -

[View USGS digital orthophoto quadrangle (DOQ)](#) covering this location from TerraServer; **USGS Aerial Photograph** may also be available from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the [USGS](#) for more information.

Watershed/Stream Flow Information -

[Find the Watershed](#) for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study, please refer to [NOAA Atlas 14 Document](#).

Using the **[National Climatic Data Center's (NCDC)](#)** station search engine, locate other climate stations within:

[+/-30 minutes] ...OR... [+/-1 degree] of this location (39.72048/-111.20086). Digital ASCII data can be obtained directly from **[NCDC](#)**.

Find [Natural Resources Conservation Service (NRCS)](#) SNOTEL (SNOwpack TELemetry) stations by visiting the **[Western Regional Climate Center's state-specific SNOTEL station maps](#)**.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

(301) 713-1669
Questions?: [HDSC.Questions@noaa.gov](#)

[Disclaimer](#)

Hydrologic Soil Group—Carbon Area, Utah, Parts of Carbon and Emery Counties; and Manti-Lasal National Forest, Manti Division - Parts of Sanpete and Emery Counties
(Winter Quarters Canyon)

N

Meters: 0, 350, 700, 1,400, 2,100

Feet: 0, 1,500, 3,000, 6,000, 9,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Carbon Area, Utah, Parts of Carbon and Emery Counties
Survey Area Data: Version 4, Jul 2, 2008

Soil Survey Area: Manti-Lasal National Forest, Manti Division - Parts of Sanpete and Emery Counties
Survey Area Data: Not available

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 9/30/1997; 10/5/1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Carbon Area, Utah, Parts of Carbon and Emery Counties				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
23	Curecanti family-Pathead complex	C	2,030.6	24.7%
115	Trag stony loam, 30 to 60 percent slopes	B	259.7	3.2%
118	Trag-Croydon complex	B	550.2	6.7%
125	Uinta-Toze families complex	B	5.7	0.1%
Totals for Area of Interest (AOI)			8,217.0	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

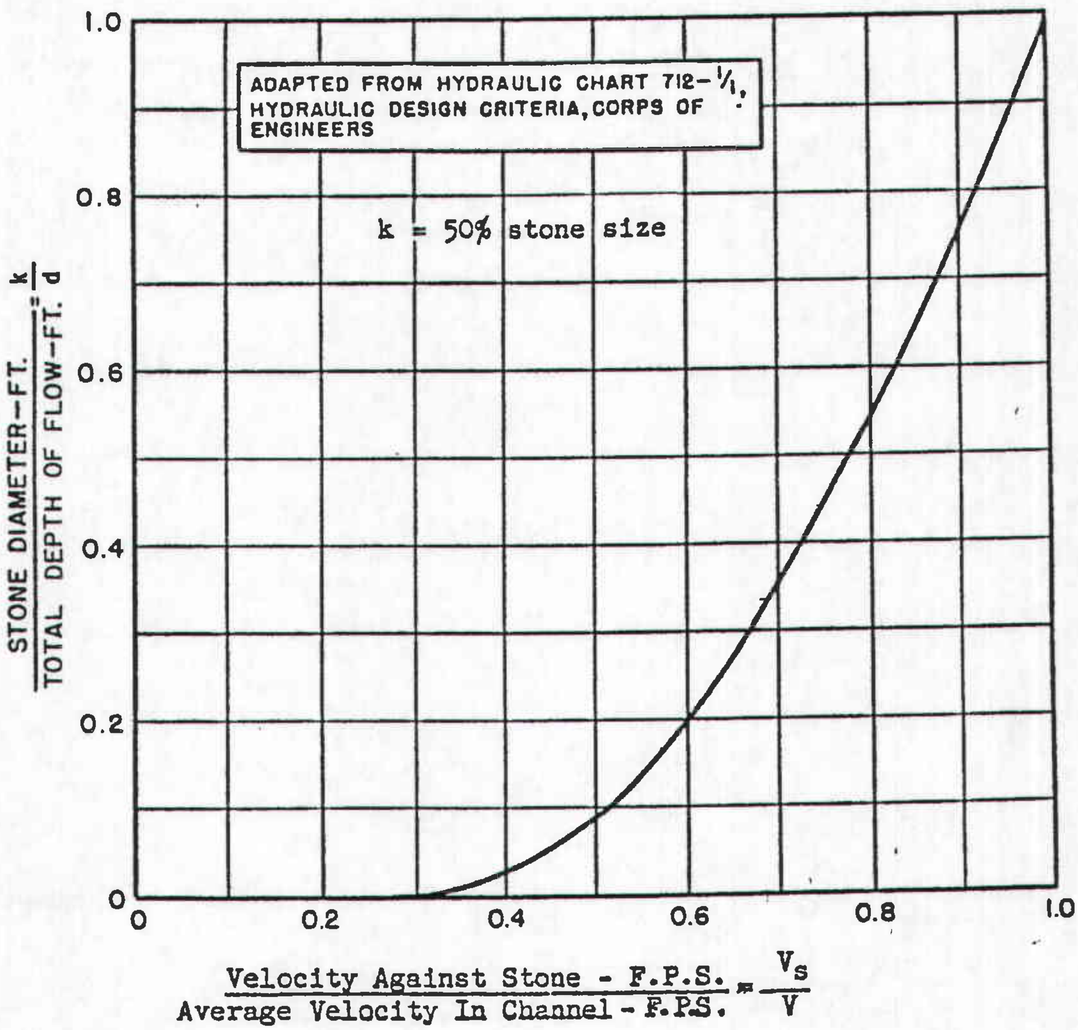


FIGURE 5-1 Velocity Against Stone on Channel Bottom (U.S. Department of Transportation, 1978).

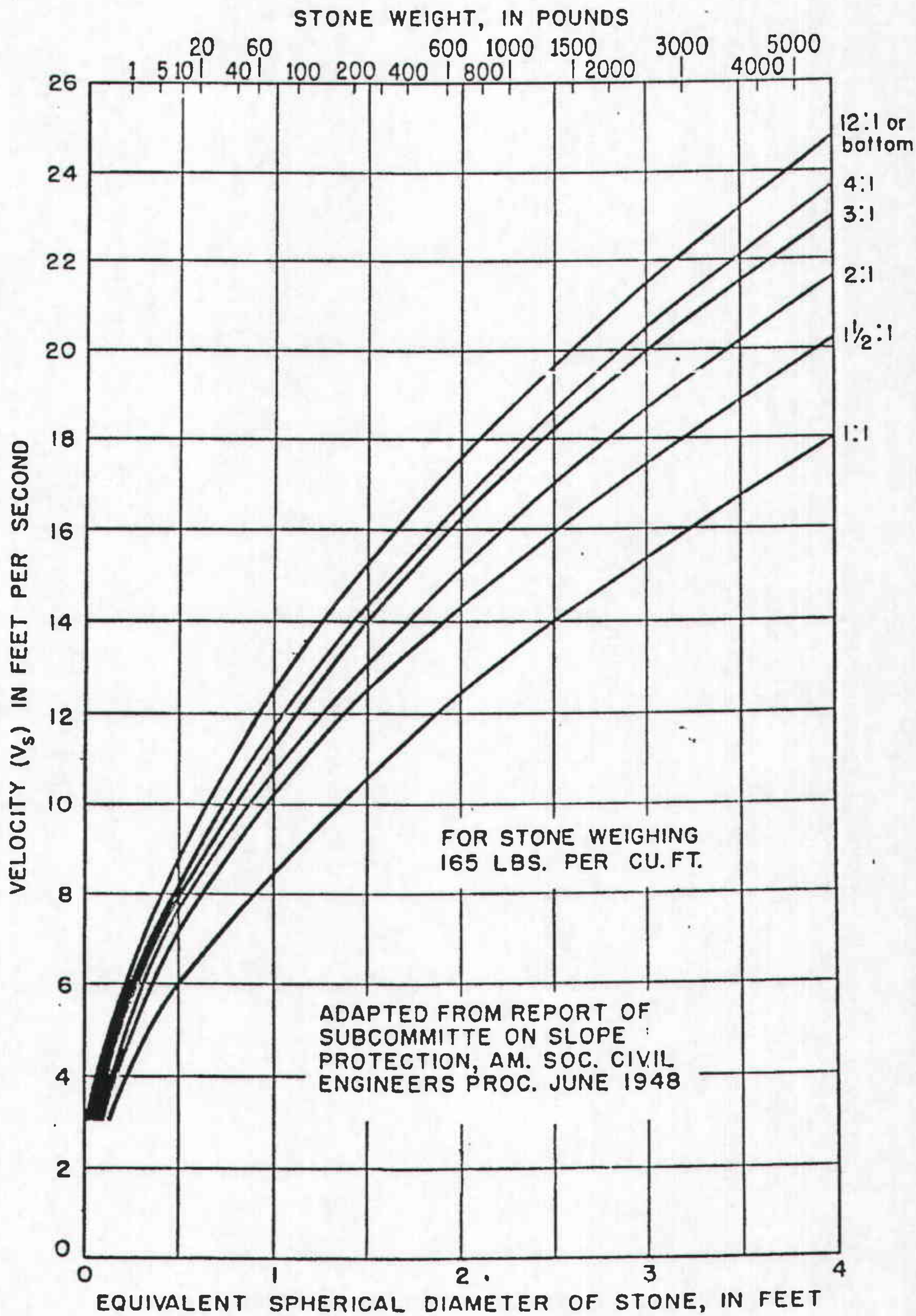
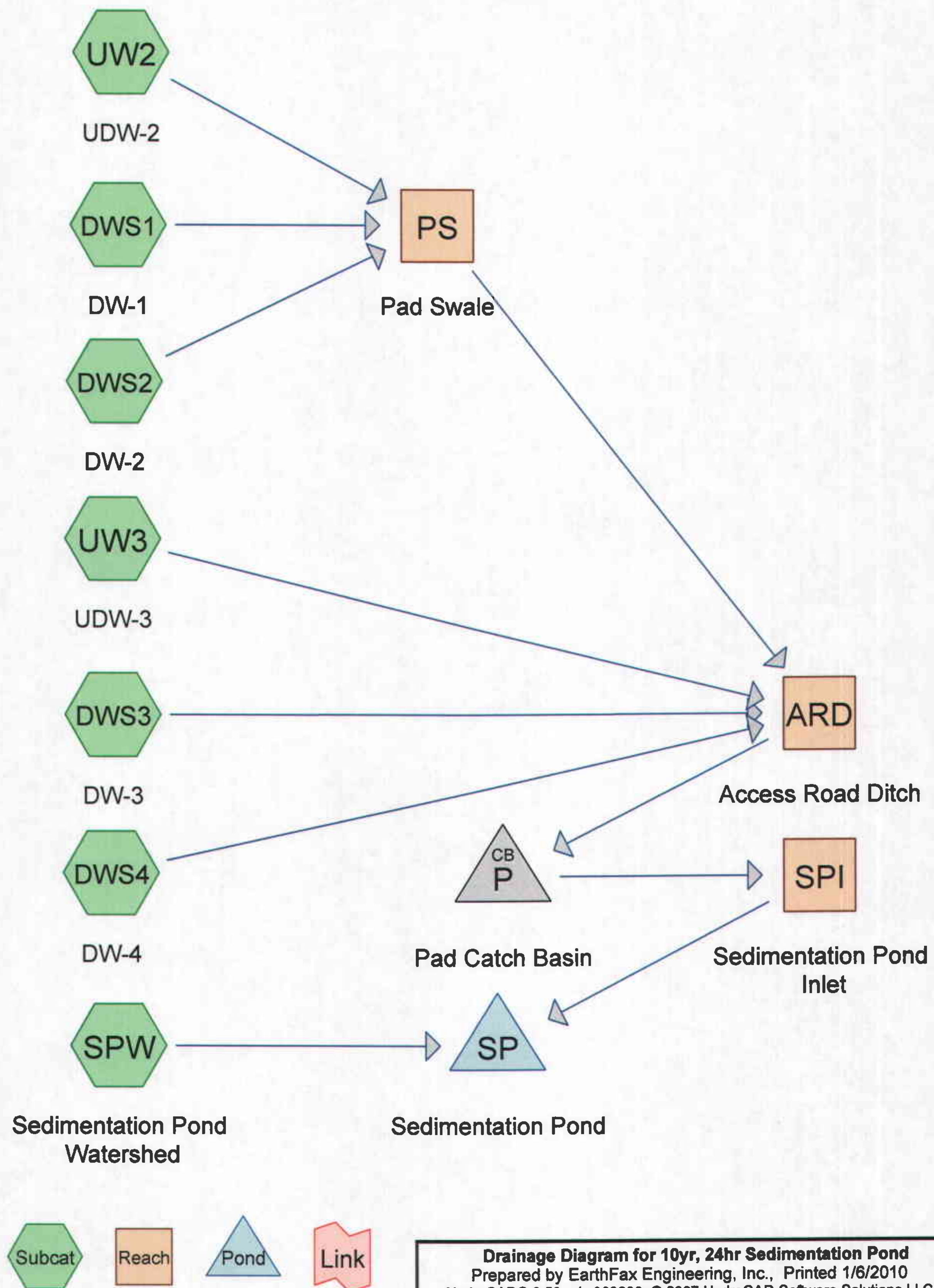


FIGURE 5-2 Size of Stone that will Resist Displacement for Various Velocities and Side Slopes (U.S. Department of Transportation, 1978).



Drainage Diagram for 10yr, 24hr Sedimentation Pond
Prepared by EarthFax Engineering, Inc., Printed 1/6/2010
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Summary for Subcatchment DWS1: DW-1

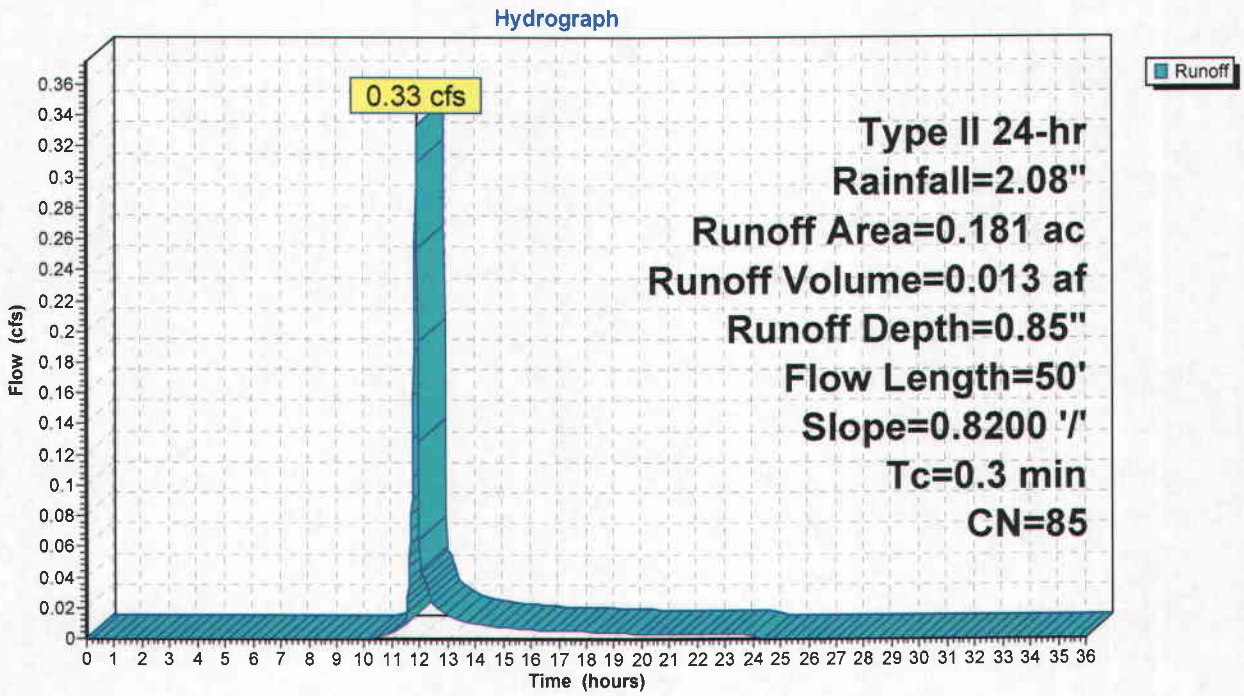
Runoff = 0.33 cfs @ 11.90 hrs, Volume= 0.013 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.181	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.181		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	50	0.8200	3.08		**Lag/CN Method, Slope from 8,182 to 8,121**

Subcatchment DWS1: DW-1



Summary for Subcatchment DWS2: DW-2

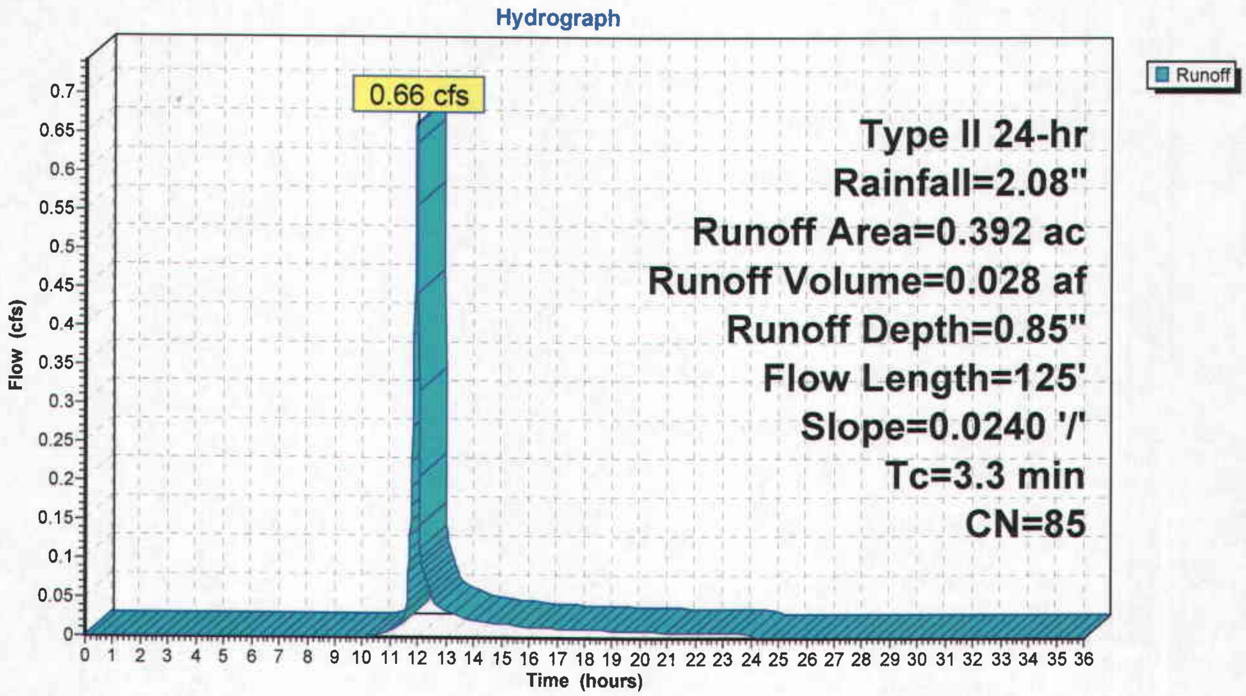
Runoff = 0.66 cfs @ 11.94 hrs, Volume= 0.028 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.392	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.392		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	125	0.0240	0.63		**Lag/CN Method, Slope from 8,122 to 8,119**

Subcatchment DWS2: DW-2



Summary for Subcatchment DWS3: DW-3

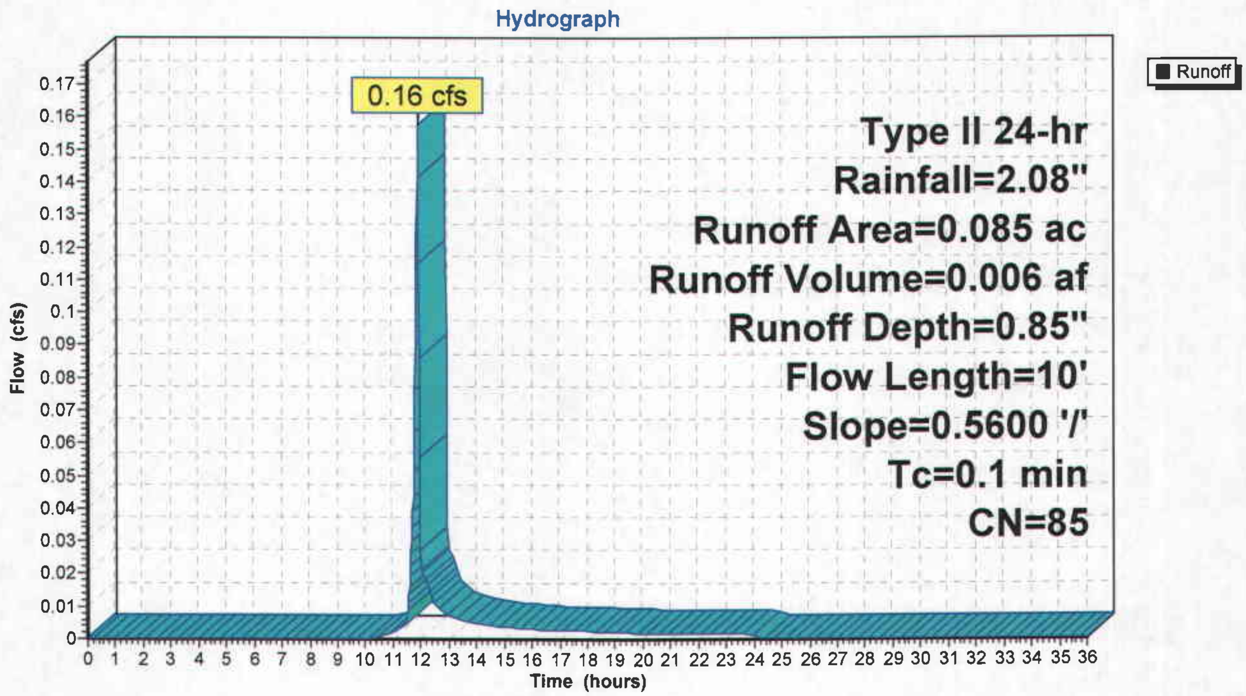
Runoff = 0.16 cfs @ 11.90 hrs, Volume= 0.006 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.085	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.085		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	10	0.5600	1.84		**Lag/CN Method, Slope from 8,133 to 8,115**

