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

WINTER QUARTERS VENTILATION FACILITY

OCTOBER 2009

1 of 2

For additional information
File in:
❑ Confidential
☒ Shelf
❑ Expandable
Refer to Record No 0058 Date 10222009
In C/0070005 2009 Incoming &
For additional information Confidential

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

COPY

Gregg Galecki, Environ. Engineer
HCR 35, Box 380
Helper, UT 84526
(435) 448-2636 - Office
(435) 448-2632 - Fax

October 22, 2009

Mr. James D. Smith
Division of Oil, Gas, and Mining
1594 West North Temple
Salt Lake City, Utah 84114-5801

RE: Winter Quarters Ventilation Facility (WQVF), Canyon Fuel Company, LLC, Skyline Mine, C/007/005,

Dear Jim:

Attached to this letter is pertinent information requesting approval to construct a ventilation facility in Winter Quarters Canyon. The information is being submitted with the hope the site will be permitted for initial construction during the 2010 field season. The facility is necessary for ventilation to continue mining north of Winter Quarters Canyon. No coal is proposed to be shipped from the WQVF site. The site's primary function is to provide ventilation to the mine to continue moving north of Winter Quarters Canyon. The WQVF proposes to add approximately 8.38 acres to the permit area. Due to the recent interpretation changes in the definition of the permit boundary, every plate illustrating permit areas was modified as part of this submittal.

Attached to this cover letter are completed C1 and C2 (two-pages) forms, five (5) copies of redline/strikeout text of the M&RP modified information, numerous plates and independent reports, and one (1) Compact Disc (CD) containing the complete submittal package. One copy of the submittal was delivered directly to the Price Field Office.

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

Sincerely:

Gregg A. Galecki

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

Enclosures

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☒ Shelf
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DIV. OF OIL, GAS & MINING

APPLICATION FOR COAL PERMIT PROCESSING

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

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
Sign Name, Position, Date General Manager 10/21/09

Subscribed and sworn to before me this 21st day of Oct 20 09

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
		RECEIVED OCT 22 2009 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.

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Section 1; pages 1-30, 1-34, 1-37, 1-38
☐ 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 2-51
☐ 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; pages 3-15, 3-23, 3-23(a), 331, 3-31(a), 3-31(b)
☐ 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, 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 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; pages 4-102, 4-103(b)

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

Five (5) redline-strikout copies of the submittal. Four copies to the Salt Lake Office, and one (1) copy to the Price Field Office.

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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.

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Section 4.19; page 4-110, ADD 4-110(a)
☒ Add	☐ Replace	☐ Remove	Section 4.20; 4-144(a)
☐ Add	☒ Replace	☐ Remove	Plates 1.6-1, 1.6-2, 1.6-3, 2.2.1-1, 2.2.7-1, 2.2.7-3, 2.2.7-4, 2.2.7-5, 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 3.2.4-3i, 4.2.2-3a through 4.4.2-3c
☒ Add	☐ Replace	☐ Remove	Appendix A-1, Vol.2; Clements Geophyisical report - Seismic Refraction
☒ Add	☐ Replace	☐ Remove	Appendix A-1, Vol.2; WQ Stream Photo documentation
☒ 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 - Mt. Nebo Scientific
☒ Add	☐ Replace	☐ Remove	Appendix A-3, Vol.2; Aquatic Wildlife Consultation - Dr. Shiozawa - BYU
☒ 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 and Mine Slope 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
☐ 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.

Five (5) redline-strikout copies of the submittal. Four copies to the Salt Lake Office and one (1) hand delivered to the Price Field Office.

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Winter Quarters Ventilation Facility
2009

INTRODUCTION

The following is intended to serve as a guidance document addressing the regulatory requirements of developing a ventilation facility in Winter Quarters Canyon, near Scofield, Utah. The submittal is intended to comprehensively provide all the necessary permitting information identified in the R645-301 regulations. Modifications have been made throughout the M&RP including Section 1 – Legal and Financial; Section 2 – Environmental Resources; Section 3 – Mining Operation Plan; and Section 4 – Reclamation Plan. In support of the M&RP modifications, numerous studies are included in the submittal which will be added to the appropriate appendices of the M&RP. The primary engineering study for the design of the Ventilation Facility pad area is located in Volume 5, Section 24 Engineering Calculations.

The Winter Quarters Ventilation Facility (WQVF) is necessary to provide adequate ventilation for mining in the North Lease north of Winter Quarters Canyon. The intended operational use of the WQVF is to provide adequate ventilation and emergency access to the mine. No other mining related activities are planned for the site. The existing road accessing the site will be upgraded primarily for construction of the site, however it will be sufficiently 'all-season' having the ability to be plowed during the winter for emergency access.

The WQVF is located within the Adjacent Area associated with mining and will be added to the disturbed portion of the Permit Area. The WQVF adds approximately 8.38 acres to the permit area with approximately 7.0 acres being disturbed and reporting to the sediment pond. Supporting studies in support of the project include studies on vegetation, wildlife, soils, sedimentation and runoff calculations, geophysics, and cultural resources.

The activities associated with the construction and reclamation of the WQVF will be designed, located, constructed, maintained, and reclaimed in accordance with the operation and reclamation plans. Attachments to this document include the following reports:
- EarthFax Engineering, Inc.: Winter Quarters Ventilation and Mine Slope Pad, Skyline Mine, Runoff and Sediment Control Design Report (Appendix 5, Vol. 2, Section 24)
- Canyon Environmental, LLC: Soil Survey for the proposed Winter Quarters vent location (Appendix A-2, Vol.2)
- Earth Touch: Cultural Resource Inventory....Winter Quarters (Confidential File)
- Tetra Tech: Winter Quarters Canoyn Wildlife Studies Summary for 2006 – 2008(Appendix A-3, Vol.2)
- Mt. Nebo Scientific: Dr. Shiozawa – Aquatic Wildlife Consultation (Appendix A-3, Vol.2)
- Mt. Nebo Scientific: Vegetation Sampling & Sensitive Species at the Ventilation Shaft Site in Winter Quarters Canyon: (Appendix A-2, Vol.2)
- Clement Drilling and Geophysical, Inc.: Seismic Refraction Testing (Appendix A-1, Vol.2)
- Natural Resource Conservation Service: Production Estimates (Appendix A-2, Vol.2)
- Western Lands Services, Inc.: Northern Goshawk, Flammulated Owl and other Wildlife Surveys (Appendix A-3, Vol.2)

GENERAL CONTENTS

IDENTIFICATION OF INTERESTS

Regulatory Reference: 30 CFR 773.22; 30 CFR 778.13; R645-301-112

-301-112; See General Chapter 1 volume of the currently approved M&RP. General Chapter 1 was last updated May 26, 2009, and is updated annually in the Annual Report process.

VIOLATION INFORMATION

Regulatory Reference: 30 CFR 773.15(b); 30 CFR 773.23; 30 CFR 778.14; R645-300-132; R645-301-113

-301-113; See General Chapter 1 of currently approved M&RP, last updated May 26, 2009 and updated annually during the Annual Report process.

RIGHT OF ENTRY

Regulatory Reference: 30 CFR 778.15; R645-301-114

-301-114; Agreements with all the pertinent landowners affected by the Winter Quarters Ventilation Facility are currently being negotiated.

LEGAL DESCRIPTION AND STATUS OF UNSUITABILITY CLAIMS

Regulatory Reference: 30 CFR 778.16; 30 CFR 779.12(a); 30 CFR 779.24(a)(b)(c); R645-300-121.120; R645-301-112.800; R645-300-141; R645-301-115.

-301-141; The addition of the Winter Quarters Ventilation Facility increases the disturbed area acreage by approximately 7 acres, and the permitted area by approximately 8.38 acres. All the area encompassing the Winter Quarters Ventilation Facility is on private land. Modifications are included on page 1-37, Plate 1.6-3, and Plates 3.2.4-3a through 3i.