Subcatchment DWS3: DW-3



Summary for Subcatchment DWS4: DW-4

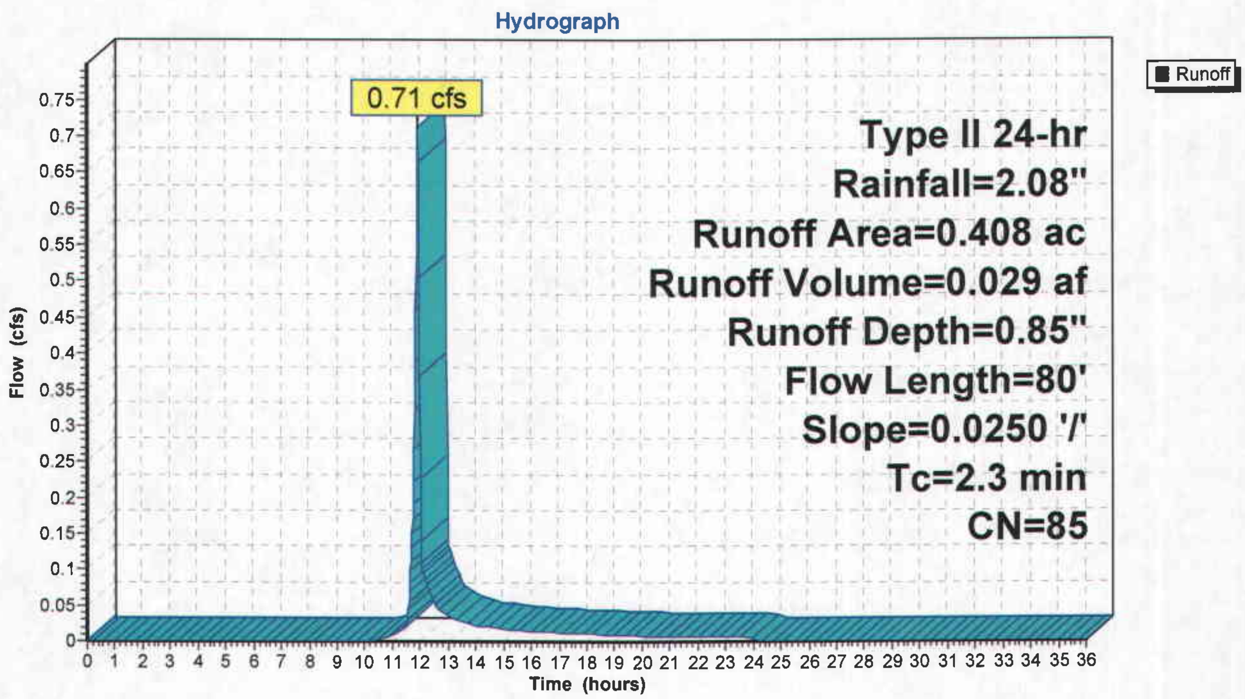
Runoff = 0.71 cfs @ 11.93 hrs, Volume= 0.029 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.408	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.408		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	80	0.0250	0.59		**Lag/CN Method, Slope from 8,118 to 8,116**

Subcatchment DWS4: DW-4



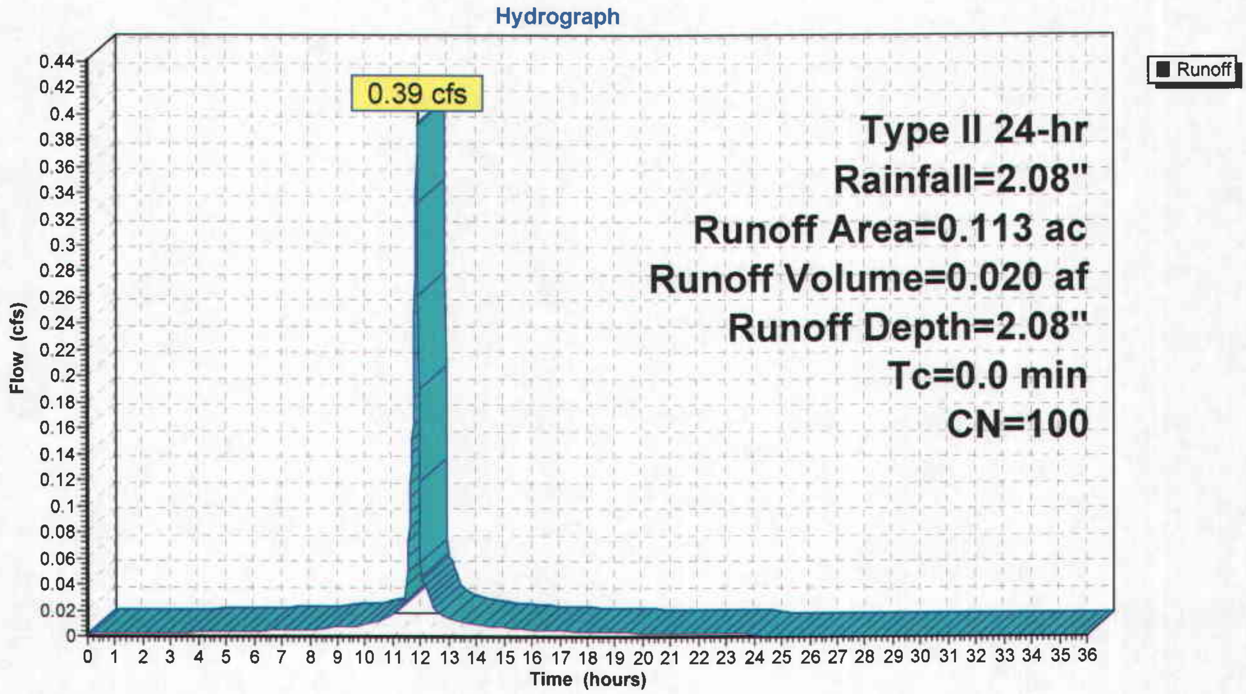
Summary for Subcatchment SPW: Sedimentation Pond Watershed

Runoff = 0.39 cfs @ 11.89 hrs, Volume= 0.020 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.113	100	
	0.113		Impervious Area

Subcatchment SPW: Sedimentation Pond Watershed



Summary for Subcatchment UW2: UDW-2

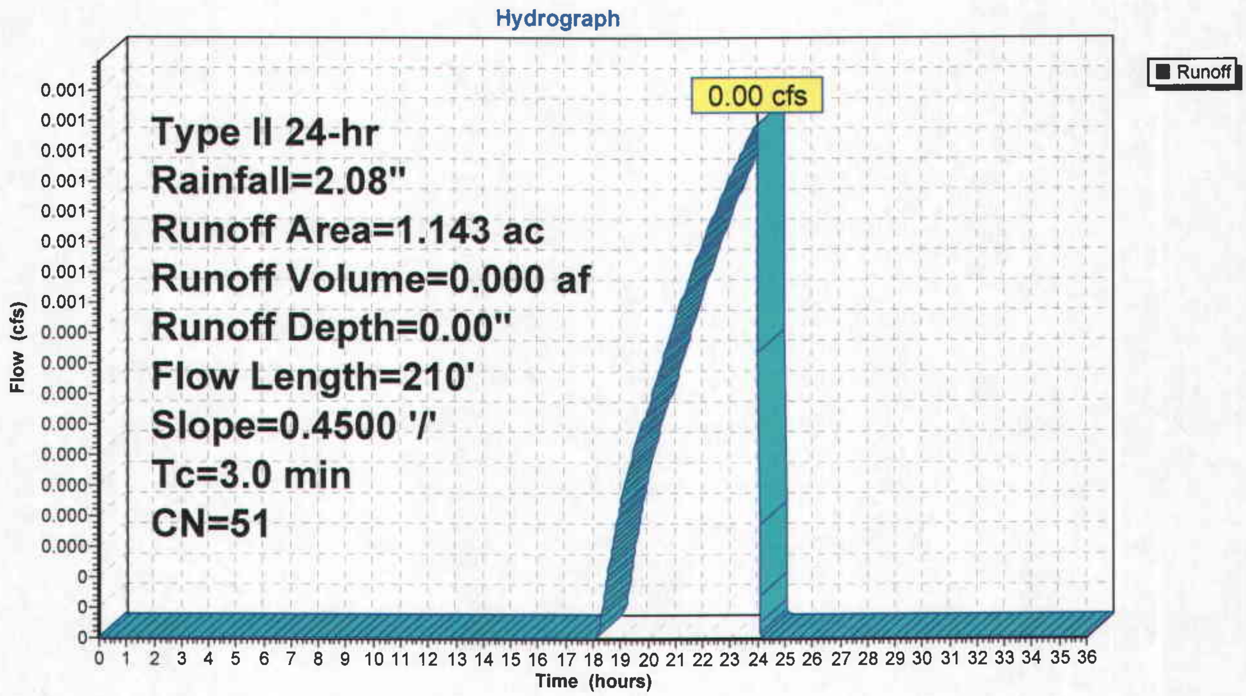
Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

Area (ac)	CN	Description
1.143	51	Sagebrush range, Fair, HSG B
1.143		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	210	0.4500	1.18		**Lag/CN Method, Slope from 8,231 to 8,136**

Subcatchment UW2: UDW-2



Summary for Subcatchment UW3: UDW-3

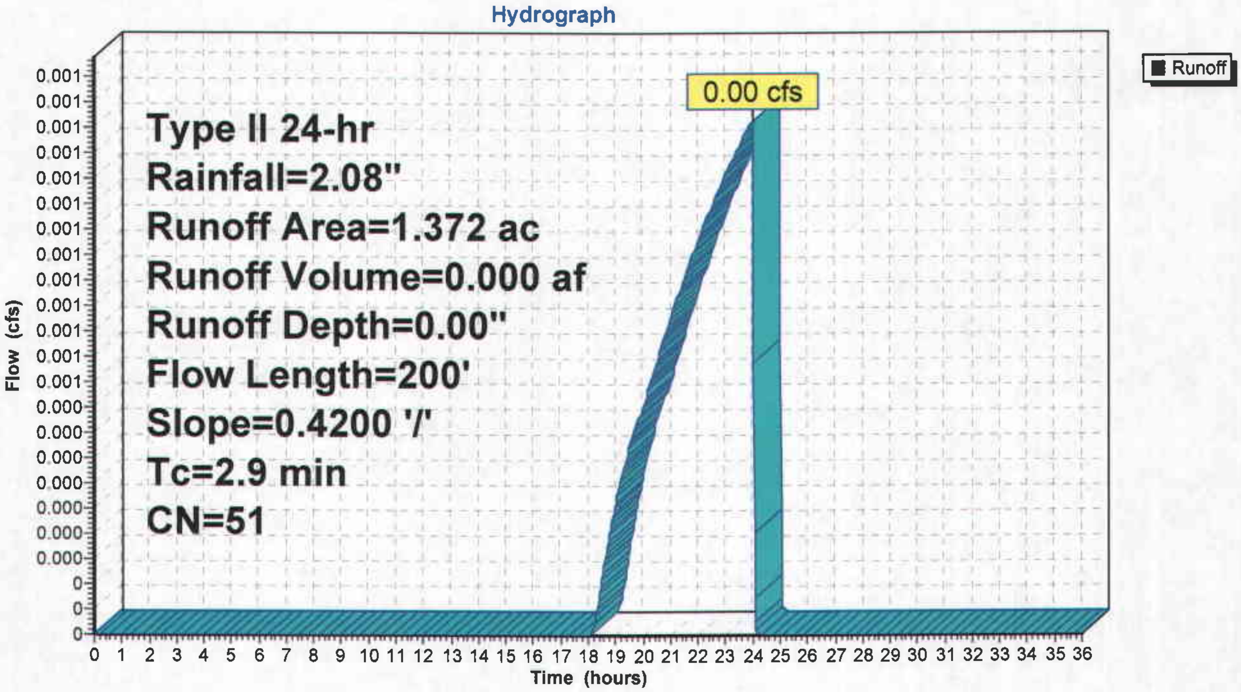
Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

Area (ac)	CN	Description
1.372	51	Sagebrush range, Fair, HSG B
1.372		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	200	0.4200	1.13		**Lag/CN Method, Slope from 8,214 to 8,130**

Subcatchment UW3: UDW-3



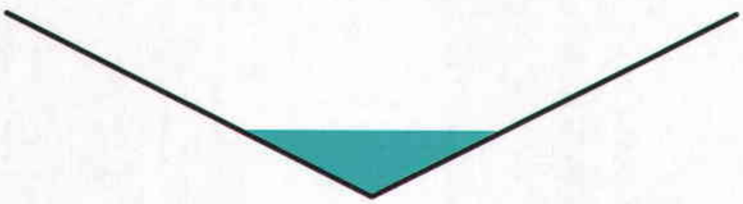
Summary for Reach ARD: Access Road Ditch

Inflow Area = 3.581 ac, 0.00% Impervious, Inflow Depth = 0.26"
Inflow = 1.75 cfs @ 11.93 hrs, Volume= 0.076 af
Outflow = 1.74 cfs @ 11.95 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.9 min

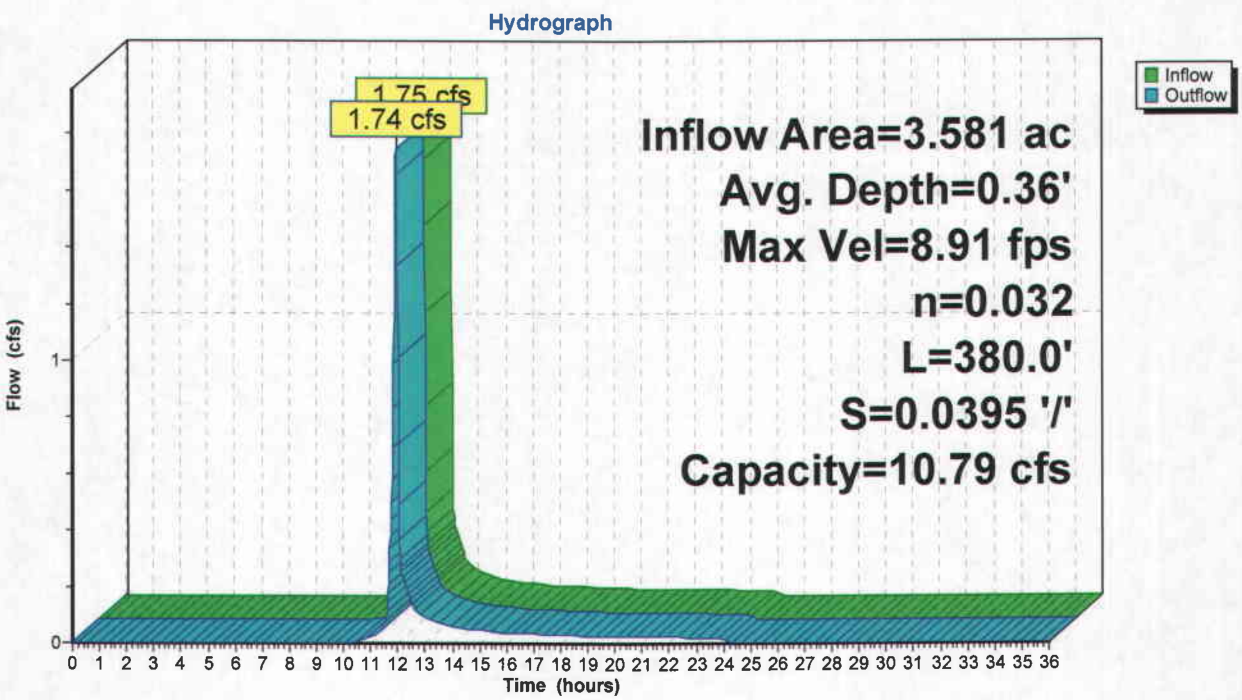
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Reference Flow= 8.09 cfs Estimated Depth= 0.90' Velocity= 5.02 fps
m= 1.333, c= 6.69 fps, dt= 1.2 min, dx= 380.0' / 1 = 380.0', K= 0.9 min, X= 0.478
Max. Velocity= 8.91 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 6.69 fps, Avg. Travel Time= 0.9 min

Peak Storage= 98 cf @ 11.94 hrs, Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 10.79 cfs

0.00' x 1.00' deep channel, n= 0.032
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 380.0' Slope= 0.0395 '/'
Inlet Invert= 8,116.00', Outlet Invert= 8,101.00'



Reach ARD: Access Road Ditch



Access Road Ditch Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	ARD Max. Slop
Flow Element	Triangular Char
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	083300	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	1.75	cfs

Results		
Depth	0.44	ft
Flow Area	0.4	ft²
Wetted Perim	1.97	ft
Top Width	1.76	ft
Critical Depth	0.54	ft
Critical Slope	0.026726	ft/ft
Velocity	4.53	ft/s
Velocity Head	0.32	ft
Specific Energ	0.76	ft
Froude Numb	1.70	
Flow Type	Supercritical	

Access Road Ditch Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	ARD Max. Dept
Flow Element	Triangular Char
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	020000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	1.75	cfs

Results		
Depth	0.57	ft
Flow Area	0.7	ft²
Wetted Perim	2.57	ft
Top Width	2.30	ft
Critical Depth	0.54	ft
Critical Slope	0.026726	ft/ft
Velocity	2.65	ft/s
Velocity Head	0.11	ft
Specific Enerç	0.68	ft
Froude Numb	0.87	
Flow Type	Subcritical	

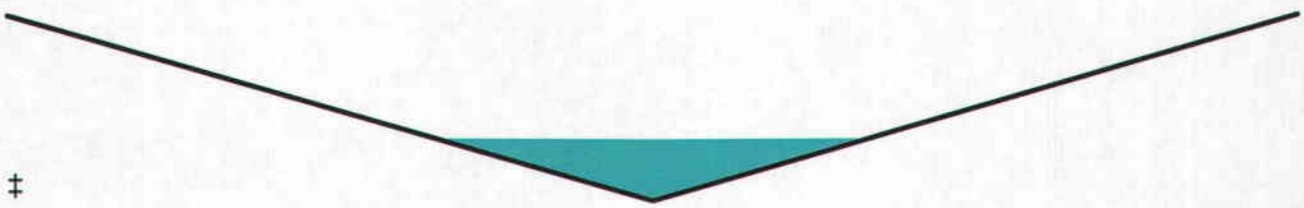
Summary for Reach PS: Pad Swale

Inflow Area = 1.716 ac, 0.00% Impervious, Inflow Depth = 0.29"
Inflow = 0.93 cfs @ 11.93 hrs, Volume= 0.041 af
Outflow = 0.92 cfs @ 11.95 hrs, Volume= 0.041 af, Atten= 0%, Lag= 1.2 min

Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Reference Flow= 4.97 cfs Estimated Depth= 0.45' Velocity= 2.47 fps
m= 1.333, c= 3.29 fps, dt= 1.2 min, dx= 240.0' / 1 = 240.0', K= 1.2 min, X= 0.466
Max. Velocity= 4.61 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 3.29 fps, Avg. Travel Time= 1.2 min

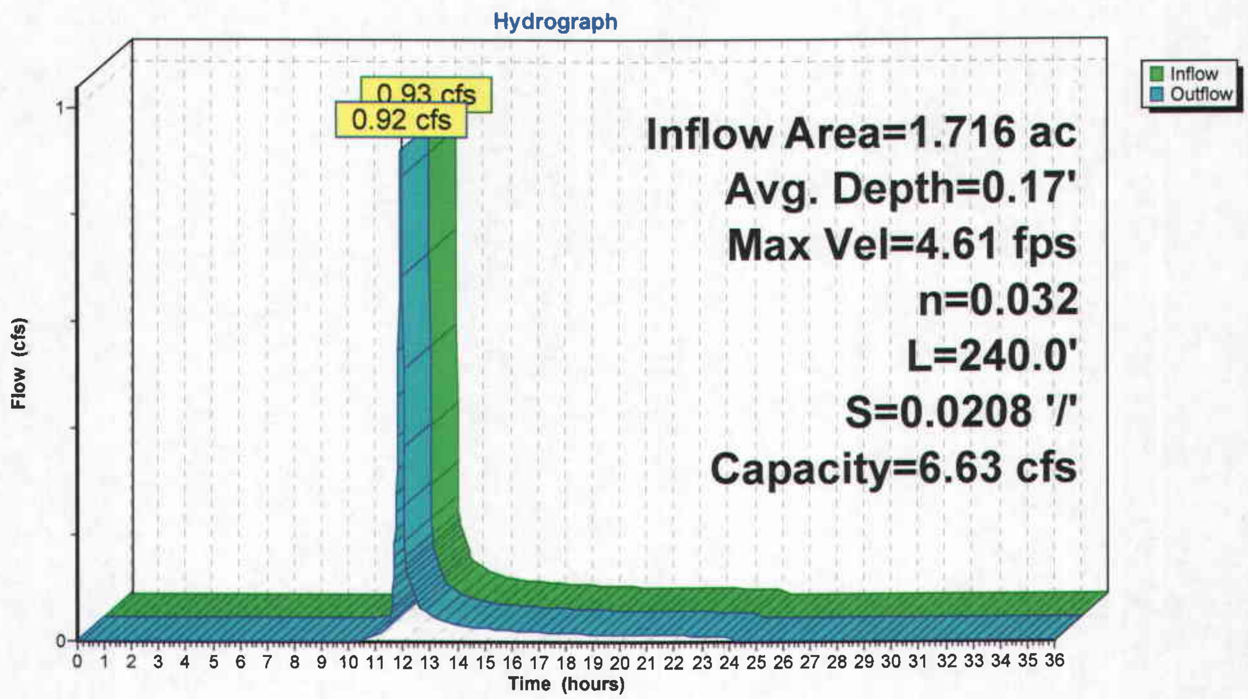
Peak Storage= 67 cf @ 11.94 hrs, Average Depth at Peak Storage= 0.17'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 6.63 cfs

0.00' x 0.50' deep channel, n= 0.032
Side Slope Z-value= 10.0 '/' Top Width= 10.00'
Length= 240.0' Slope= 0.0208 '/'
Inlet Invert= 8,121.00', Outlet Invert= 8,116.00'



‡

Reach PS: Pad Swale



Pad Swale Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	PS Max. Slope
Flow Element	Triangular Char
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	030000	ft/ft
Left Side Slope	0.10	V : H
Right Side Slope	0.10	V : H
Discharge	0.93	cfs

Results		
Depth	0.22	ft
Flow Area	0.5	ft²
Wetted Perim	4.49	ft
Top Width	4.47	ft
Critical Depth	0.22	ft
Critical Slope	0.031262	ft/ft
Velocity	1.86	ft/s
Velocity Head	0.05	ft
Specific Energ	0.28	ft
Froude Numb	0.98	
Flow Type	Subcritical	

EarthFax Engineering Inc
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666
Project Engineer: Richard White

Pad Swale Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	PS Max. Depth
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	015000	ft/ft
Left Side Slope	0.10	V : H
Right Side Slope	0.10	V : H
Discharge	0.93	cfs

Results		
Depth	0.25	ft
Flow Area	0.6	ft²
Wetted Perim	5.12	ft
Top Width	5.09	ft
Critical Depth	0.22	ft
Critical Slope	0.031261	ft/ft
Velocity	1.43	ft/s
Velocity Head	0.03	ft
Specific Energ	0.29	ft
Froude Numb	0.71	
Flow Type	Subcritical	

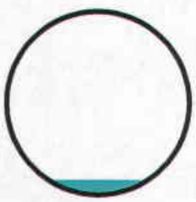
Summary for Reach SPI: Sedimentation Pond Inlet

Inflow Area = 3.581 ac, 0.00% Impervious, Inflow Depth = 0.26"
Inflow = 1.74 cfs @ 11.95 hrs, Volume= 0.076 af
Outflow = 1.74 cfs @ 11.95 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min

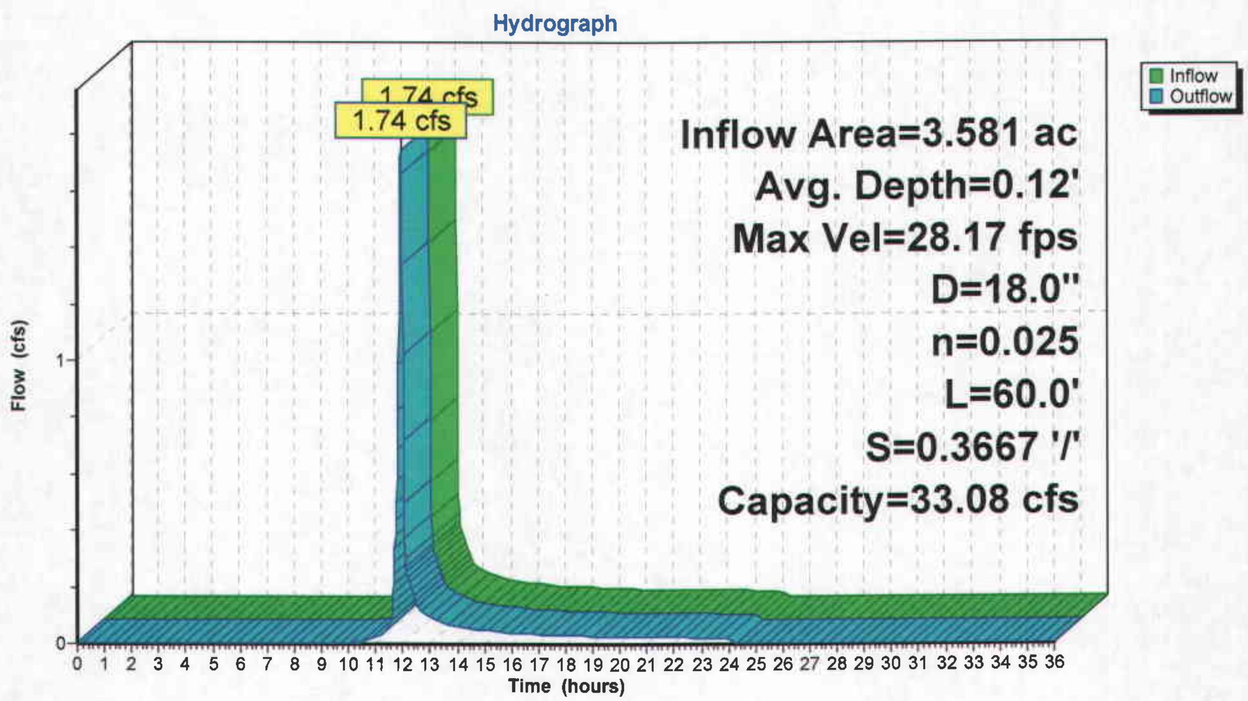
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Reference Flow= 24.81 cfs Estimated Depth= 0.97' Velocity= 20.54 fps
m= 1.355, c= 27.83 fps, dt= 1.2 min, dx= 60.0' / 1 = 60.0', K= 0.0 min, X= 0.484
Max. Velocity= 28.17 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 27.83 fps, Avg. Travel Time= 0.0 min

Peak Storage= 4 cf @ 11.95 hrs, Average Depth at Peak Storage= 0.12'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 33.08 cfs

18.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 60.0' Slope= 0.3667 '/'
Inlet Invert= 8,096.00', Outlet Invert= 8,074.00'



Reach SPI: Sedimentation Pond Inlet



Sedimentation Pond Inlet
Worksheet for Circular Channel

Project Description	
Worksheet	SPI
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Slope	500000	ft/ft
Diameter	18	in
Discharge	1.74	cfs

Results		
Depth	0.22	ft
Flow Area	0.2	ft²
Wetted Perime	1.17	ft
Top Width	1.06	ft
Critical Depth	0.50	ft
Percent Full	14.5	%
Critical Slope	0.018182	ft/ft
Velocity	11.04	ft/s
Velocity Head	1.89	ft
Specific Energ	2.11	ft
Froude Numbe	5.04	
Maximum Disc	41.55	cfs
Discharge Full	38.62	cfs
Slope Full	0.001015	ft/ft
Flow Type	Supercritical	

Summary for Pond P: Pad Catch Basin

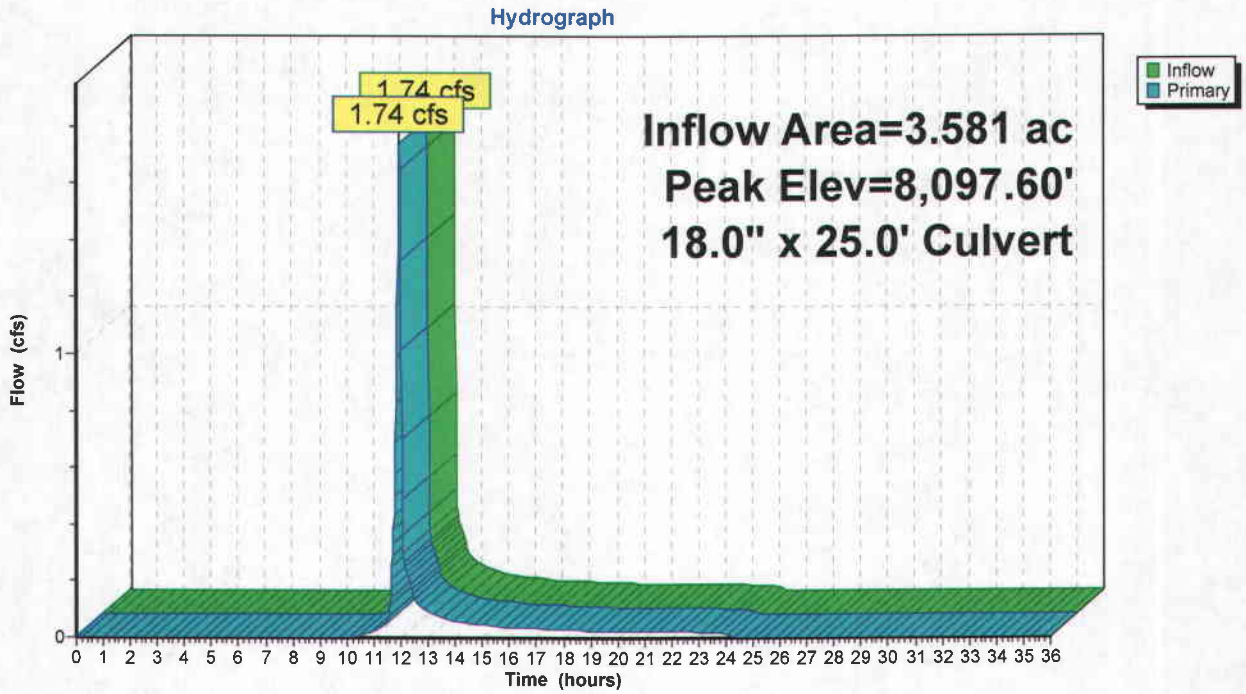
Inflow Area =	3.581 ac,	0.00% Impervious,	Inflow Depth = 0.26"	
Inflow =	1.74 cfs @	11.95 hrs, Volume=	0.076 af	
Outflow =	1.74 cfs @	11.95 hrs, Volume=	0.076 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.74 cfs @	11.95 hrs, Volume=	0.076 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Peak Elev= 8,097.60' @ 11.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	8,097.00'	**18.0" x 25.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 8,096.00' S= 0.0400 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=1.72 cfs @ 11.95 hrs HW=8,097.60' TW=8,096.11' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 1.72 cfs @ 2.63 fps)

Pond P: Pad Catch Basin



Summary for Pond SP: Sedimentation Pond

Inflow Area = 3.694 ac, 3.06% Impervious, Inflow Depth = 0.31"
Inflow = 1.98 cfs @ 11.94 hrs, Volume= 0.096 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

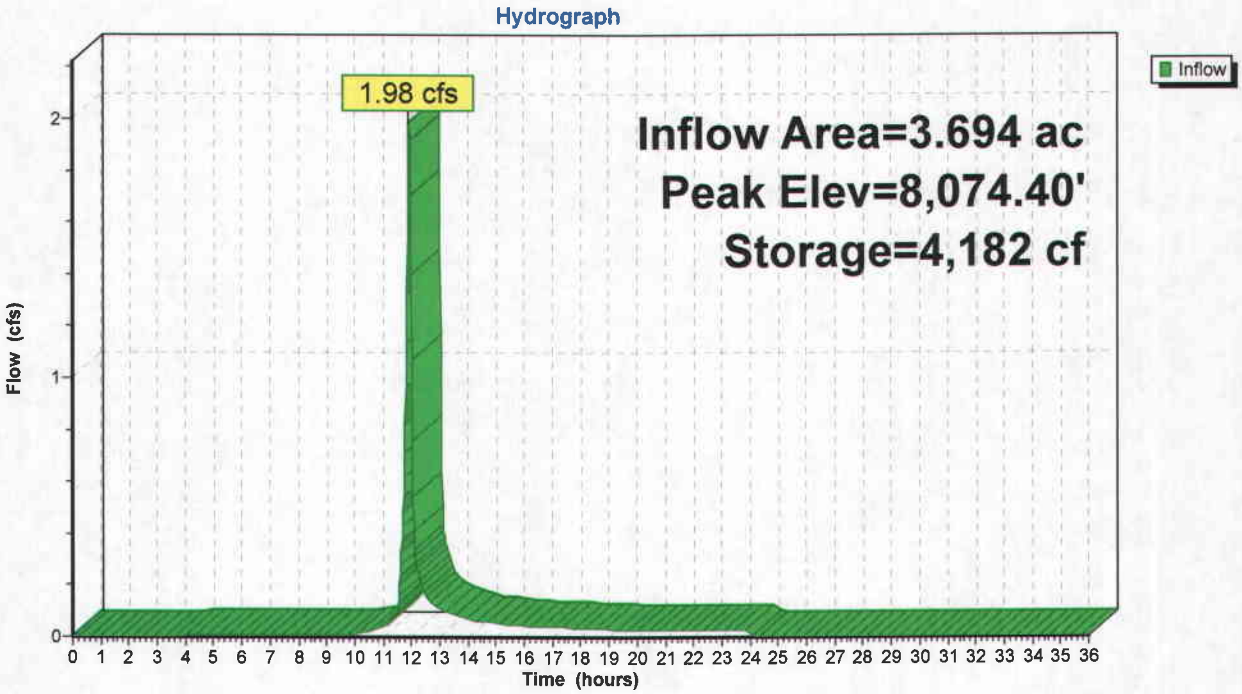
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Peak Elev= 8,074.40' @ 24.36 hrs Surf.Area= 1,696 sf Storage= 4,182 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	8,070.50'	8,508 cf	**Custom Stage Data (Irregular)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,070.50	0	0.0	0	0	0
8,071.00	744	123.4	124	124	1,212
8,071.50	862	132.7	401	525	1,412
8,071.65	900	135.5	132	657	1,475
8,072.00	987	142.0	330	987	1,627
8,072.10	1,014	143.9	100	1,087	1,672
8,072.50	1,120	151.3	427	1,514	1,856
8,073.00	1,260	160.6	595	2,109	2,100
8,073.50	1,408	169.9	667	2,775	2,358
8,074.00	1,564	179.2	743	3,518	2,630
8,074.50	1,728	188.5	823	4,341	2,918
8,075.00	1,899	197.8	906	5,247	3,219
8,075.05	1,917	198.7	95	5,343	3,250
8,075.50	2,079	207.1	899	6,241	3,536
8,075.55	2,098	208.0	104	6,346	3,567
8,076.00	2,265	216.4	981	7,327	3,867
8,076.50	2,460	225.7	1,181	8,508	4,212

Pond SP: Sedimentation Pond



Summary for Pond SP: Sedimentation Pond

Inflow Area = 3.654 ac, 2.00% Impervious, Inflow Depth = 0.21"
Inflow = 3.07 cfs @ 3.02 hrs, Volume= 0.063 af
Outflow = 1.09 cfs @ 3.09 hrs, Volume= 0.061 af, Atten= 64%, Lag= 4.4 min
Primary = 1.09 cfs @ 3.09 hrs, Volume= 0.061 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Peak Elev= 8,075.52' @ 3.09 hrs Surf.Area= 2,085 sf Storage= 1,029 cf

Plug-Flow detention time= 40.3 min calculated for 0.061 af (95% of inflow)
Center-of-Mass det. time= 33.8 min (243.6 - 209.8)

Volume	Invert	Avail.Storage	Storage Description
#1	8,070.50'	3,261 cf	**Custom Stage Data (Irregular)** Listed below

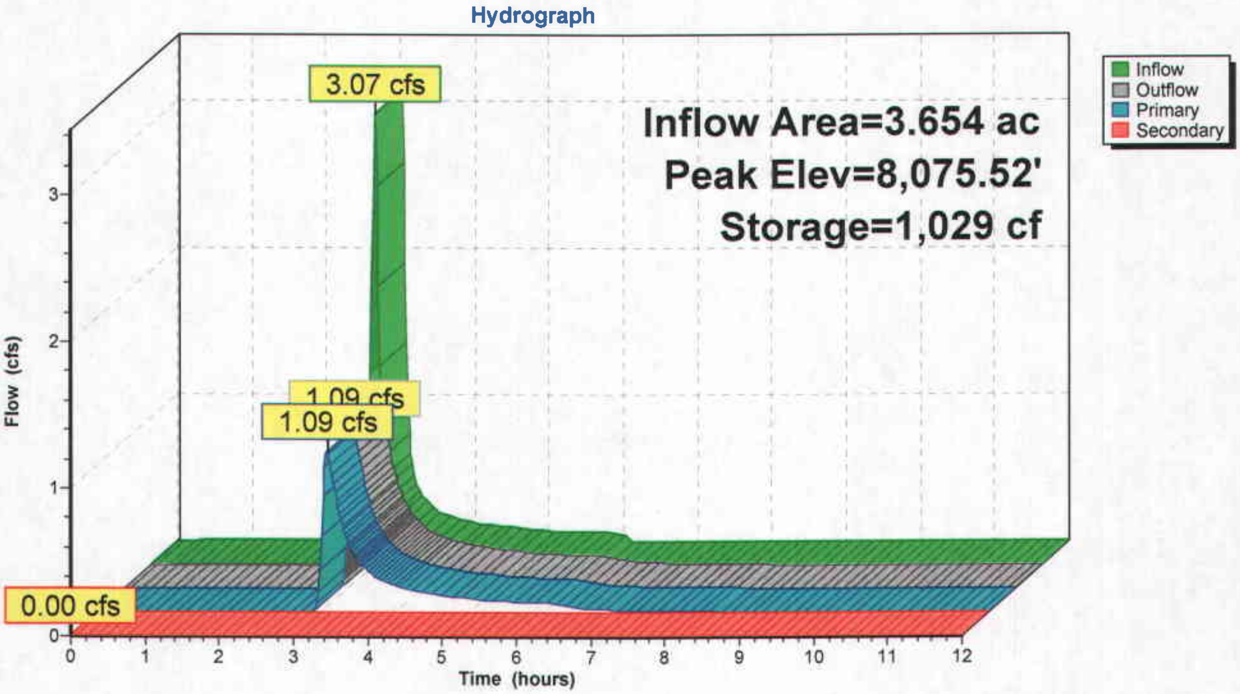
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,070.50	0	0.0	0.0	0	0	0
8,071.00	744	123.4	0.0	0	0	1,212
8,071.50	862	132.7	0.0	0	0	1,412
8,071.65	900	135.5	0.0	0	0	1,475
8,072.00	987	142.0	0.0	0	0	1,627
8,072.10	1,014	143.9	0.0	0	0	1,672
8,072.50	1,120	151.3	0.0	0	0	1,856
8,073.00	1,260	160.6	0.0	0	0	2,100
8,073.50	1,408	169.9	0.0	0	0	2,358
8,074.00	1,564	179.2	0.0	0	0	2,630
8,074.50	1,728	188.5	0.0	0	0	2,918
8,075.00	1,899	197.8	0.0	0	0	3,219
8,075.05	1,917	198.7	100.0	95	95	3,250
8,075.50	2,079	207.1	100.0	899	994	3,536
8,075.55	2,098	208.0	100.0	104	1,099	3,567
8,076.00	2,265	216.4	100.0	981	2,080	3,867
8,076.50	2,460	225.7	100.0	1,181	3,261	4,212

Device	Routing	Invert	Outlet Devices
#1	Primary	8,075.05'	**18.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	8,075.55'	**Special & User-Defined** Head (feet) 0.00 0.09 Disch. (cfs) 0.000 0.840

Primary OutFlow Max=1.08 cfs @ 3.09 hrs HW=8,075.52' TW=8,071.21' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 1.08 cfs @ 2.32 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=8,075.00' (Free Discharge)
└─**2=Special & User-Defined** (Controls 0.00 cfs)

Pond SP: Sedimentation Pond



Sedimentation Pond Primary Outlet
Worksheet for Circular Channel

Project Description	
Worksheet	SPPO
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Slope	023800	ft/ft
Diameter	18	in
Discharge	1.09	cfs

Results		
Depth	0.36	ft
Flow Area	0.3	ft²
Wetted Perime	1.55	ft
Top Width	1.29	ft
Critical Depth	0.39	ft
Percent Full	24.3	%
Critical Slope	0.018197	ft/ft
Velocity	3.29	ft/s
Velocity Head	0.17	ft
Specific Energ;	0.53	ft
Froude Numbe	1.14	
Maximum Disc	9.06	cfs
Discharge Full	8.43	cfs
Slope Full	0.000398	ft/ft
Flow Type	;upercritical	

Summary for Pond FP: Sedimentation Pond

Inflow Area = 3.654 ac, 2.00% Impervious, Inflow Depth = 0.21"
Inflow = 3.07 cfs @ 3.02 hrs, Volume= 0.063 af
Outflow = 2.06 cfs @ 3.04 hrs, Volume= 0.061 af, Atten= 33%, Lag= 1.1 min
Secondary = 2.06 cfs @ 3.04 hrs, Volume= 0.061 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Peak Elev= 8,075.73' @ 3.06 hrs Surf.Area= 2,165 sf Storage= 498 cf

Plug-Flow detention time= 12.4 min calculated for 0.061 af (96% of inflow)
Center-of-Mass det. time= 7.0 min (216.8 - 209.8)

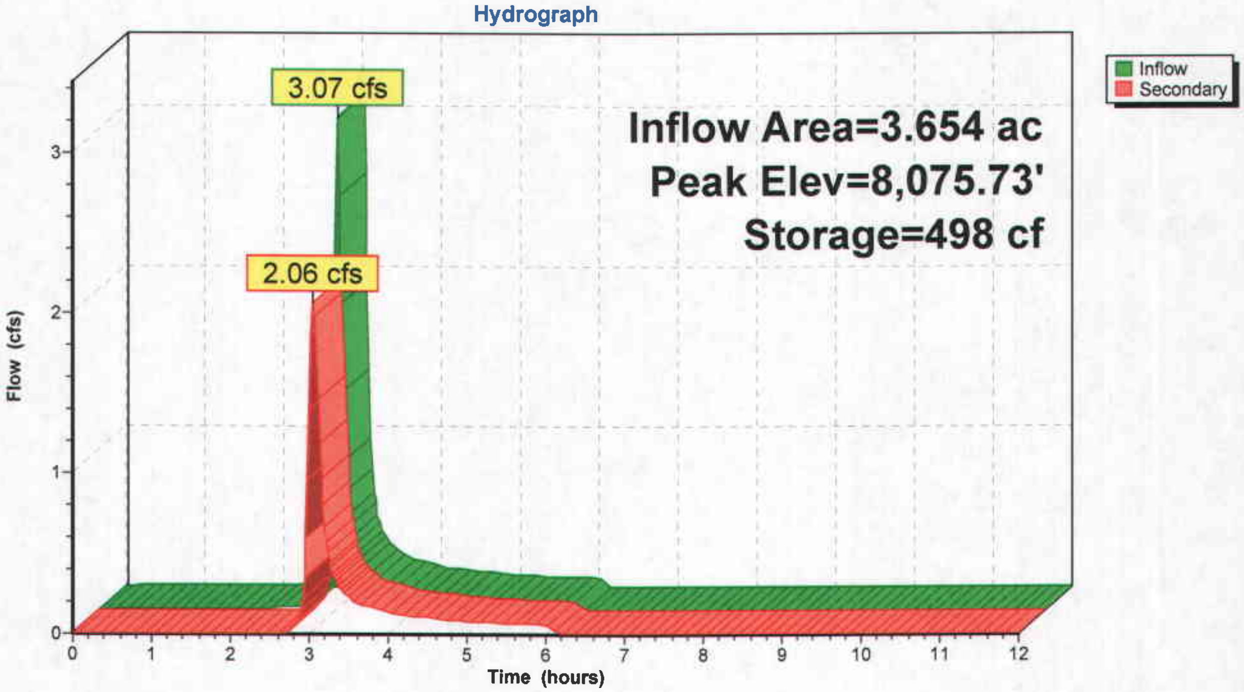
Volume	Invert	Avail.Storage	Storage Description
#1	8,070.50'	2,267 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,070.50	0	0.0	0.0	0	0	0
8,071.00	744	123.4	0.0	0	0	1,212
8,071.50	862	132.7	0.0	0	0	1,412
8,071.65	900	135.5	0.0	0	0	1,475
8,072.00	987	142.0	0.0	0	0	1,627
8,072.10	1,014	143.9	0.0	0	0	1,672
8,072.50	1,120	151.3	0.0	0	0	1,856
8,073.00	1,260	160.6	0.0	0	0	2,100
8,073.50	1,408	169.9	0.0	0	0	2,358
8,074.00	1,564	179.2	0.0	0	0	2,630
8,074.50	1,728	188.5	0.0	0	0	2,918
8,075.00	1,899	197.8	0.0	0	0	3,219
8,075.05	1,917	198.7	0.0	0	0	3,250
8,075.50	2,079	207.1	0.0	0	0	3,536
8,075.55	2,098	208.0	100.0	104	104	3,567
8,076.00	2,265	216.4	100.0	981	1,086	3,867
8,076.50	2,460	225.7	100.0	1,181	2,267	4,212

Device	Routing	Invert	Outlet Devices
#1	Secondary	8,075.55'	**Special & User-Defined** Head (feet) 0.00 0.16 Disch. (cfs) 0.000 2.060

Secondary OutFlow Max=2.06 cfs @ 3.04 hrs HW=8,075.72' (Free Discharge)
└─**1=Special & User-Defined** (Custom Controls 2.06 cfs)

Pond FP: Sedimentation Pond



Sedimentation Pond Secondary Spillway (Upper)
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	SPSS (Upper)
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	050000	ft/ft
Left Side Slope	0.20	V : H
Right Side Slope	0.20	V : H
Bottom Width	5.00	ft
Discharge	2.06	cfs