PERMIT TERM

Regulatory References: 30 CFR 778.17; R645-301-116.

-301-116; The addition of the Winter Quarters Ventilation Facility does not affect the permit term information.

PUBLIC NOTICE AND COMMENT

Regulatory References: 30 CFR 778.21; 30 CFR 773.13; R645-300-120; R645-301-117.200.

-300-120; The permit modification does not require Public Notice because it is contained within private landownership and is not considered a Significant Permit Revision. The addition of the Winter Quarters Ventilation Facility does not constitute Significant Permit Revision because the surface disturbance is less than 15 percent of the currently approved permit, is contained within the current CHIA area, and is within a hydrologic basin currently within the permit.

-301-117; Certificates of Insurance are located in the General Chapter 1 Volume, App. 1-2. The insurance provider is Marsh USA, Inc. and the company affording coverage is Ace American Insurance Co. The Division of Oil Gas and Mining is listed as the Certificate holder. Policies are current through July 2010 and are on file at the Division.

PERMIT APPLICATION FORMAT AND CONTENTS

Regulatory Reference: 30 CFR 777.11; R645-301-120.

-310-120; The format and contents of the information provided is consistent with previously submitted information available in the currently approved M&RP.

REPORTING OF TECHNICAL DATA

Regulatory Reference: 30 CFR 777.13; R645-301-130.

-301-130; The reporting and collecting of technical data has been conducted or directed by qualified professionals. Submitted maps/plates are P.E. or P.G. certified where appropriate.

MAPS AND PLANS

Regulatory Reference: 30 CFR 777.14; R645-301-140.

-301-140; All submitted maps and plans are scaled at 1:24,000 or larger.

COMPLETENESS

Regulatory Reference: 30 CFR 777.15; R645-301-150.

-301-150; Skyline Mine, to the best of their knowledge, has submitted all the necessary information for approval of the Winter Quarters Ventilation Facility.

ENVIRONMENTAL RESOURCE INFORMATION

Regulatory Reference: Pub. L 95-87 Sections 507(b), 508(a), and 516(b); 30 CFR 783., et. al.

GENERAL

Regulatory Reference: 30 CFR 783.12; R645-301-411, -301-521, -301-721.

The Winter Quarters Ventilation Facility is necessary for continued mining in the North Lease of Skyline mine to provide necessary ventilation to the mine. The facility consists of a vertical shaft and a steep slope portal. The pad containing both structures and associated support facilities encompasses a permitted area of approximately 8.38 acres at an approximate elevation of 8,110 feet within the bottom of Winter Quarters Canyon. An access road of approximately 1000 feet in length was added to a pre-existing road to access the site. The sole intended use of the site is to provide ventilation and emergency access to the Mine. No shipping or other production related activities are intended for the facility.

PERMIT AREA

Regulatory Requirements: 30 CFR 783.12; R645-301-521.

-301-521; The designated permit area(s) has been modified with the current application. Plate 1.6-3 illustrates both the permit and adjacent areas.

HISTORIC AND ARCHEOLOGICAL RESOURCE INFORMATION

Regulatory Reference: 30 CFR 783.12; R645-301-411.

-301-411; A archeological survey of the proposed WQVF permit area has been conducted by Earth Touch Inc., an archeological consulting company. Their report is included as an appendix to the current application and will likely be included in the "Confidential" File of the M&RP. The initial report identifies some sites with the potential for historical significance. A research design report is being prepared for SHPO to review after they have assessed the initial report.

CLIMATOLOGICAL RESOURCE INFORMATION

Regulatory Reference: 30 CFR 783.18; R645-301-724.

-301-724; Climatological information for the mine site is outlined in Section 2.6 of the approved

MR&P. The Winter Quarters Portal Facility is within the North Lease area. The climate for the Winter Quarters Portal Facility is the same as the existing permit area. No new addition has been provided.

VEGETATION RESOURCE INFORMATION

Regulatory Reference: 30 CFR 783.19; R645-301-320.