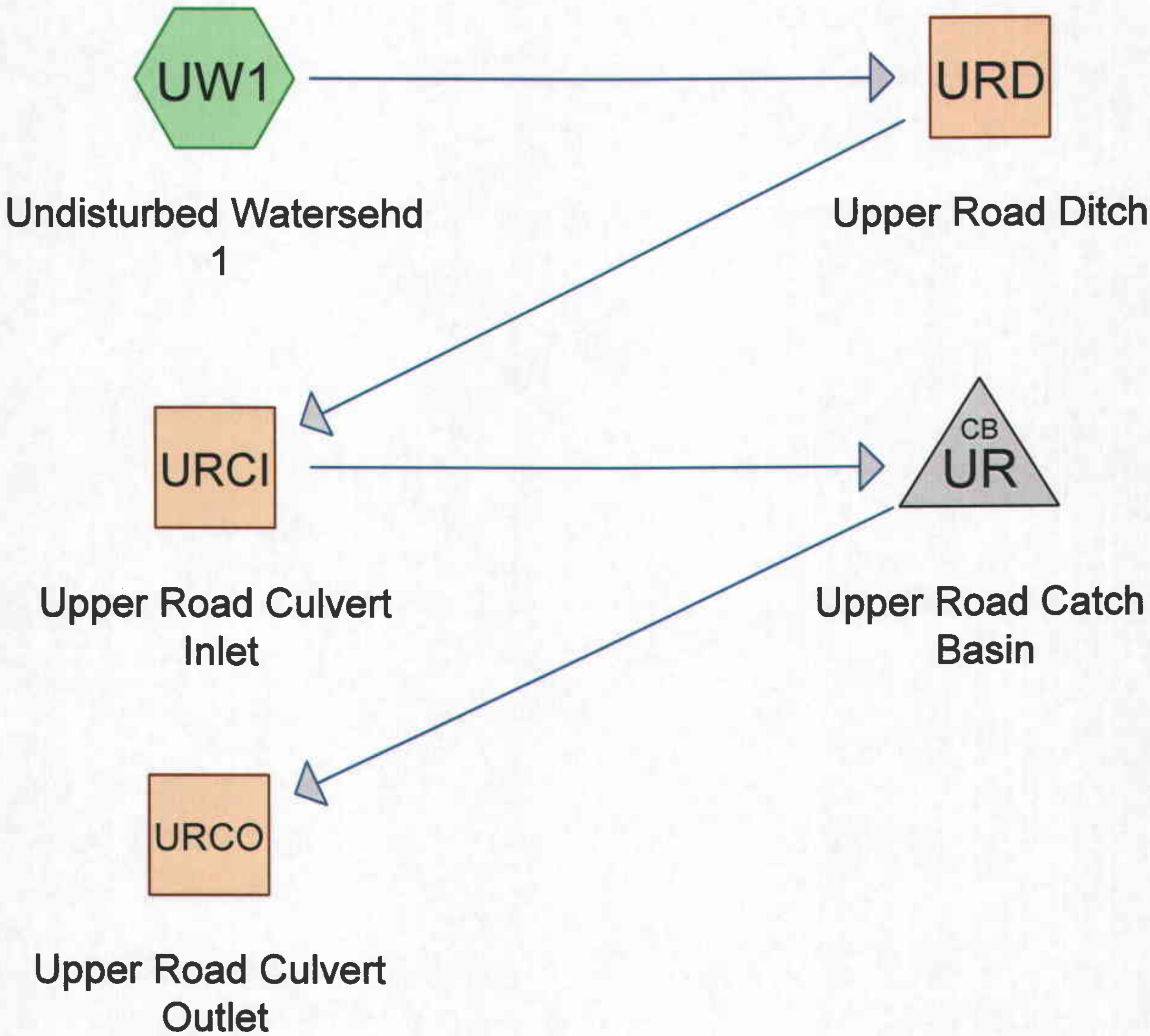
Results		
Depth	0.16	ft
Flow Area	0.9	ft²
Wetted Perimı	6.62	ft
Top Width	6.59	ft
Critical Depth	0.16	ft
Critical Slope	0.044769	ft/ft
Velocity	2.23	ft/s
Velocity Head	0.08	ft
Specific Enerç	0.24	ft
Froude Numbı	1.05	
Flow Type	Supercritical	

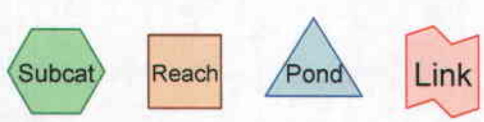
Sedimentation Pond Secondary Spillway (Lower)
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	SPSS (Lower)
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	500000	ft/ft
Left Side Slope	0.20	V : H
Right Side Slope	0.20	V : H
Bottom Width	5.00	ft
Discharge	2.06	cfs

Results		
Depth	0.08	ft
Flow Area	0.4	ft²
Wetted Perim	5.83	ft
Top Width	5.81	ft
Critical Depth	0.16	ft
Critical Slope	0.044769	ft/ft
Velocity	4.69	ft/s
Velocity Head	0.34	ft
Specific Energ	0.42	ft
Froude Numb	3.01	
Flow Type	Supercritical	





Drainage Diagram for 100yr, 6hr Upper Road
Prepared by EarthFax Engineering, Inc., Printed 12/30/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Summary for Subcatchment UW1: Undisturbed Watersehd 1

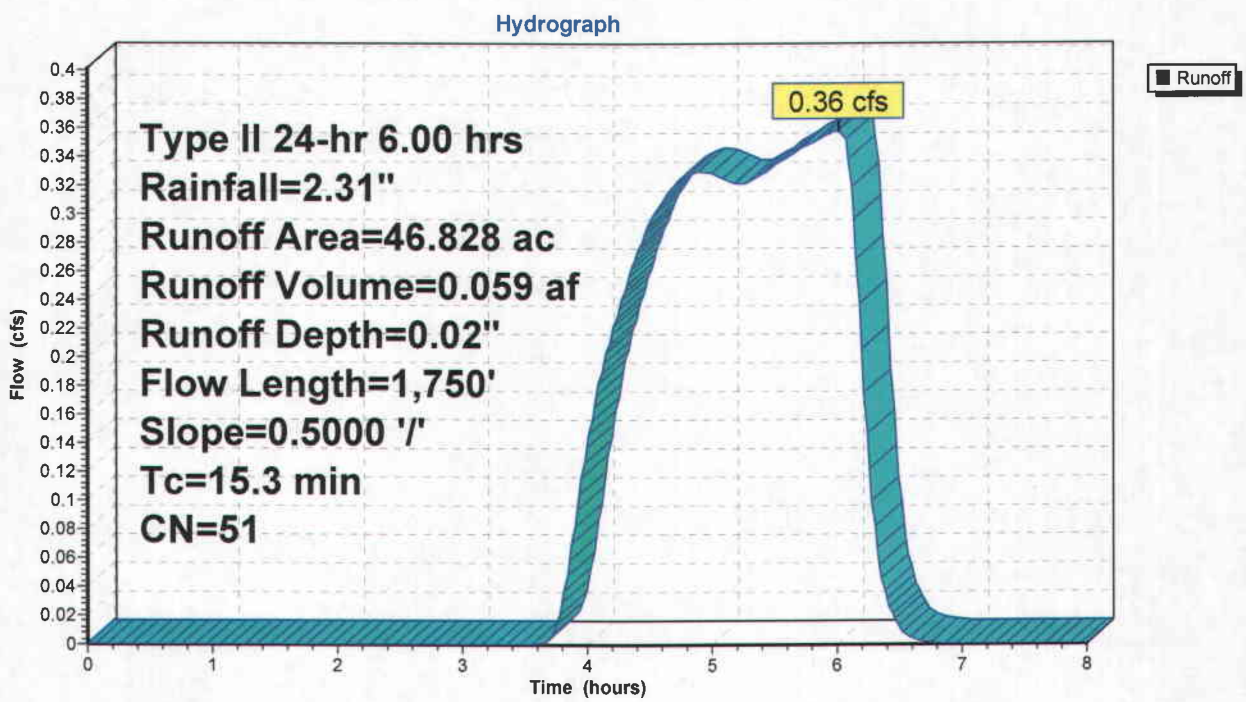
Runoff = 0.36 cfs @ 6.02 hrs, Volume= 0.059 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-8.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=2.31"

Area (ac)	CN	Description
46.828	51	Sagebrush range, Fair, HSG B
46.828		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.3	1,750	0.5000	1.91		**Lag/CN Method, Slope from 9,050 to 8,178**

Subcatchment UW1: Undisturbed Watersehd 1



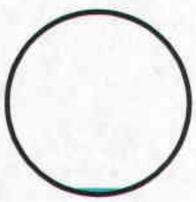
Summary for Reach URCI: Upper Road Culvert Inlet

Inflow Area = 46.828 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af
Outflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min

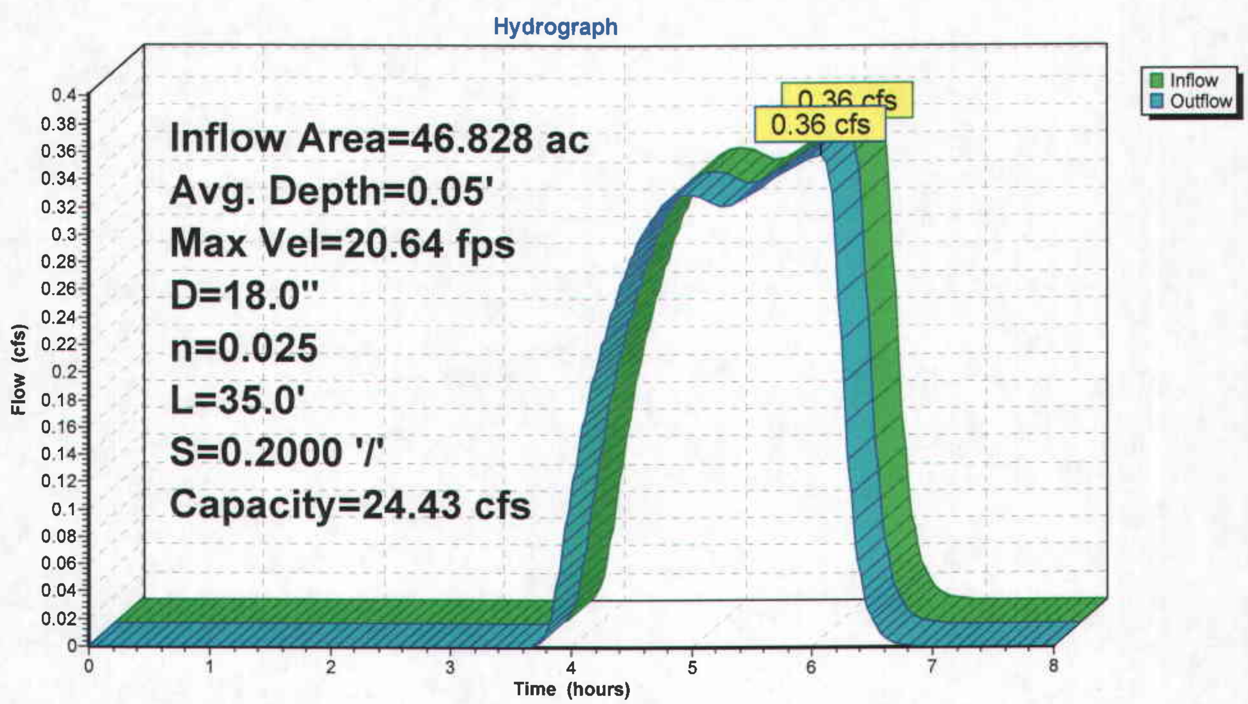
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-8.00 hrs, dt= 0.02 hrs
Reference Flow= 18.32 cfs Estimated Depth= 0.97' Velocity= 15.17 fps
m= 1.355, c= 20.56 fps, dt= 1.2 min, dx= 35.0' / 1 = 35.0', K= 0.0 min, X= 0.449
Max. Velocity= 20.64 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 20.56 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 6.07 hrs, Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 24.43 cfs

18.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 35.0' Slope= 0.2000 '/'
Inlet Invert= 8,094.00', Outlet Invert= 8,087.00'



Reach URCI: Upper Road Culvert Inlet



Upper Road Culvert Inlet
Worksheet for Circular Channel

Project Description	
Worksheet	URCI
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Slope	200000	ft/ft
Diameter	18	in
Discharge	0.36	cfs

Results		
Depth	0.13	ft
Flow Area	0.1	ft²
Wetted Perime	0.89	ft
Top Width	0.84	ft
Critical Depth	0.22	ft
Percent Full	8.5	%
Critical Slope	0.019640	ft/ft
Velocity	4.99	ft/s
Velocity Head	0.39	ft
Specific Energ	0.51	ft
Froude Numbe	3.00	
Maximum Disc	26.28	cfs
Discharge Full	24.43	cfs
Slope Full	0.000043	ft/ft
Flow Type	;upercritical	

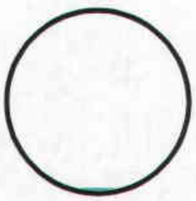
Summary for Reach URCO: Upper Road Culvert Outlet

Inflow Area =	46.828 ac,	0.00% Impervious,	Inflow Depth = 0.02"	
Inflow =	0.36 cfs @	6.07 hrs, Volume=	0.059 af	
Outflow =	0.36 cfs @	6.07 hrs, Volume=	0.059 af,	Atten= 0%, Lag= 0.0 min

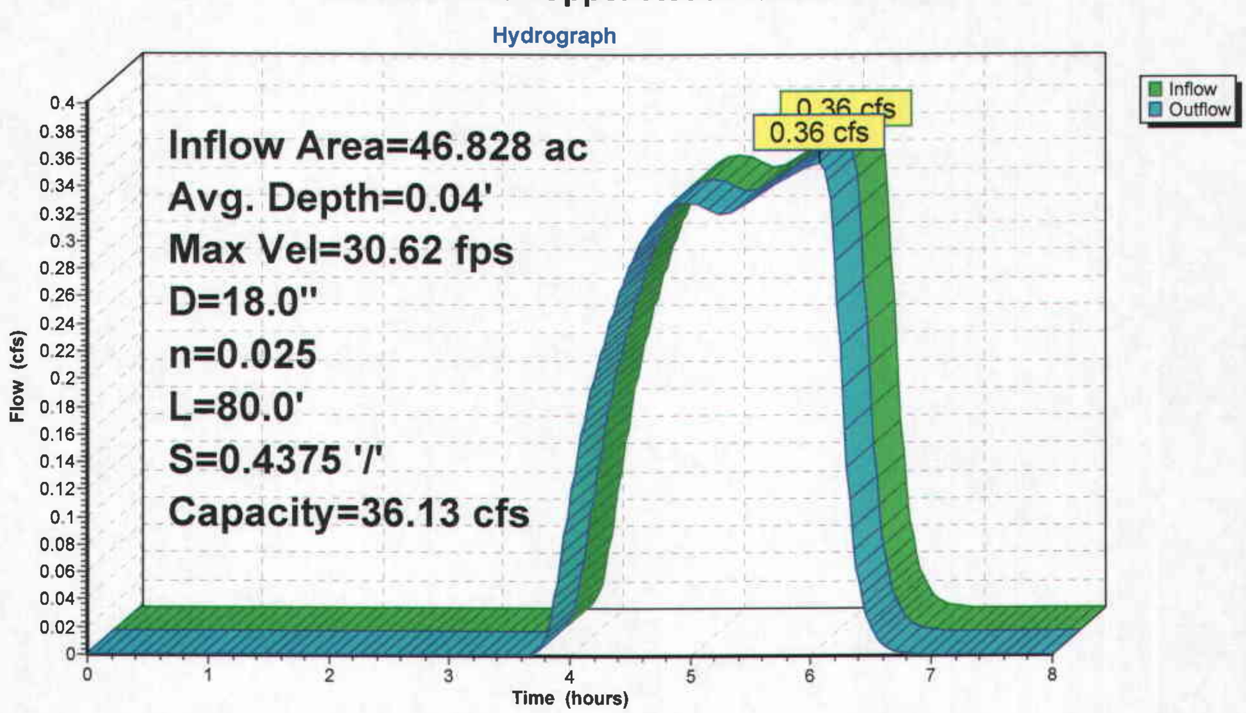
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-8.00 hrs, dt= 0.02 hrs
Reference Flow= 27.10 cfs Estimated Depth= 0.97' Velocity= 22.44 fps
m= 1.355, c= 30.40 fps, dt= 1.2 min, dx= 80.0' / 1 = 80.0', K= 0.0 min, X= 0.490
Max. Velocity= 30.62 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 30.40 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 6.07 hrs, Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 36.13 cfs

18.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 80.0' Slope= 0.4375 '/'
Inlet Invert= 8,087.00', Outlet Invert= 8,052.00'



Reach URCO: Upper Road Culvert Outlet



Upper Road Culvert Outlet
Worksheet for Circular Channel

Project Description	
Worksheet	URCO
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Slope	437500	ft/ft
Diameter	18	in
Discharge	0.36	cfs

Results		
Depth	0.11	ft
Flow Area	0.1	ft²
Wetted Perime	0.81	ft
Top Width	0.77	ft
Critical Depth	0.22	ft
Percent Full	7.0	%
Critical Slope	0.019640	ft/ft
Velocity	6.56	ft/s
Velocity Head	0.67	ft
Specific Energ;	0.77	ft
Froude Numbe	4.32	
Maximum Disc	38.86	cfs
Discharge Full	36.13	cfs
Slope Full	0.000043	ft/ft
Flow Type	;upercritical	

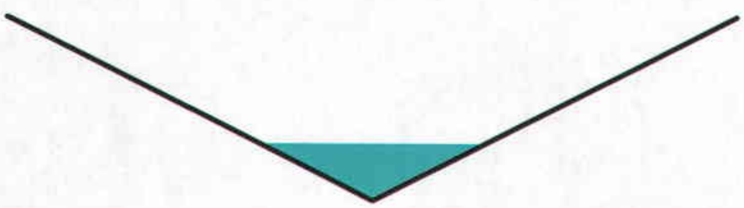
Summary for Reach URD: Upper Road Ditch

Inflow Area = 46.828 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 0.36 cfs @ 6.02 hrs, Volume= 0.059 af
Outflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af, Atten= 0%, Lag= 3.0 min

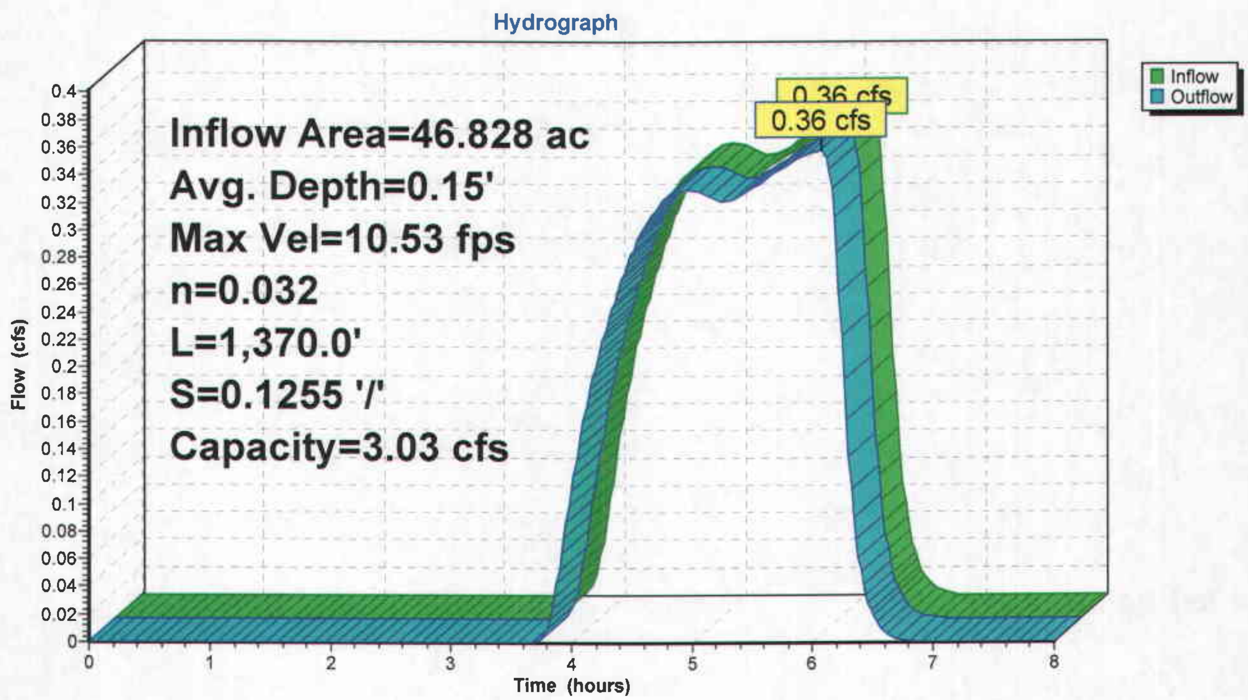
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-8.00 hrs, dt= 0.02 hrs
Reference Flow= 2.27 cfs Estimated Depth= 0.45' Velocity= 5.64 fps
m= 1.333, c= 7.52 fps, dt= 1.2 min, dx= 1,370.0' / 3 = 456.7', K= 1.0 min, X= 0.497
Max. Velocity= 10.53 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 7.59 fps, Avg. Travel Time= 3.0 min

Peak Storage= 65 cf @ 6.04 hrs, Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 3.03 cfs

0.00' x 0.50' deep channel, n= 0.032
Side Slope Z-value= 2.0 '/' Top Width= 2.00'
Length= 1,370.0' Slope= 0.1255 '/'
Inlet Invert= 8,266.00', Outlet Invert= 8,094.00'



Reach URD: Upper Road Ditch



Upper Road Ditch Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	URD Max. Slop
Flow Element	Triangular Char
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	200000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.36	cfs

Results		
Depth	0.21	ft
Flow Area	0.1	ft²
Wetted Perim	0.92	ft
Top Width	0.82	ft
Critical Depth	0.29	ft
Critical Slope	0.032998	ft/ft
Velocity	4.24	ft/s
Velocity Head	0.28	ft
Specific Energ	0.49	ft
Froude Numb	2.33	
Flow Type	;upercritical	

EarthFax Engineering Inc
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666
Project Engineer: Richard White

Upper Road Ditch Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	URD Max. Dept
Flow Element	Triangular Char
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	070000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.36	cfs

Results		
Depth	0.25	ft
Flow Area	0.1	ft²
Wetted Perim	1.12	ft
Top Width	1.00	ft
Critical Depth	0.29	ft
Critical Slope	0.032997	ft/ft
Velocity	2.86	ft/s
Velocity Head	0.13	ft
Specific Energ	0.38	ft
Froude Numb	1.42	
Flow Type	Supercritical	

Summary for Pond UR: Upper Road Catch Basin

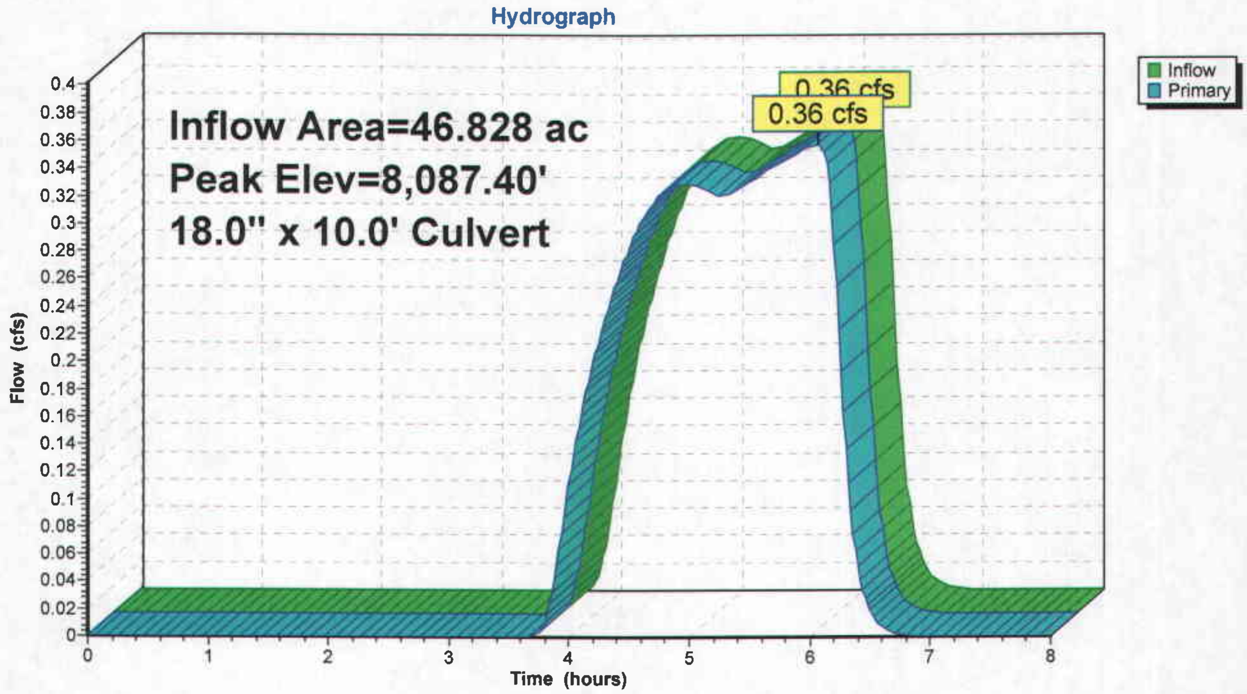
Inflow Area = 46.828 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af
Outflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min
Primary = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af

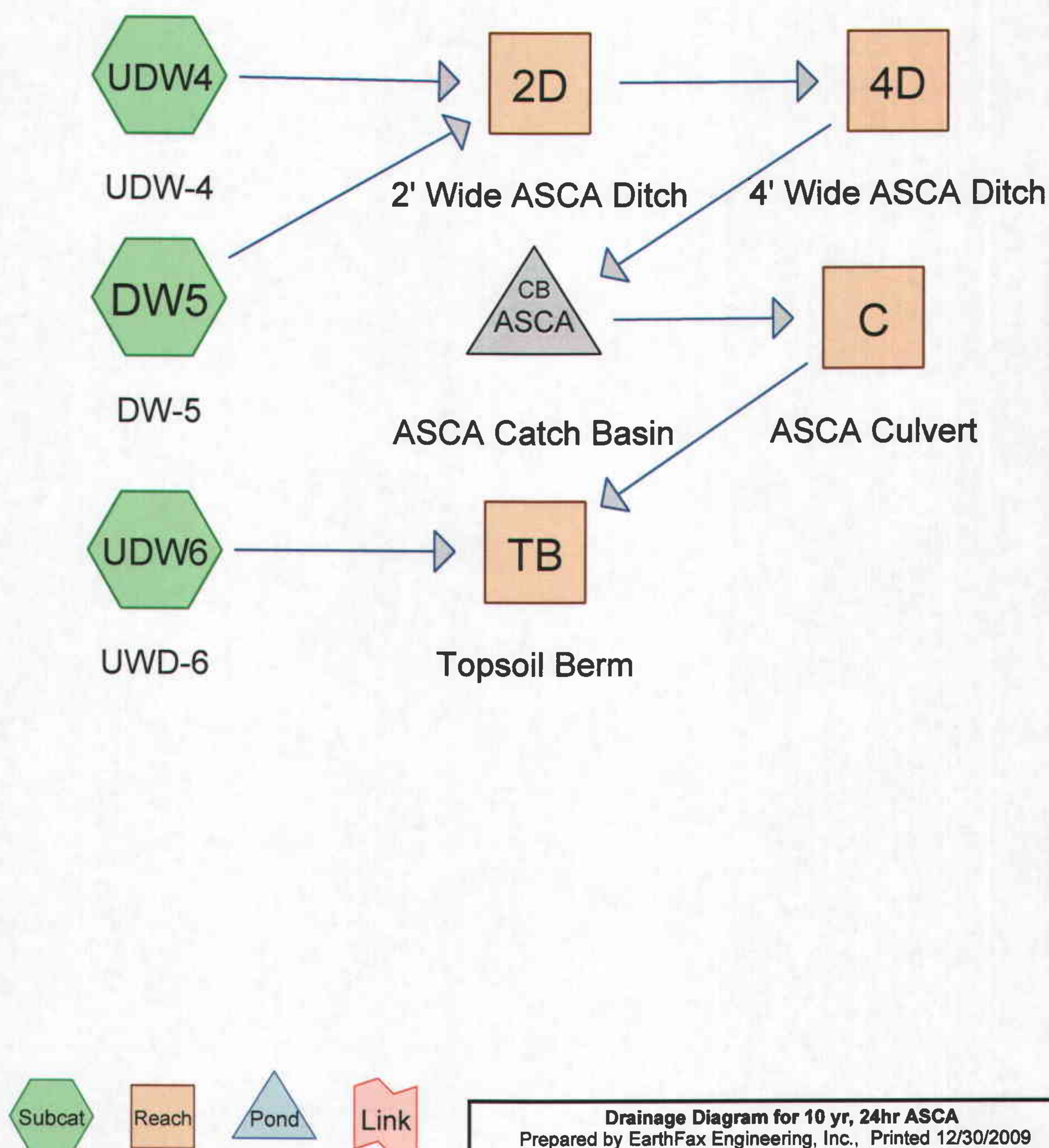
Routing by Dyn-Stor-Ind method, Time Span= 0.00-8.00 hrs, dt= 0.02 hrs
Peak Elev= 8,087.40' @ 6.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	8,087.00'	**18.0" x 10.0' long Culvert** CMP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 8,087.00' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=0.36 cfs @ 6.07 hrs HW=8,087.40' TW=8,087.04' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.36 cfs @ 1.41 fps)

Pond UR: Upper Road Catch Basin





Drainage Diagram for 10 yr, 24hr ASCA
Prepared by EarthFax Engineering, Inc., Printed 12/30/2009

Summary for Subcatchment DW5: DW-5

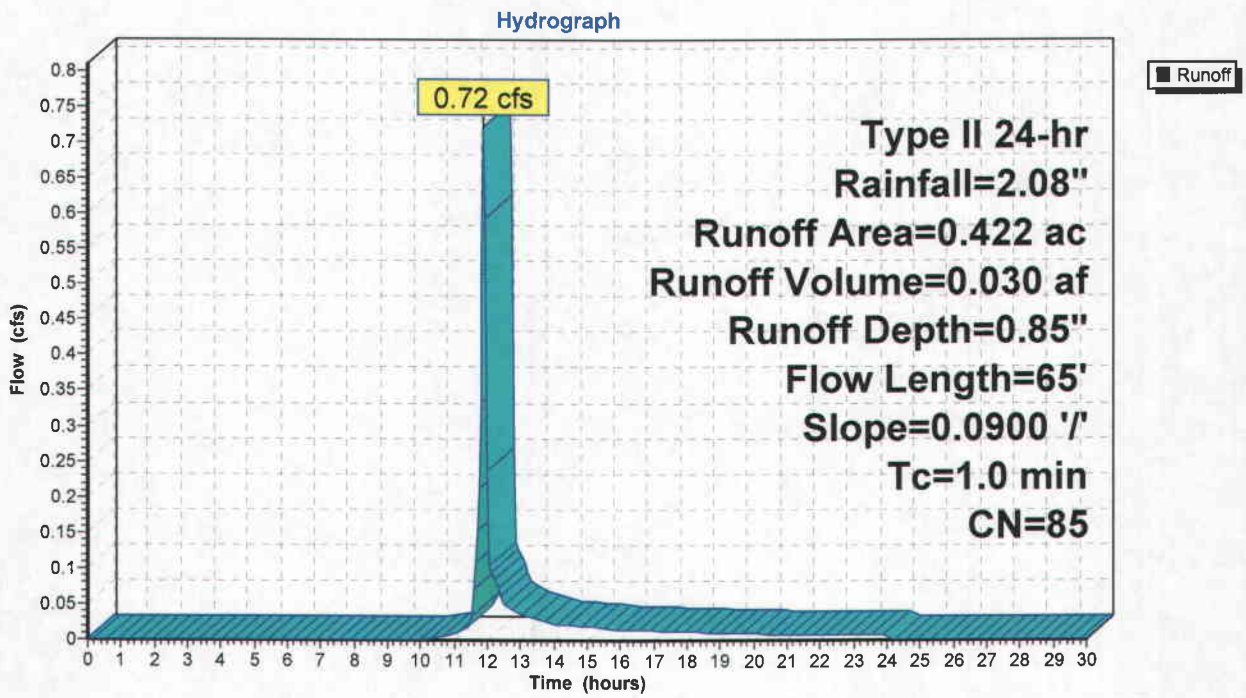
Runoff = 0.72 cfs @ 11.91 hrs, Volume= 0.030 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.422	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.422		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	65	0.0900	1.07		**Lag/CN Method,**

Subcatchment DW5: DW-5



Summary for Subcatchment UDW4: UDW-4

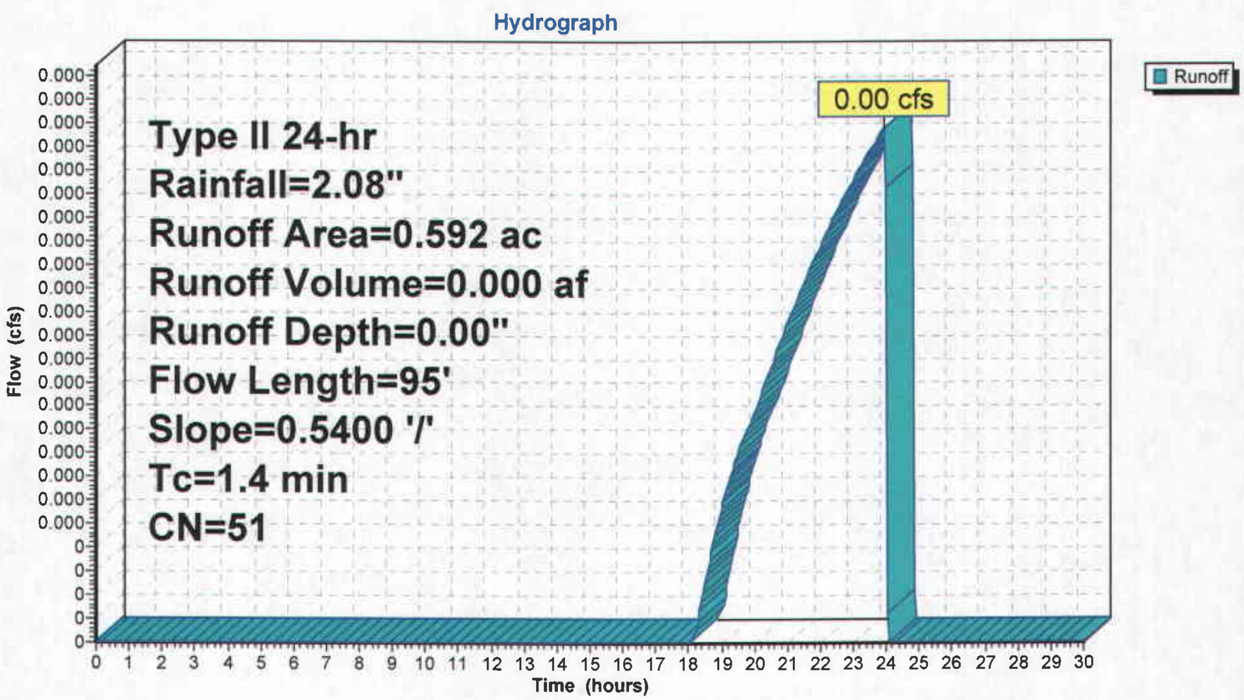
Runoff = 0.00 cfs @ 23.95 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.08"

Area (ac)	CN	Description
0.592	51	Sagebrush range, Fair, HSG B
0.592		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	95	0.5400	1.11		**Lag/CN Method,**

Subcatchment UDW4: UDW-4



Summary for Subcatchment UDW6: UWD-6

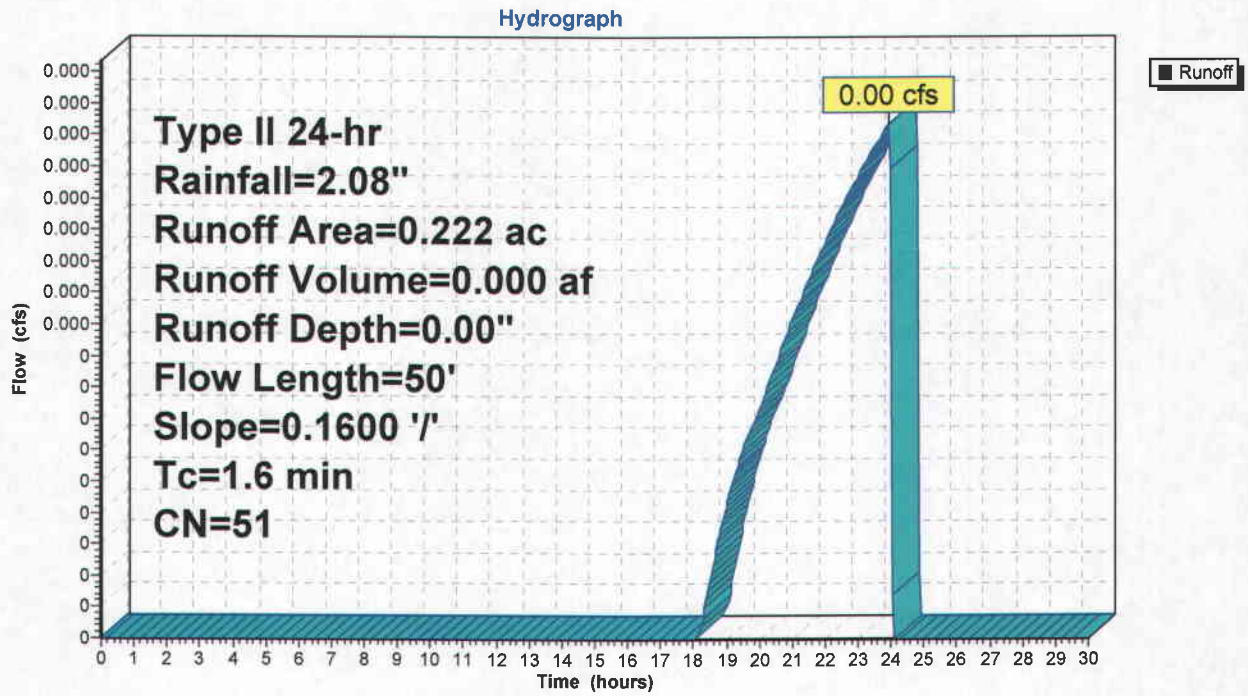
Runoff = 0.00 cfs @ 23.95 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.08"

Area (ac)	CN	Description
0.222	51	Sagebrush range, Fair, HSG B
0.222		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	50	0.1600	0.53		**Lag/CN Method,**

Subcatchment UDW6: UWD-6



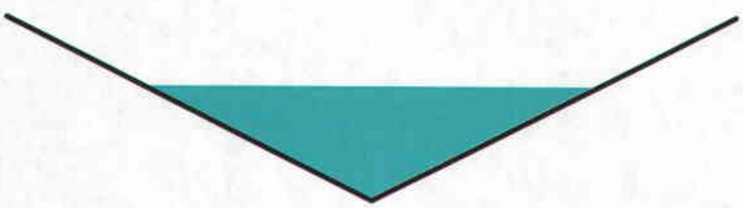
Summary for Reach 2D: 2' Wide ASCA Ditch

Inflow Area =	1.014 ac,	0.00% Impervious,	Inflow Depth = 0.36"	
Inflow =	0.72 cfs @	11.91 hrs, Volume=	0.030 af	
Outflow =	0.67 cfs @	11.94 hrs, Volume=	0.030 af,	Atten= 8%, Lag= 1.8 min

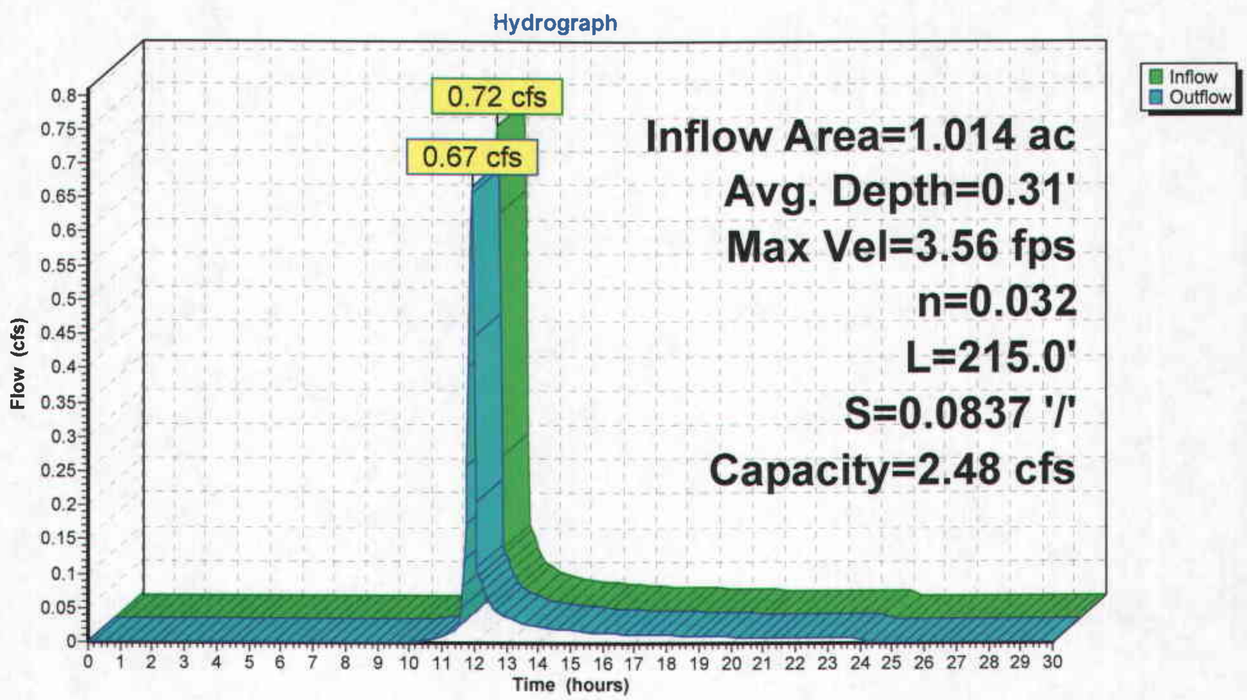
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.56 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.34 fps, Avg. Travel Time= 2.7 min

Peak Storage= 41 cf @ 11.92 hrs, Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 2.48 cfs

0.00' x 0.50' deep channel, n= 0.032
Side Slope Z-value= 2.0 '/' Top Width= 2.00'
Length= 215.0' Slope= 0.0837 '/'
Inlet Invert= 8,100.00', Outlet Invert= 8,082.00'



Reach 2D: 2' Wide ASCA Ditch



2' Wide ASCA Ditch Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	2' ASCA Ditch Max.
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	090000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.72	cfs

Results		
Depth	0.31	ft
Flow Area	0.2	ft²
Wetted Perim	1.39	ft
Top Width	1.24	ft
Critical Depth	0.38	ft
Critical Slope	0.030085	ft/ft
Velocity	3.74	ft/s
Velocity Head	0.22	ft
Specific Energ	0.53	ft
Froude Numb	1.67	
Flow Type	Supercritical	

2' Wide ASCA Ditch Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	2' ASCA Ditch Max.
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	080000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.72	cfs

Results		
Depth	0.32	ft
Flow Area	0.2	ft²
Wetted Perim	1.42	ft
Top Width	1.27	ft
Critical Depth	0.38	ft
Critical Slope	0.030086	ft/ft
Velocity	3.57	ft/s
Velocity Head	0.20	ft
Specific Energ	0.52	ft
Froude Numb	1.58	
Flow Type	Supercritical	

Summary for Reach 4D: 4' Wide ASCA Ditch

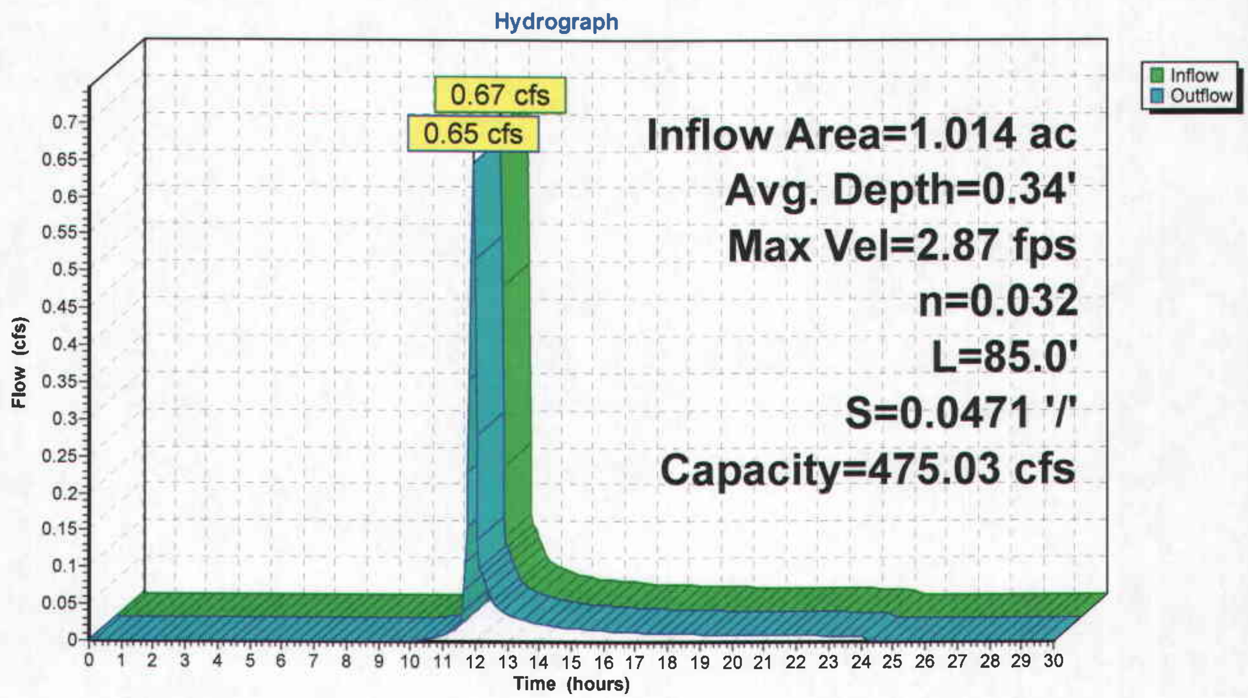
Inflow Area = 1.014 ac, 0.00% Impervious, Inflow Depth = 0.36"
Inflow = 0.67 cfs @ 11.94 hrs, Volume= 0.030 af
Outflow = 0.65 cfs @ 11.95 hrs, Volume= 0.030 af, Atten= 3%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.87 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.13 fps, Avg. Travel Time= 1.2 min