-301-320; The MRP includes a summary of vegetation common to the permit area (Vol. 1A, Sec. 2.7, 2.7.1, 2.7.6). The MRP also includes survey reports submitted for different projects (Vol. A-2 North Lease 2nd Volume; Vol. A-2 2nd Volume). Plate 2.7.1-1a was modified in 2007 to reflect areas where the vegetation was field checked for accuracy. In 2007, the vegetation in Section 1, T13S, R6E was field verified. The Winter Quarters Ventilation Facility is located in the center of Section 1. In addition, an additional detailed vegetation survey was conducted in 2008 specifically in the area proposed for the Winter Quarters Ventilation Facility. The 2008 vegetation survey conducted by Mt. Nebo Scientific is included in the current submittal – to be added to Appendix A-2, Volume 2.

FISH AND WILDLIFE RESOURCE INFORMATION

Regulatory Reference: 30 CFR 784.21; R645-301-322.

GENERAL WILDLIFE

-301-322; In the currently approved M&RP, Section 2.8 addresses Aquatic Wildlife, Section 2.9 addresses Terrestrial Wildlife, and Section 2.10 addresses raptors, respectively. Vol. A-2; Vol. A-3; Confidential Binder Vol. A-4 2nd Volume; Vol. A-2 North Lease 2nd Volume; Vol. A-3, Volume 2. Vol. 1A (Secs. 2.8 through 2.10) provide summaries of fish and wildlife that may occur within or adjacent to the permit area. Volume 3 (Sec. 4.18) provides a fish and wildlife plan. There is sufficient information to design or implement protection and enhancement plans.

Ungulates

Macroinvertebrates, Fish, and other Aquatics

Dennis Shiozawa, PhD. Aquatic habitats BYU was consulted concerning the affects of the WQVF in Winter Quarters Creek with respect to both macroivertebrates and fish. Macroinvertebrates have been monitored upstream of the site since 2002. Dr. Shiozawa did not feel macroinvertebrates were necessary to monitor because the area of the WQVF is not in critical habitat for macroinvetebrates – that portion of the area is too sandy with little gravel necessary for macroinvertebrates. The area is not considered as sports fishery due to the small nature of the creek and limited access from private land. Dr. Shiozawa mentioned concern with the length of the stream culvert and the ability of migrating fish to move upstream of the site. Based on his recommendation, fish baffles are to be installed in the culvert to provide 'resting areas' for migrating fish. Email correspondence with Dr. Shiozawa is included in Appendix A-3, Volume 2.

Migratory and Game Birds, and Raptors

No concerns with respect to raptors or wildlife have been identified in the WQVF area. A summary report compiling surveys from 2006 through 2008 and conducted by Tetra Tech, of Murray, Utah is located in Appendix A-3, Volume 2. An additional wildlife survey conducted in 2009 by Western Land Services is also included in Appendix A-3, Volume 2.

THREATENED, ENDANGERED, AND SENSITIVE ANIMAL/PLANT SPECIES

SOILS RESOURCE INFORMATION

Regulatory Reference: 30 CFR 783.21; 30 CFR 817.22; 30 CFR 817.200(c); 30 CFR 823; R645-301-220; R645-301-411.

-301-220, -411; A soil survey conducted by Canyon Environmental, LLC is included in Appendix A-2, Volume2. The area of the survey focuses on the area(s) to be disturbed by the WQVF. Based on the survey, approximately 30-45 centimeters of topsoil was identified in the area. During construction, it is hopeful that 1.5 to 2.0 feet of material will be located and stored for topsoil placement at the time of reclamation.

301-211, -212, 222; A soil survey conducted by Canyon Environmental, LLC is included in Appendix A-2, Volume 2. The WQVF and the surrounding area were evaluated using the United States Department of Agriculture (USDA), Natural Resources Conservation Services' (NRCS) WEB Soil Survey utility. Based on the test pits and soil samples collected from the A and B horizons in the pits, approximately 1.5 to 2 feet of material will be salvaged and segregated from other material.

301-221; Dean Stacy of the NRCS conducted a land productivity report for the area that is included in Appendix Volume A-2, Volume 2.

Section 4.6.4.1 of the M&RP provides a narrative of the topsoil / subsoil removal and placement plan common to all the disturbed areas of the permit. Suitable soil and subsoil, where encountered will be salvaged, and stockpiled within the disposal site. Table 4.6-4 Topsoil Redistribution has been modified to include the Winter Quarters Ventilation Facility.

LAND-USE RESOURCE INFORMATION

Regulatory Reference: 30 CFR 783.22; R645-301-411.

-301-411; Land Use is discussed in Section 2.12 of the M&RP. The existing land use for the North Lease area is wildlife habitat, grazing, recreation, forestry and mining. Previously mined areas are shown on Drawing 2.2.7-7. Land Use for the area is shown on Drawing No. 2.12.1-1.

The area has historically been used for mining, livestock grazing, and wildlife.

ALLUVIAL VALLEY FLOORS

Regulatory Reference: 30 CFR 785.19; 30 CFR 822; R645-302-320.

-302-320; As previously identified in the M&RP, the only alluvial valley deposits in Winter Quarters Canyon exist in the mouth of the canyon, the nearest located approximately one-mile east of the Winter Quarters Ventilation Facility. Supporting field investigations illustrating the absence of an Alluvial Valley Floor- by definition - include land use, both soils and vegetation surveys, and geophysical mapping through the proposed site. Portions of the site area are riparian in nature, and have been documented for reclamation success standard purposes. No impact to delivery of water downstream is anticipated. No subsidence is planned. All water upstream of the site will be transported past the site through a culvert.

No agricultural activities such as crops, flood irrigate lands, or pasture lands are affected by the proposed WQVF pad.

PRIME FARMLAND

Regulatory Reference: 30 CFR 785.16, 823; R645-301-221, -302-270.

A soil survey was conducted by Canyon Environmental, LLC. The site is located in a narrow mountainous valley at an approximately 8,100 foot elevation and has never been used as cropland. The south-facing exposure is a steep 1 ½:1 slope dominated by sagebrush and grass with scattered Mountain brush as identified on Plate 2.7.1-1A in the M&RP. The north-facing slope is moderately steep, has been previously logged and is dominated by conifers and smaller areas of sagebrush and grasses. A total of approximately 1.5 acres of riparian stream bottom is disturbed with the proposed ventilation facility, which will be restored at reclamation. Soil pits in the valley bottom identified the A horizon ranging only from 0.3 to 1.0 ft in depth, with limited root depth. Mr. Kenneth Gregg (MLRA Soil survey Leader) of the NRCS researched and confirmed that the area surrounding the WQVF does not have a prime farmland designation.

GEOLOGIC RESOURCE INFORMATION

Regulatory Reference: 30 CFR 784.22; R645-301-623, -301-724.

Geologic information at the Winter Quarters Ventilation Facility include three (3) holes drilled to the coal seam with one being developed as a monitoring well (08-1-5), eight (8) piezometers or shallow alluvial wells, and three (3) seismic lines or cross sections of the site. The seismic information is located in Appendix A-1, Volume 2. The well log for well 08-1-5 is included in the application to be located in the Confidential File.

HYDROLOGIC RESOURCE INFORMATION

Regulatory Reference: 30 CFR Sec. 701.5, 784.14; R645-100-200, -301-724.

Baseline hydrologic information includes multiple years of stream flow monitoring in Winter Quarters Creek – the upstream site located approximately ½-mile upstream of the WQVF. An additional water monitoring site, CS-24 has been added immediately below the site. Water monitoring well WQ 08-1-5 has been completed below the coal seam. In 2008, piezometers WQC-1 through WQC-8 were completed in the shallow aquifer. Some of the piezometers will likely be destroyed in the construction of the WQVF pad. The shallow wells or piezometers have indicated Winter Quarters Creek in the vicinity of the ventilation facility is a gaining stream.