Peak Storage= 20 cf @ 11.94 hrs, Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 475.03 cfs

0.00' x 4.00' deep channel, n= 0.032
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 85.0' Slope= 0.0471 '/'
Inlet Invert= 8,082.00', Outlet Invert= 8,078.00'

Reach 4D: 4' Wide ASCA Ditch



4' Wide ASCA Ditch Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	4' ASCA Ditch Max.
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	080000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.67	cfs

Results		
Depth	0.31	ft
Flow Area	0.2	ft²
Wetted Perim	1.38	ft
Top Width	1.24	ft
Critical Depth	0.37	ft
Critical Slope	0.030376	ft/ft
Velocity	3.51	ft/s
Velocity Head	0.19	ft
Specific Energ	0.50	ft
Froude Numb	1.57	
Flow Type	Supercritical	

4' Wide ASCA Ditch Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	4' ASCA Ditch Max.
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	040000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.67	cfs

Results		
Depth	0.35	ft
Flow Area	0.2	ft²
Wetted Perim(	1.57	ft
Top Width	1.41	ft
Critical Depth	0.37	ft
Critical Slope	0.030375	ft/ft
Velocity	2.71	ft/s
Velocity Head	0.11	ft
Specific Energ	0.47	ft
Froude Numb(	1.14	
Flow Type	;upercritical	

EarthFax Engineering Inc
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666
Project Engineer: Richard White

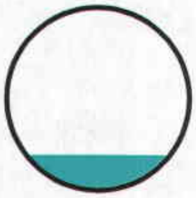
Summary for Reach C: ASCA Culvert

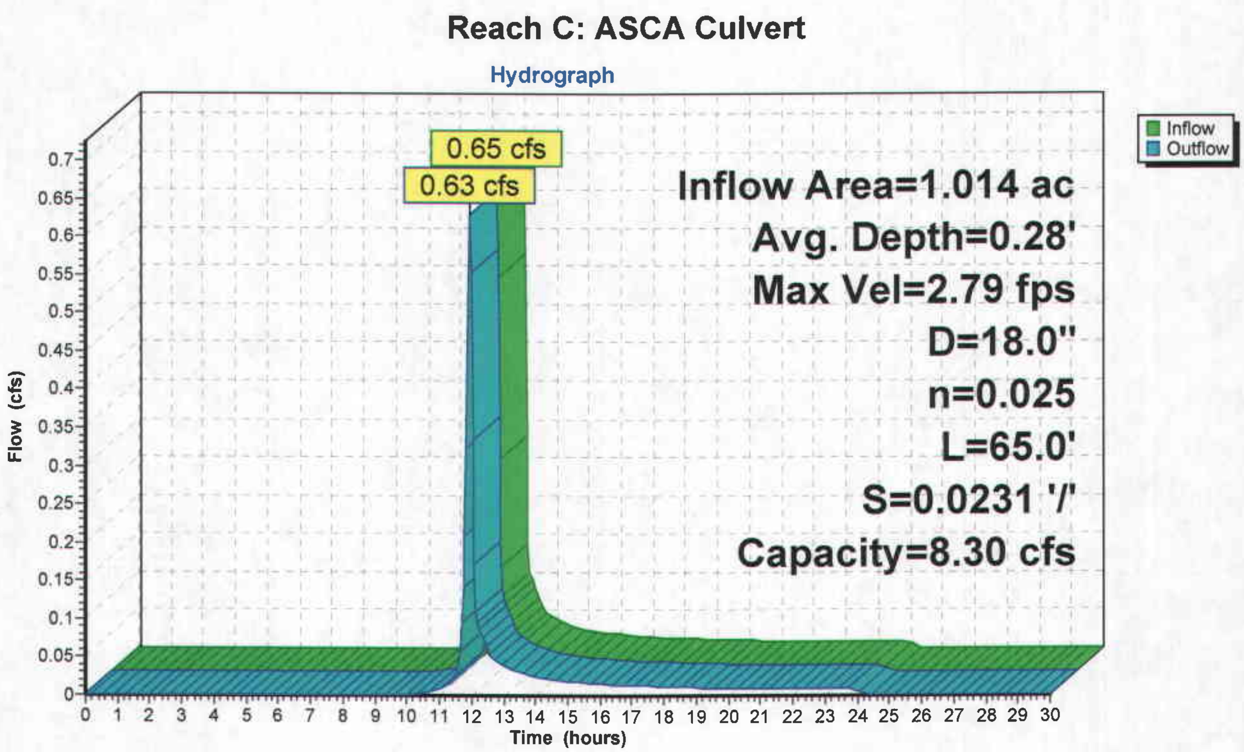
Inflow Area =	1.014 ac,	0.00% Impervious,	Inflow Depth = 0.36"	
Inflow =	0.65 cfs @	11.95 hrs, Volume=	0.030 af	
Outflow =	0.63 cfs @	11.96 hrs, Volume=	0.030 af,	Atten= 3%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.79 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.89 fps, Avg. Travel Time= 1.2 min

Peak Storage= 15 cf @ 11.95 hrs, Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 8.30 cfs

18.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 65.0' Slope= 0.0231 '/'
Inlet Invert= 8,075.50', Outlet Invert= 8,074.00'





ASCA Culvert
Worksheet for Circular Channel

Project Description	
Worksheet	ASCA Culvert
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Slope	023100	ft/ft
Diameter	18	in
Discharge	0.65	cfs

Results		
Depth	0.28	ft
Flow Area	0.2	ft²
Wetted Perime	1.35	ft
Top Width	1.18	ft
Critical Depth	0.30	ft
Percent Full	18.9	%
Critical Slope	0.018705	ft/ft
Velocity	2.80	ft/s
Velocity Head	0.12	ft
Specific Energ;	0.41	ft
Froude Numbe	1.11	
Maximum Disc	8.93	cfs
Discharge Full	8.30	cfs
Slope Full	0.000142	ft/ft
Flow Type	;upercritical	

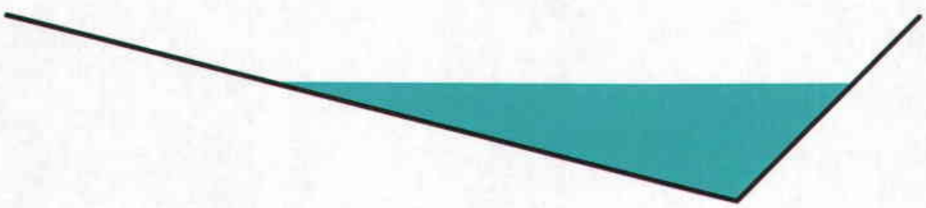
Summary for Reach TB: Topsoil Berm

Inflow Area = 1.236 ac, 0.00% Impervious, Inflow Depth = 0.29"
Inflow = 0.63 cfs @ 11.96 hrs, Volume= 0.030 af
Outflow = 0.60 cfs @ 11.98 hrs, Volume= 0.030 af, Atten= 4%, Lag= 1.4 min

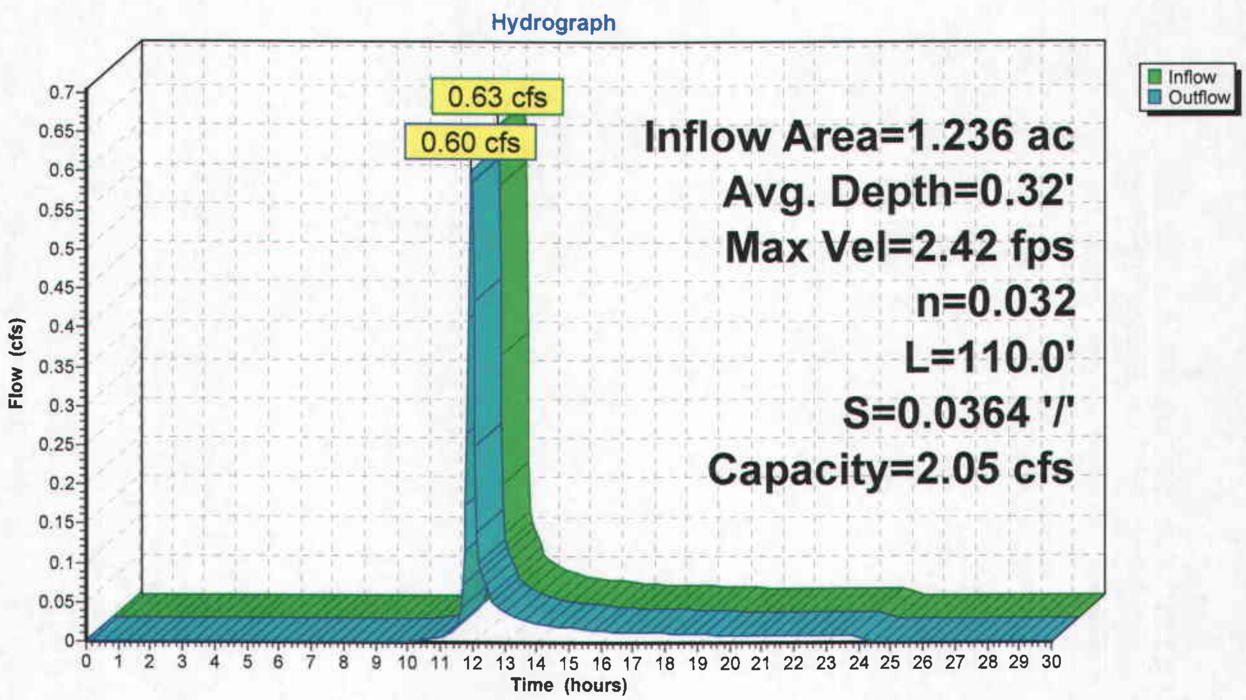
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.42 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.93 fps, Avg. Travel Time= 2.0 min

Peak Storage= 28 cf @ 11.97 hrs, Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 2.05 cfs

0.00' x 0.50' deep channel, n= 0.032
Side Slope Z-value= 4.0 1.0 '/' Top Width= 2.50'
Length= 110.0' Slope= 0.0364 '/'
Inlet Invert= 8,069.00', Outlet Invert= 8,065.00'



Reach TB: Topsoil Berm



ASCA Topsoil Berm (North Side of Berm, South of Existing Road) Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	ASCA TB Max.
Flow Element	Triangular Char
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	100000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.50	V : H
Discharge	0.63	cfs

Results		
Depth	0.25	ft
Flow Area	0.2	ft²
Wetted Perim	1.56	ft
Top Width	1.47	ft
Critical Depth	0.31	ft
Critical Slope	0.030104	ft/ft
Velocity	3.49	ft/s
Velocity Head	0.19	ft
Specific Energ	0.43	ft
Froude Numb	1.76	
Flow Type	Supercritical	

ASCA Topsoil Berm (North Side of Berm, South of Existing Road) Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	ASCA TB Max.
Flow Element	Triangular Char
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	012500	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.50	V : H
Discharge	0.63	cfs

Results		
Depth	0.36	ft
Flow Area	0.4	ft²
Wetted Perim	2.30	ft
Top Width	2.17	ft
Critical Depth	0.31	ft
Critical Slope	0.030104	ft/ft
Velocity	1.60	ft/s
Velocity Head	0.04	ft
Specific Energ	0.40	ft
Froude Numb	0.66	
Flow Type	Subcritical	

Summary for Pond ASCA: ASCA Catch Basin

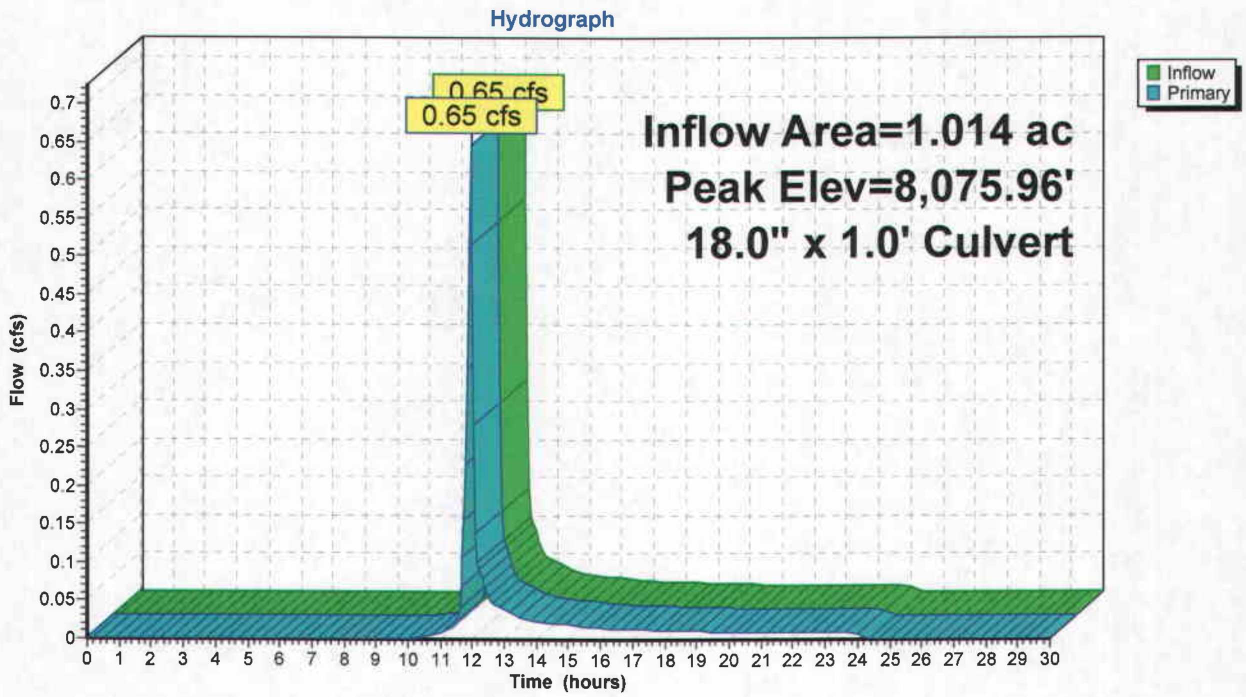
Inflow Area =	1.014 ac,	0.00% Impervious,	Inflow Depth = 0.36"		
Inflow =	0.65 cfs @	11.95 hrs,	Volume=	0.030 af	
Outflow =	0.65 cfs @	11.95 hrs,	Volume=	0.030 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.65 cfs @	11.95 hrs,	Volume=	0.030 af	

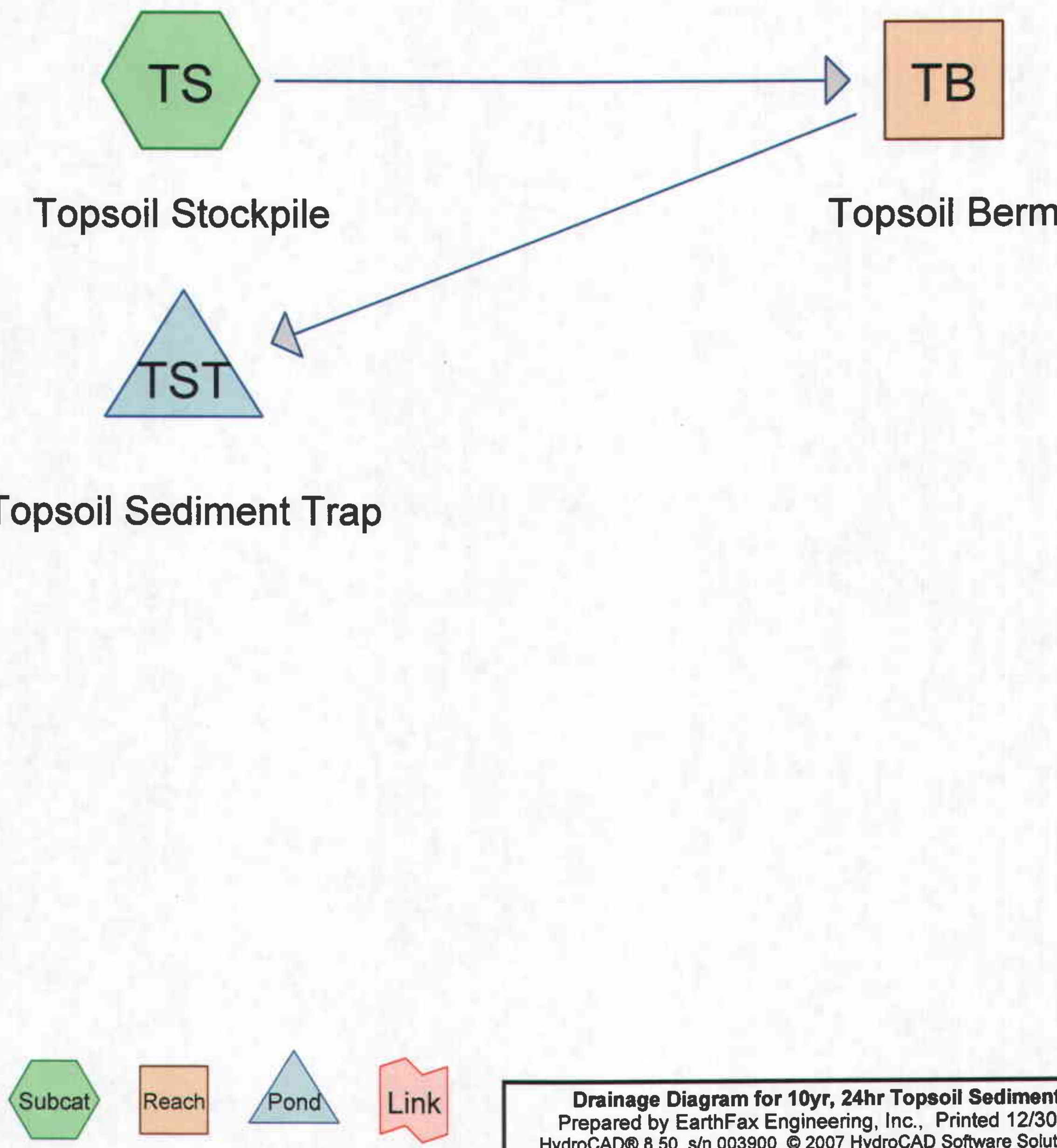
Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 8,075.96' @ 11.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	8,075.52'	**18.0" x 1.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 8,075.50' S= 0.0200 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=0.64 cfs @ 11.95 hrs HW=8,075.96' TW=8,075.50' (Fixed TW Elev= 8,075.50')
1=Culvert (Barrel Controls 0.64 cfs @ 2.24 fps)

Pond ASCA: ASCA Catch Basin





Drainage Diagram for 10yr, 24hr Topsoil Sediment Trap
Prepared by EarthFax Engineering, Inc., Printed 12/30/2009

Summary for Subcatchment TS: Topsoil Stockpile

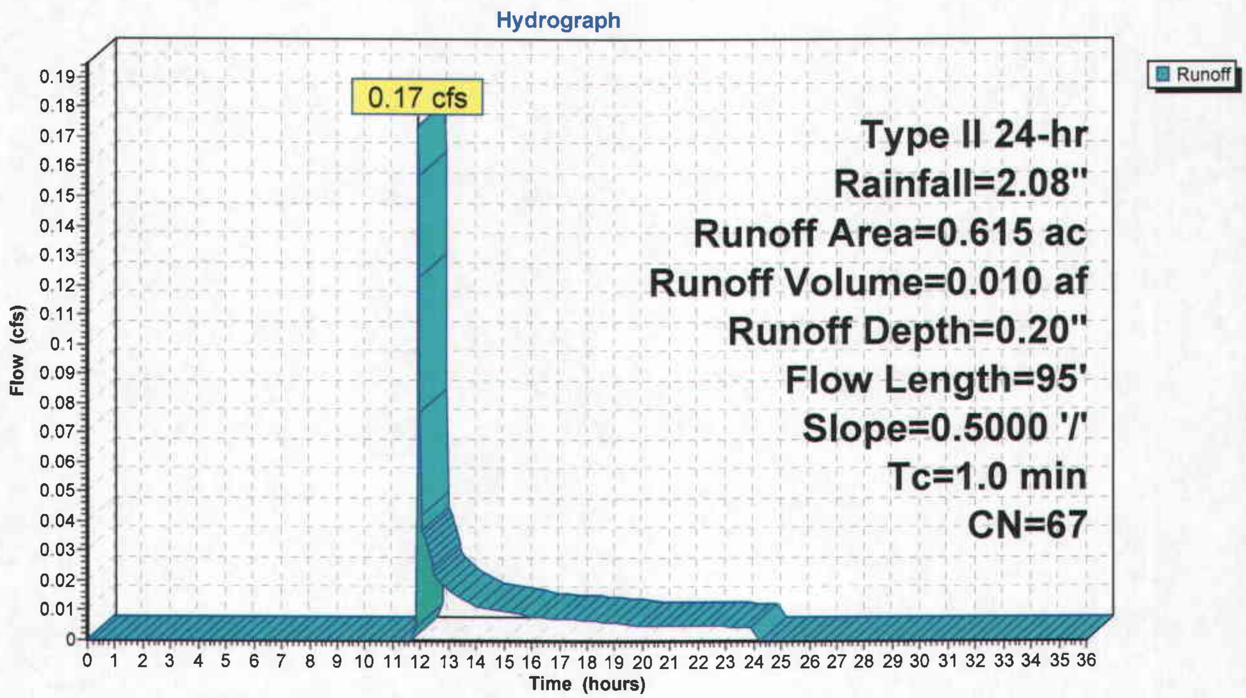
Runoff = 0.17 cfs @ 11.94 hrs, Volume= 0.010 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

Area (ac)	CN	Description
0.615	67	Sagebrush range, Poor, HSG B
0.615		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	95	0.5000	1.60		**Lag/CN Method, Slope From 8,100 to 8,053**

Subcatchment TS: Topsoil Stockpile



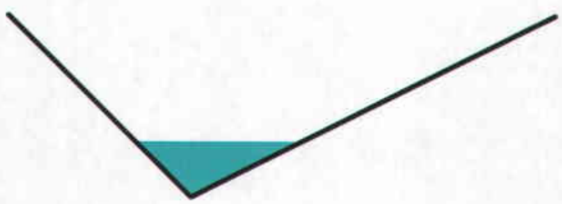
Summary for Reach TB: Topsoil Berm

Inflow Area = 0.615 ac, 0.00% Impervious, Inflow Depth = 0.20"
Inflow = 0.17 cfs @ 11.94 hrs, Volume= 0.010 af
Outflow = 0.17 cfs @ 11.98 hrs, Volume= 0.010 af, Atten= 0%, Lag= 2.6 min

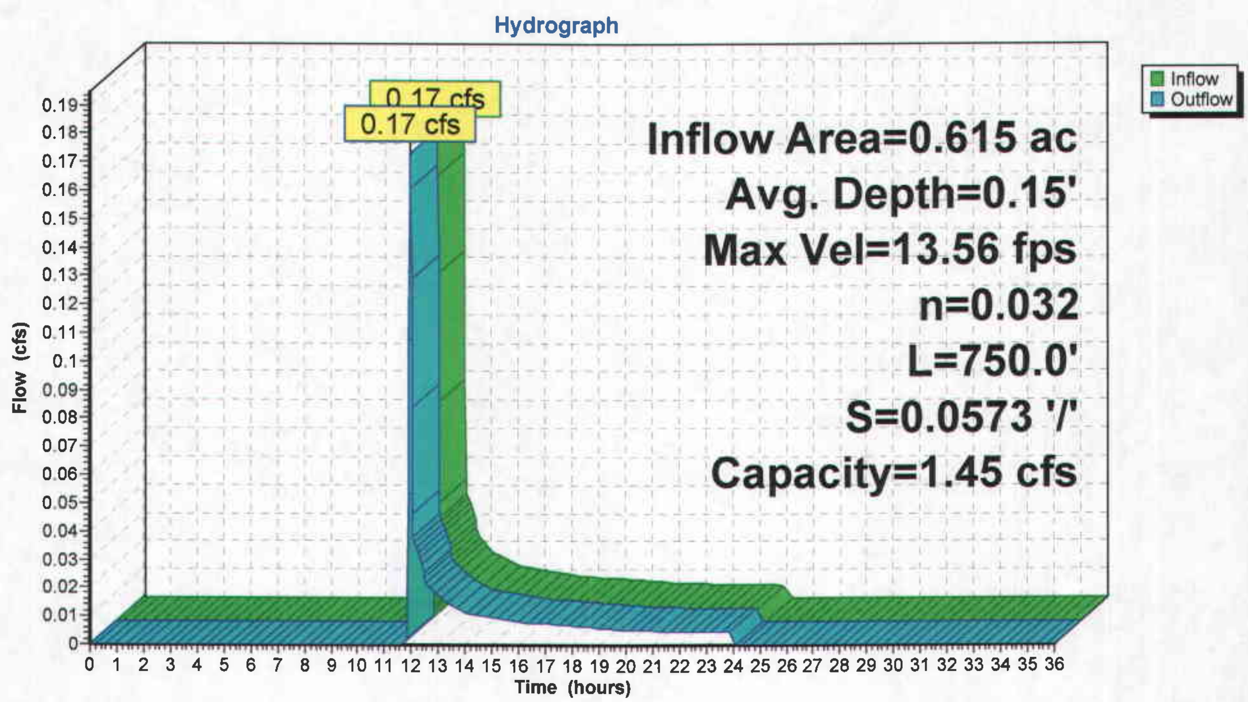
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Reference Flow= 1.09 cfs Estimated Depth= 0.45' Velocity= 3.60 fps
m= 1.333, c= 4.80 fps, dt= 1.2 min, dx= 750.0' / 2 = 375.0', K= 1.3 min, X= 0.492
Max. Velocity= 13.56 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 5.04 fps, Avg. Travel Time= 2.5 min

Peak Storage= 26 cf @ 11.96 hrs, Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 1.45 cfs

0.00' x 0.50' deep channel, n= 0.032
Side Slope Z-value= 1.0 2.0 '/' Top Width= 1.50'
Length= 750.0' Slope= 0.0573 '/'
Inlet Invert= 8,096.00', Outlet Invert= 8,053.00'



Reach TB: Topsoil Berm



Topsoil Berm Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	TB Max. Slope
Flow Element	Triangular Char
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	133000	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	0.50	V : H
Discharge	0.17	cfs

Results		
Depth	0.19	ft
Flow Area	0.1	ft²
Wetted Perim	0.70	ft
Top Width	0.57	ft
Critical Depth	0.24	ft
Critical Slope	0.039291	ft/ft
Velocity	3.10	ft/s
Velocity Head	0.15	ft
Specific Energ	0.34	ft
Froude Numb	1.77	
Flow Type	Supercritical	

Topsoil Berm Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	TB Max. Depth
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	013330	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	0.50	V : H
Discharge	0.17	cfs

Results		
Depth	0.29	ft
Flow Area	0.1	ft²
Wetted Perim	1.07	ft
Top Width	0.88	ft
Critical Depth	0.24	ft
Critical Slope	0.039290	ft/ft
Velocity	1.31	ft/s
Velocity Head	0.03	ft
Specific Energ	0.32	ft
Froude Numb	0.60	
Flow Type	Subcritical	

Summary for Pond TST: Topsoil Sediment Trap

Inflow Area = 0.615 ac, 0.00% Impervious, Inflow Depth = 0.20"
Inflow = 0.17 cfs @ 11.98 hrs, Volume= 0.010 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

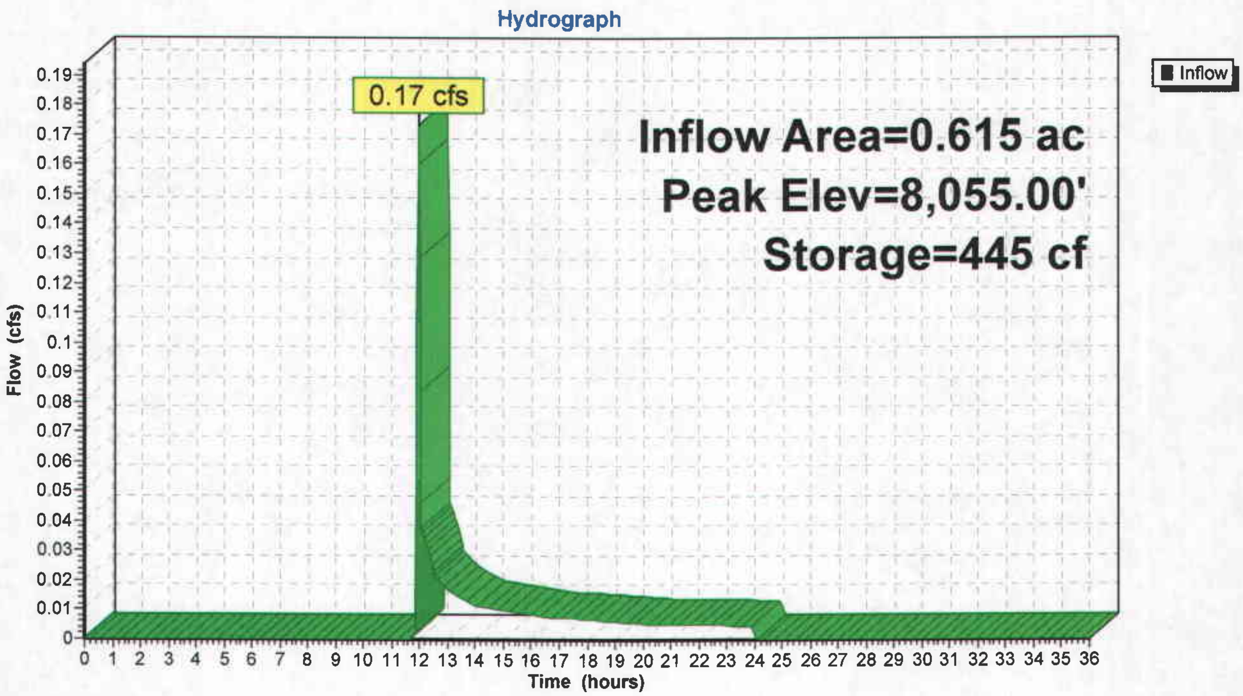
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Peak Elev= 8,055.00' @ 24.22 hrs Surf.Area= 450 sf Storage= 445 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	8,053.00'	1,053 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
8,053.00	0	0	0
8,054.00	220	110	110
8,055.00	450	335	445
8,056.00	765	608	1,053

Pond TST: Topsoil Sediment Trap



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 loca- tion 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 approx- imately 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 inter- cepted, 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 recur- rence 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 col- lected 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.)

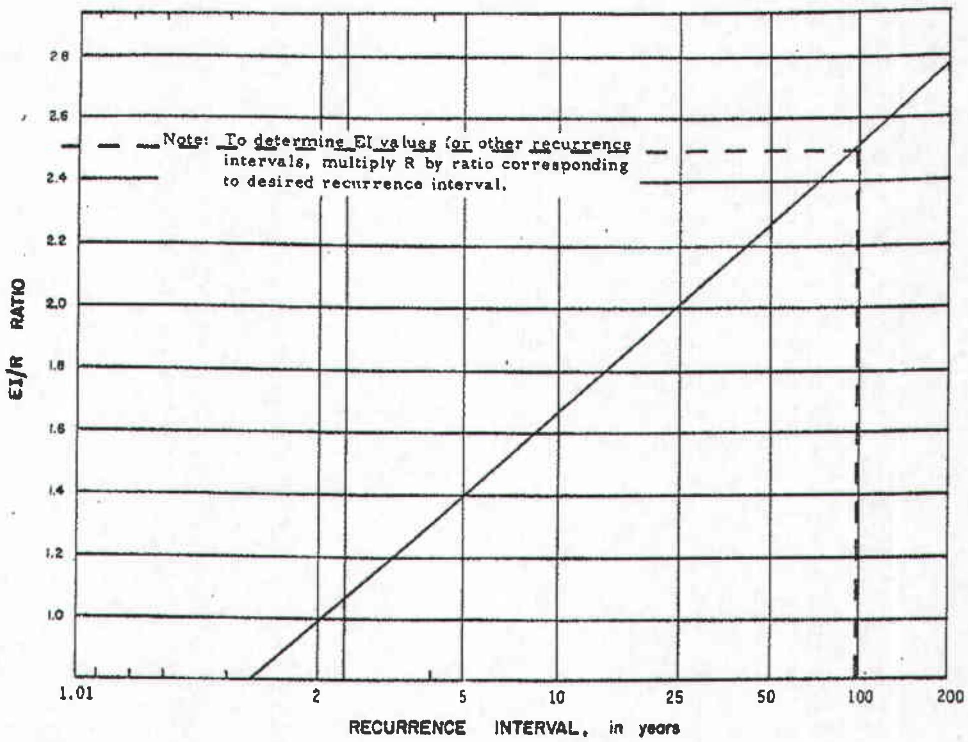


Figure 9. The relationship between the EI/R ratio and recurrence interval.

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·K·LS = 22.19 x 0.31 x 33.34

= 229.34 t/ac/yr

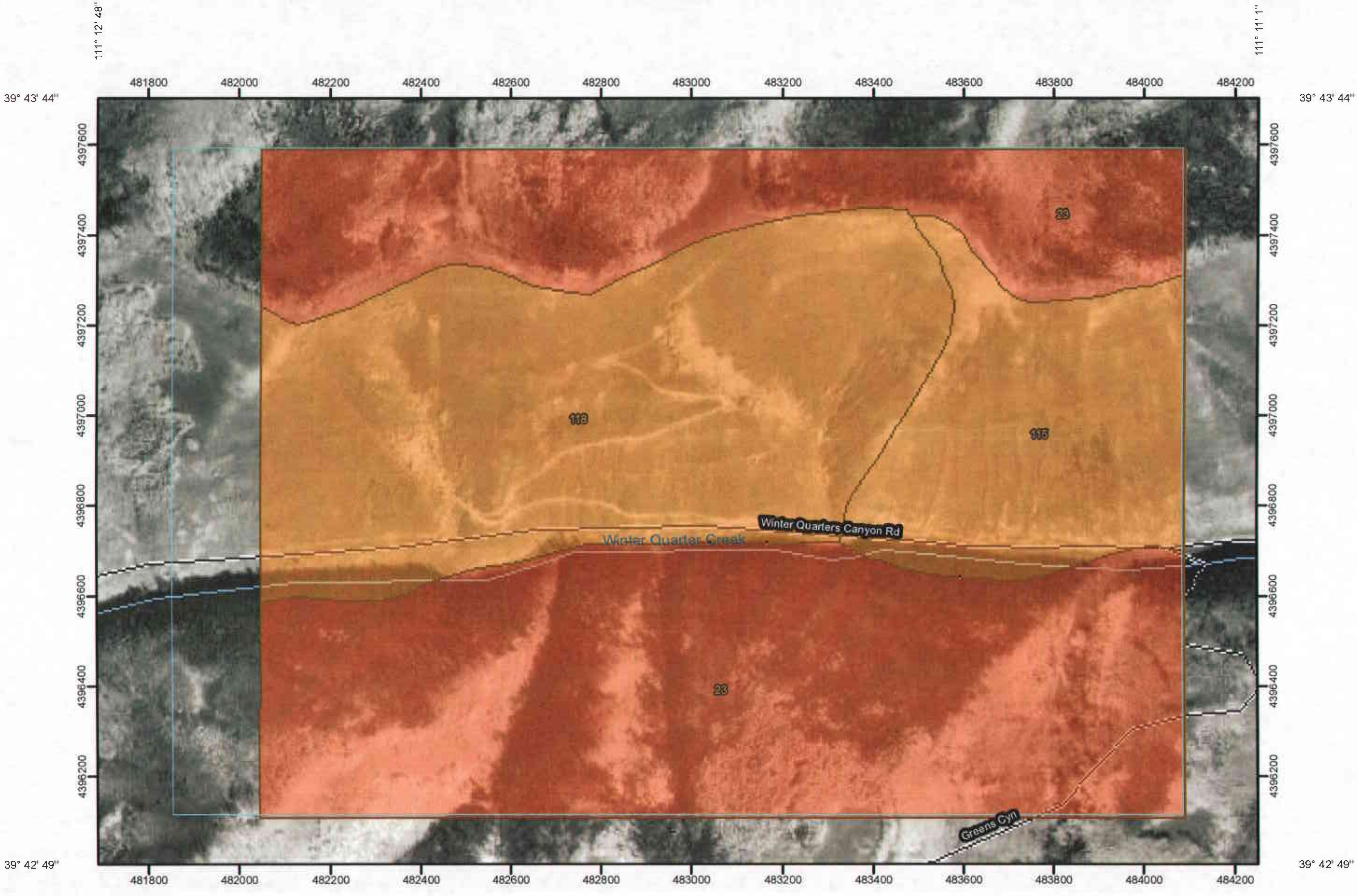
10. The amount of mulch required to reduce the potential erosion to the amount of 1 ton/acre can be determined from Figures 3 through 6. Other control measures are listed in Table 3 together with their approximate VM values. The VM value of any particular control measure, multiplied by the R·K·LS value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

If R·K·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

K Factor, Whole Soil—Carbon Area, Utah, Parts of Carbon and Emery Counties and Manti-Lasal National Forest, Manti Division - Parts of Sanpete and Emery Counties
(Winter Quarters Canyon)



Map Scale: 1:12,200 if printed on A size (8.5" x 11") sheet.

Meters: 0, 150, 300, 600, 900

Feet: 0, 500, 1,000, 2,000, 3,000

N

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:12,200 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Carbon Area, Utah, Parts of Carbon and Emery Counties
Survey Area Data: Version 4, Jul 2, 2008

Soil Survey Area: Manti-Lasal National Forest, Manti Division - Parts of Sanpete and Emery Counties
Survey Area Data: Not available

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 9/30/1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Carbon Area, Utah, Parts of Carbon and Emery Counties				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
23	Curecanti family-Pathead complex	.05	411.6	50.4%
115	Trag stony loam, 30 to 60 percent slopes	.10	98.9	12.1%
118	Trag-Croydon complex	.10	234.0	28.7%
Subtotals for Soil Survey Area			**744.5**	**91.2%**
Totals for Area of Interest			**816.0**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Layer Options: Surface Layer

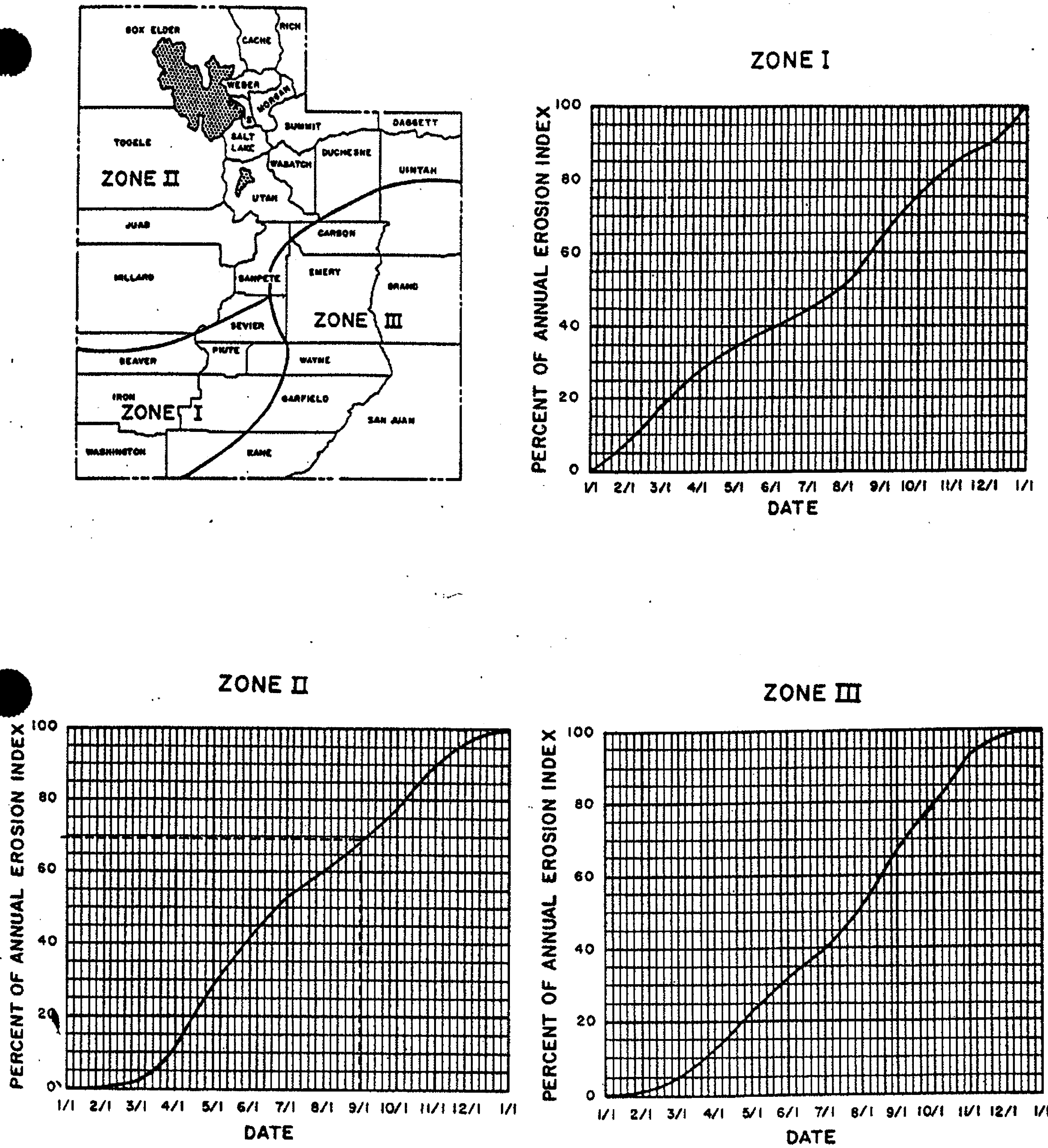


Figure 1. Erosion index distribution curves.

Table 2. LS values.

Slope Ratio	Slope Gradient "s" (%)	Slope Length "λ" (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
1¾:1	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	28.41	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

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1973

MEAN ANNUAL ISO-ERODENT (R) VALUES

...e:
...lues shown are for rain and ...wmelt together. R value for ...wmelt alone = R_s = 0.23881 R ...34328.

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

...H WATER RESEARCH LABORATORY UTAH STATE UNIVERSITY LOGAN, UTAH 1983

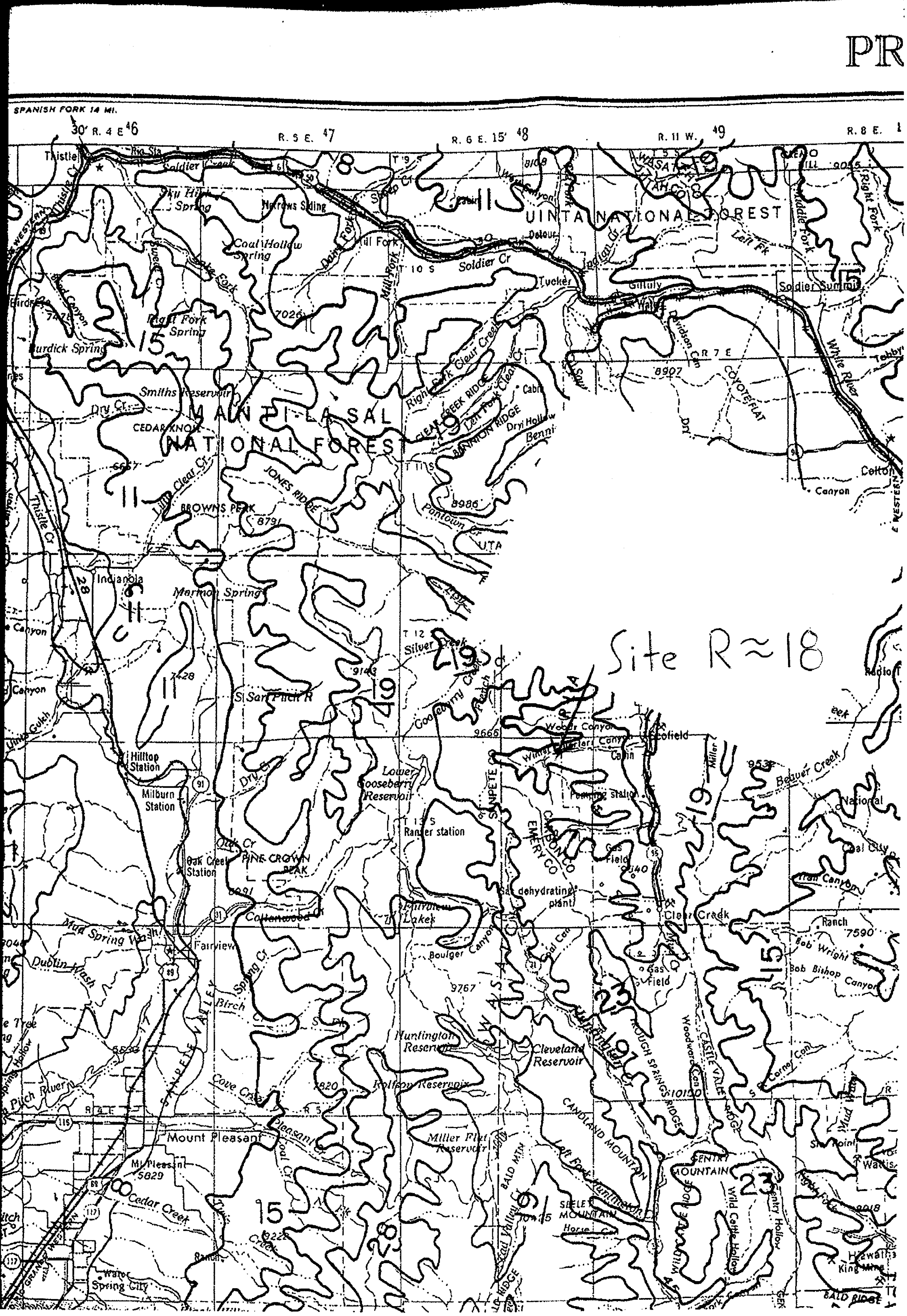

PR
SPANISH FORK 14 MI.
R. 4 E.
R. 5 E.
R. 6 E.
R. 11 W.
R. 8 E.
Thistle
Soldier Creek
Sky High Spring
Narrows Siding
Coal Hollow Spring
UINTA NATIONAL FOREST
Soldier Cr
Tucker
Gilluly
Soldier Summit
White River
Right Fork Spring
Burdick Spring
Smiths Reservoir
MANTI-LA SAL NATIONAL FOREST
CEDAR KNOLL
BROWNS PEAK
JONES RIDGE
Right Fork Clear Creek
CLEAR CREEK RIDGE
COYOTE FLAT
Colton
Canyon
Indianola
Mormon Spring
Silver Creek
Site R ≈ 18
Scofield
Beaver Creek
National
Coal City
Hilltop Station
Milburn Station
Lower Gooseberry Reservoir
Ranger station
PINE CROWN PEAK
Oak Creek Station
Cottonwood Cr
Gas dehydrating plant
Gas Field
Clear Creek
Mud Spring Wash
Fairview
Dublin Wash
Boulger Canyon
Huntington Reservoir
Cleveland Reservoir
Rolfson Reservoir
Miller Flat Reservoir
CANDLAND MOUNTAIN
SENTRY MOUNTAIN
Mount Pleasant
Mt Pleasant
Cedar Creek
SEELEY MOUNTAIN
Wild Cattle Hollow
Spring City
King Mine
BALD RIDGE
11
15
19
23

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

Condition	VM Factor
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.

ATTACHMENT C

Slope Stability Calculations

Winter Quarters Ventilation Shaft Pad Slope Stability Analysis

Canyon Fuel Company
Skyline Mine
Scofield, Utah

January 2010

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WINTER QUARTERS
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CHAPTER 1

INTRODUCTION

The purpose of this report is to summarize the methods and results of a slope stability analysis performed for the proposed ventilation and mine slope pad for the Skyline Mine in Winter Quarters Canyon near Scofield, Utah. Construction of this pad will require a cut into the rock slope along the north side of the pad as well as construction of a sediment runoff collection pond. This report will include an analysis of the stability of the rock slope as well as the sedimentation pond embankment. It is divided into 5 chapters, including this introduction. Chapter 2 includes a discussion of the geology surrounding the site. Chapter 3 outlines the various stability evaluation methods, with the corresponding model inputs and results included in Chapter 4. A list of references is included in Chapter 5. Tables and figures follow the text.

CHAPTER 2
SITE GEOLOGY

The proposed mine pad is located on the northern slope of Winter Quarters Canyon, approximately 2.2 miles west of Scofield, Utah. According to the geologic map of the area, this pad will be located within the Blackhawk Formation. This formation consists of alternating layers of sandstone, shaly siltstone, shale, carbonaceous shale and coal of continental and deltaic origin. The dip of these units in the vicinity of the pad is toward the north to north-northwest at approximately 6 degrees (Witkind et al., 1991).

CHAPTER 3
EVALUATION METHODS

3.1 ROTATIONAL SHEAR FAILURE

Rotational shear failure refers to a global, deep seated failure of a rock or soil mass. The factor of safety against rotational shear failure for the proposed rock slope and sediment pond embankment was calculated using Bishop's Simplified Method of Slices and the computer program *Slide 5.0* by RocScience. This method is the most common used in practice since it has been found to compare well with actual failure surfaces that occur in the field (Anderson et al., 1980). *Slide* uses an iterative procedure to evaluate the factor of safety against failure for thousands of failure surfaces that may develop in the slope. The failure surface is discretized into small slices and the driving and resisting forces/moments are calculated for each and summed over the entire failure surface to obtain a factor of safety defined as:

$$\text{Factor of Safety} = \frac{\text{Sum of Resisting Forces}}{\text{Sum of Driving Forces}}$$

In addition to the slope's factor of safety, the probability of rotational shear failure was also calculated using the "probabilistic analysis" subprogram within the slope stability program *Slide*. This analysis accounts for the uncertainty in the defined rock or soil properties by performing a Monte-Carlo simulation in which the properties are all randomly varied according to a defined statistical distribution. The probability of failure can then be calculated as follows:

$$\text{Probability of Failure} = \frac{\text{Number of Simulations with FS} < 1.0}{\text{Total Number of Simulations}}$$

The minimum acceptable factor of safety and probability of failure is typically dependant on consequences of failure, levels of uncertainty, and industry standards. For this instance a minimum factor of safety of 1.3 and maximum probability of failure of 5% is considered acceptable against rotational shear failure. This is consistent with guidance given by the Utah Division of Oil Gas and Mining in R645-301-533.100 for sediment pond embankments.

3.2 ADDITIONAL ROCK SLOPE FAILURE METHODS

In addition to rotational shear failure, the potential for bedding plane, toppling, and wedge failure were evaluated for the cut into the rock slope. A summary of these failure modes and their applicability to the rock slope are included in the following sections.

3.2.1 Bedding Plane Failure

Bedding plane failure refers to the sliding of a rock mass as a result of separation along the contact between two bedding planes. In order for bedding plane failure to occur, the sliding plane must daylight in the slope and dip parallel to the slope face (Wyllie et al., 2004). Though the bedding planes that make up the rock cut will daylight on the slope face, they dip into the face of the slope. As a result, this type of failure and a corresponding factor of safety are not applicable for the rock slope.

3.2.2 Toppling Failure

Toppling refers to a failure that occurs when columns of rock are formed in a bed and rotate outward about a fixed base. This failure can be considered either block or flexural toppling. Block toppling refers to the rotation of well defined, individual columns and is most common in columnar basalt where orthogonal jointing is well developed (Wyllie et al., 2004). Flexural toppling refers to the toppling of continuous columns of rock separated by well developed, steeply dipping discontinuities that break in flexure as they bend forward and is most common when the slope face is parallel to the strike of a thinly bedded shale (Wyllie et al., 2004). This complex failure mode begins with the toppling of a single column near the toe of the slope due to a break in flexure and separation along the discontinuity. The toppling base plane then regresses up the slope with the toppling of subsequent columns.

Due to the shallow dip of units making up the proposed rock cut (6°), the formation of the columns necessary to create the potential for toppling failure is not expected. Hence, the potential for toppling failure is not deemed probable and will not be further evaluated.

3.2.3 Wedge Failure

Wedge failure refers to the movement of a rock mass along the intersection of discontinuities striking obliquely to the slope face. They are most prevalent when the intersection of two major, planar discontinuities dip parallel to the face and daylight near its toe (Wyllie et al., 2004).

The proposed rock cut will be constructed with sloping 10-foot benches and 20-foot bench heights As a result of the sloping face and relatively small bench size, it is not anticipated that the proposed rock cut will provide the mechanics necessary for large-scale wedge failure. Any failures are likely to be small, bench-scale problems which are expected to be retained within the benches.

CHAPTER 4

MODEL INPUT AND RESULTS

4.1 ROCK SLOPE

The rock strength properties were input into *Slide* using the Generalized Hoek-Brown strength criterion. This strength model was developed specifically for rock applications and defines the rock mass strength based on the following inputs (RocScience, 2002):

- Uniaxial Compressive Strength (UCS): The compressive strength of the intact rock based on laboratory testing or estimated based on rock type.
- Geologic Strength Index (GSI): A factor used to account for the overall structure of the rock mass, ranging from massive to disintegrated or sheared. This index also accounts for the rock's surface conditions.
- Rock Group Factor (m_i): A factor used to account for the rock type and its crystalline structure.
- Disturbance Factor (D): A factor used to account for the degree of disturbance to a rock mass due to blasting or excavation. This factor also accounts for the strength loss due to the stress relief that occurs after removing the overburden from a rock.

All rock parameters used for input into *Slide* are summarized in Table 1. This table includes the fore-mentioned rock strength properties as well as the expected unit weight of the rock mass. Also included is the range of values used in the probabilistic analysis. These properties were conservatively estimated using guidance provided by RocScience (2002) assuming the rock slope is comprised primarily of weak siltstone or clayey shale with inter-beds of sandstone.

The stability of the rock cut was analyzed at its tallest cross section near the northwest corner of the pad as shown in Figure 1 as Section A-A'. As shown in the figure, this slope is proposed to consist of three 10-foot benches with 20-foot bench faces. This produces a slope height of 60 feet and an overall slope angle of approximately 0.8H:1V.

4.2 POND EMBANKMENT

The soil strength properties were input into *Slide* using the Mohr-Coulomb strength criterion. This strength model defines the soil strength based on the soil's cohesion and friction angle. All soil parameters used for input into *Slide* and their expected range are summarized in Table 2. This table includes the fore-mentioned soil strength properties as well as the expected unit weight and hydraulic conductivity of the soil mass. An estimate of the hydraulic conductivity is necessary to determine the location of the water surface within the embankment. When full, the water withheld in the pond will seep through the embankment and reduce its strength, which is accounted for within the *Slide* model. These properties were conservatively estimated based on soil type. The soil types expected are a clay loam and sandy loam as shown on the Natural Resources Conservation Service's web soil survey (2008). Of these, the clay loam has less desirable engineering properties for the embankment and was used to represent the worst-case scenario.

The stability of the embankment was analyzed at its tallest cross section on the southern end as shown in Figure 1 as Section B-B'. This analysis was performed for the outside slope (1.6H:1V) of the embankment and assumed the embankment was withholding water up to the level of its secondary spillway with steady-state seepage saturation conditions as required by R645-301-533.100.

4.3 RESULTS

4.3.1 Rock Slope

The expected minimum factor of safety for the proposed rock cut is 2.00 with a probability of failure of 0%[1] as defined within Chapter 2. The *Slide* output showing this critical failure surface and corresponding factor of safety can be seen in Figure 2. This factor of safety is significantly larger than the required value of 1.3, indicating that the slope will be stable under the anticipated conditions.

4.3.2 Pond Embankment

The expected minimum factor of safety for the proposed sediment pond embankment is 2.75 with a probability of failure of 0% as defined within Chapter 2. The *Slide* output showing this critical failure surface and corresponding factor of safety can be seen in Figure 2. This factor of safety is significantly larger than the required value of 1.3, indicating that the embankment will be stable under the anticipated operating conditions.

[1] This probability is calculated based on the Monte-Carlo simulation performed within the *Slide* program. It is calculated based on the number of simulations which resulted in a factor of safety of less than 1.0. A probability of failure of 0% indicates that none of the simulations resulted in a factor of safety of less than 1.0.

CHAPTER 5

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TABLES

TABLE 1

Rock Properties Used for Input into *Slide*

PARAMETER	EXPECTED VALUE	EXPECTED RANGE
Unit Weight (pcf)	120	110-130
UCS (psi)	7,500	4000-11,000
GSI	25	20-30
mi	9	6-12
D	0.8	0.7-0.9

Source: RocLab Version 1.0 (RocScience, 2002)

TABLE 2

Soil Properties Used for Input into *Slide*

PARAMETER	EXPECTED VALUE	EXPECTED RANGE
Unit Weight (pcf)[a]	115	110-120
Hydraulic Conductivity (cm/s)[b]	10^{-6}	e
Soil Friction Angle (°)[c]	25	22-28
Cohesion (psf)[d]	150	125-175

a - Typical unit weight for compacted sands and silts (Anderson et al, 1980).
b - Estimate of hydraulic conductivity based on soil type (Terzaghi et al., 1968).
c - Estimate of friction angle based on soil type (Terzaghi et al., 1968).
d - Estimate of fully softened strength of soil based on soil type. Taken as 60% of the peak drained strength (Duncan & Wright, 2005).
e - Not varied due to low sensitivity of parameter on factor of safety (Duncan & Wright, 2005).

FIGURES

G:\UC794\18\SLOPE STABILITY\FIGURE.DWG 12-10-09

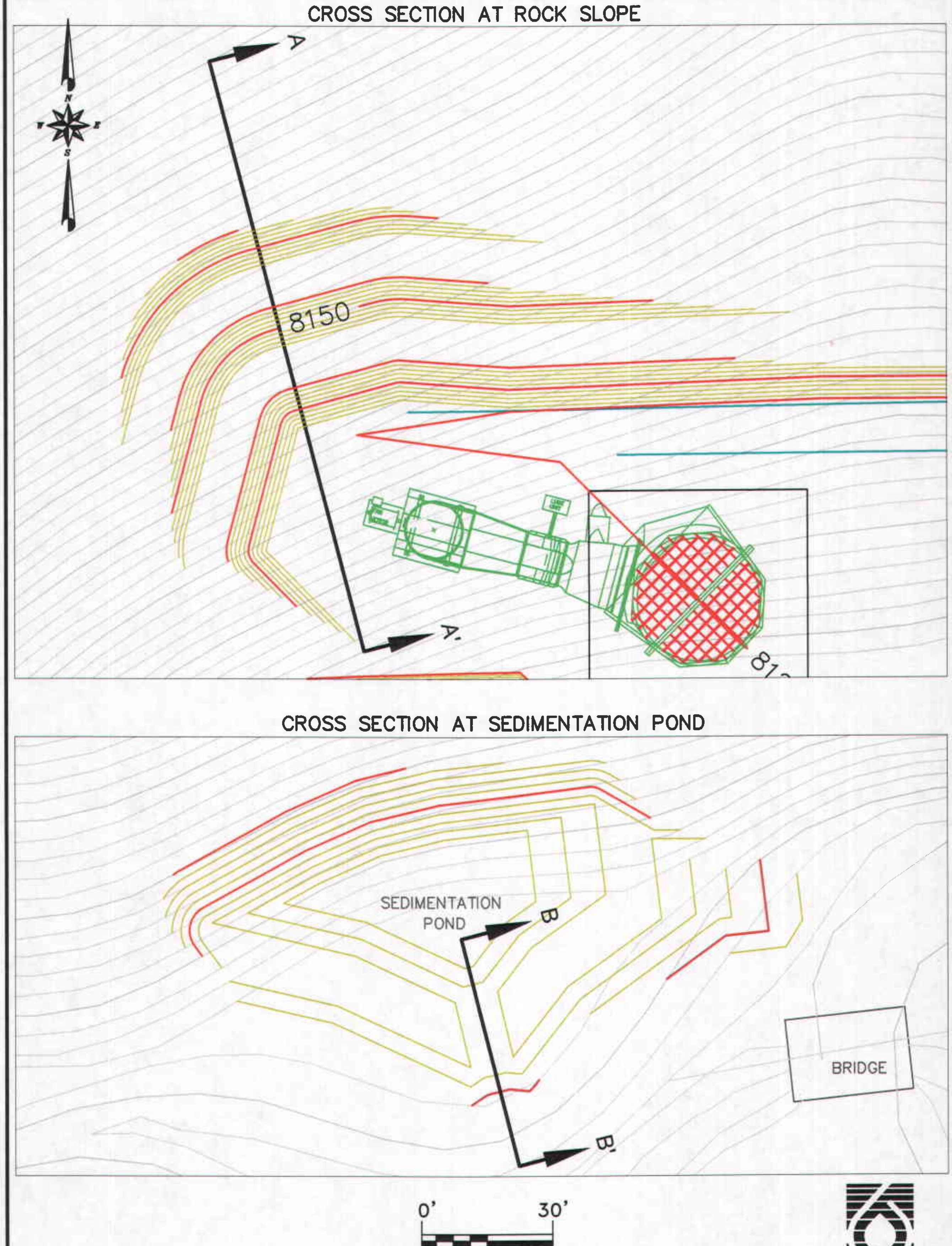

FIGURE 1. CROSS SECTIONS ANALYZED

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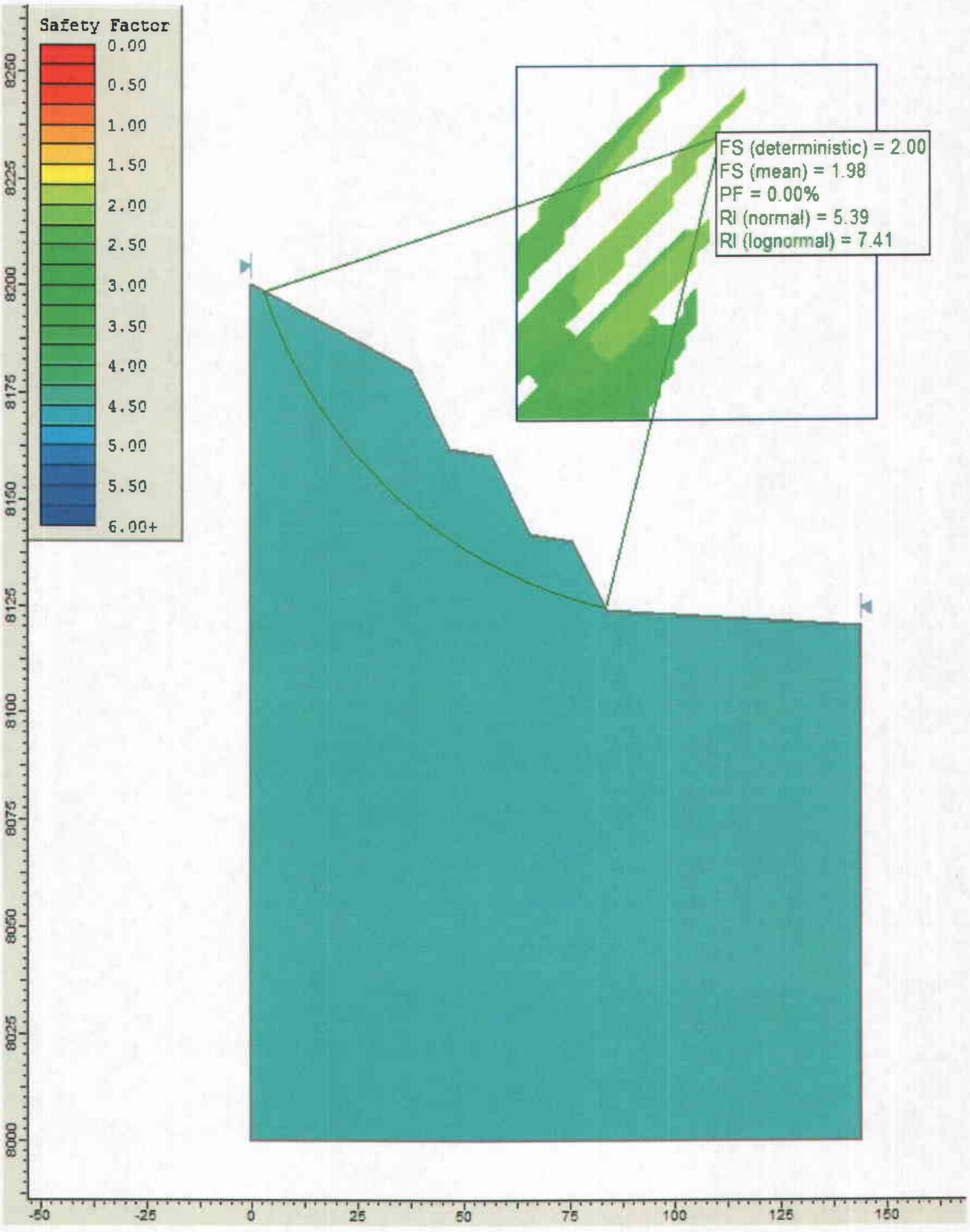

Figure 2: *Slide* Output Showing Critical Failure Surface for Rock Slope FS = 2.00

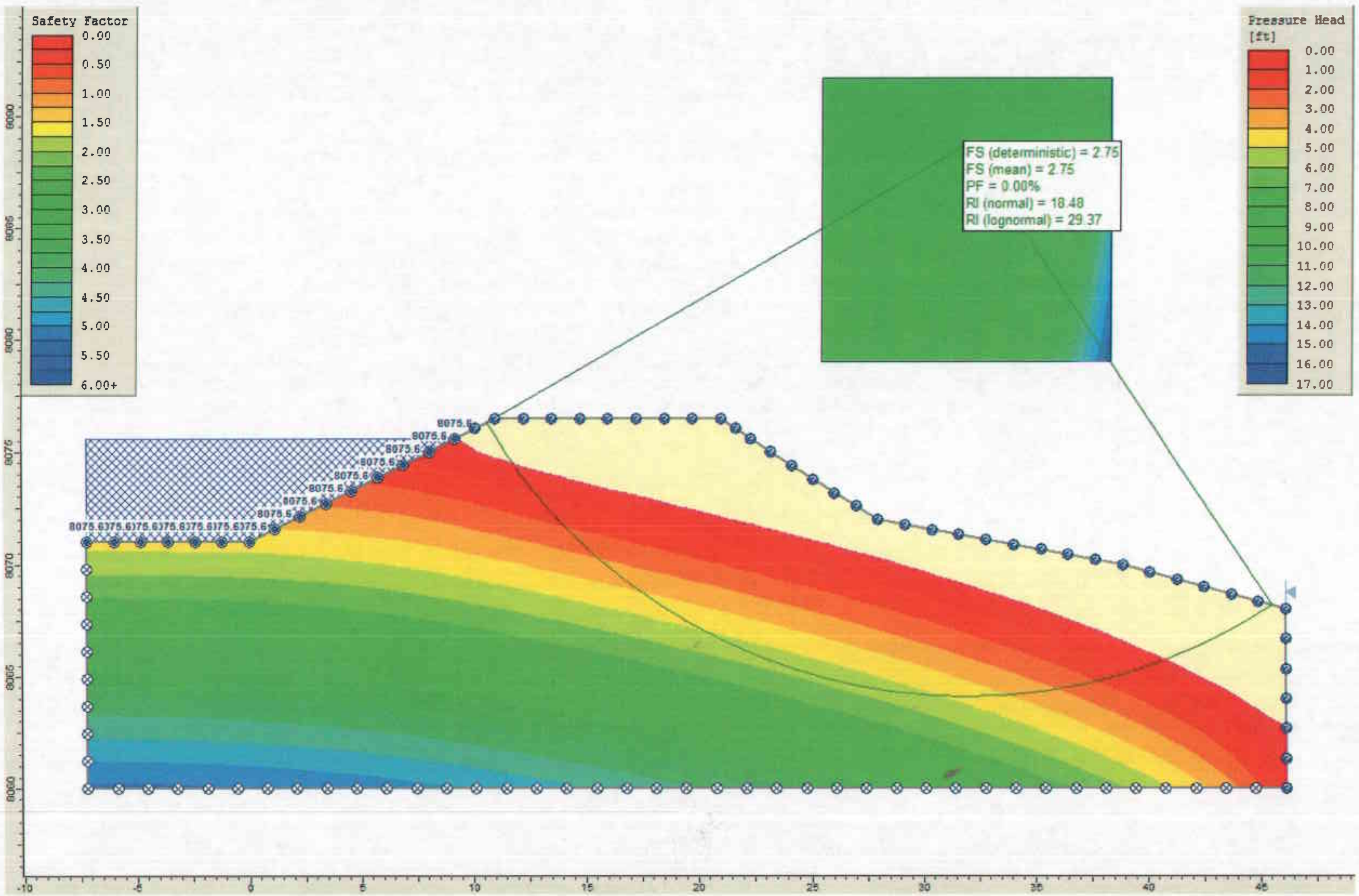

Figure 3: ***Slide*** **Output Showing Critical Failure Surface for Pond Embankment FS = 2.75**