MAPS, PLANS, AND CROSS SECTIONS OF RESOURCE INFORMATION

Regulatory Reference: 30 CFR 783.24, 783.25; R645-301-323, -301-411, -301-521, -301-622, -301-722, -301-731.

Maps, Plans, and Cross Sections specifically related to the Winter Quarters Ventilation Facility are illustrated in Plates 3.2.4-3a through 3.2.4-3i of the M&RP. A complete engineering report for the WQVF pad designed by EarthFax Engineering is located in M&RP Volume 5, Section 24. Resource maps pertaining to the permit area in general are located in the M&RP.

OPERATION PLAN

TOPSOIL AND SUBSOIL

Regulatory Reference: 30 CFR Sec. 817.22; R645-301-230.

-231; Suitable topsoil will be separated, stored, and marked with appropriate signage for protection, to be used during reclamation of the site. The Topsoil pile location is illustrated on Plate 3.2.4-3a.

-232; Based on the Canyon Environmental soil survey (Appendix A-2, Volume 2), approximately 30-45 centimeters of topsoil were identified in the area. Ideally during topsoil removal, upwards of 2-feet will be salvaged from the proposed WQVF area (see Table 4.6-4 in Section 4.6). A more accurate depth will be determined during stripping and excavation of the topsoil. These volumes will be identified in the field as the abundant root material disappears and the amount of rock and clay in the material increases.

232.400 Minor Disturbances Not Requiring Topsoil Removal

Small Structures. Topsoil will not be removed prior to construction that would result in only minor disturbances. Such construction activity includes work on small structures such as power poles, signs, fence lines, and other small structures.

Vegetation. The operator will not remove topsoil for minor disturbances where such activity will not destroy vegetation or cause erosion.

-233; The site as a whole is at a deficit concerning adequate topsoil for reclamation. Any suitable topsoil should be considered. See the Canyon Environmental survey located in Appendix A-2 Volume 2 for topsoil descriptions.

-234; Salvaged material will be stockpiled in a designated topsoil pile area located on Map 3.2.4-3a. The placement will be stable, protected from wind and water erosion through prompt establishment of vegetative cover. Sediment control measures such as silt fencing or straw bales will be implemented temporarily at the base of slope until vegetation is established.

- 240; See Section 4.6 of the currently approved M&RP for the Topsoil / Subsoil handling plan at reclamation.

MINING OPERATIONS AND FACILITIES

Regulatory Reference: 30 CFR 784.2, 784.11; R645-301-231, -301-526, -301-528.

The WQVF is being built to primarily provide ventilation to the mine. No coal is intended to be hauled out of the site. Once the facility is complete, very little surface activity will occur at the site. Plate 3.2.4-3a illustrates the proposed structures and facilities associated with the Winter Quarters Ventilation Facility. Included are vertical shaft with associated exhaust fan structure, a steep sloped portal providing intake air, an approximate 80 ft by 100 ft Electrical Substation, an approximate 12 ft by 30 ft Refuge Building used to house mine personnel in an evacuation emergency, and a sedimentation pond.

EXISTING STRUCTURES

Regulatory Reference: 30 CFR 784.12; R645-301-526.

No existing structures exist on the WQVF pad area.

PROTECTION OF PUBLIC PARKS AND HISTORIC PLACES

Regulatory Reference: 30 CFR784.17; R645-301-411.

An archeological survey of the Winter Quarters Ventilation Facility was conducted by Earth Touch, Inc. The facility is located on the western edge of the historic Winter Quarters mining district. The preliminary survey identified five (5) potential sites that have been reported to the State Historic Preservation Office (SHPO) for review. A research design report has been drafted and will be submitted to SHPO as a follow up document to the initial survey once it has been reviewed. The Earth Touch archeologist does not anticipate the sites identified will have historical significance potentially delaying the project. The report is included in Confidential File of the M&RP.

RELOCATION OR USE OF PUBLIC ROADS

Regulatory Reference: 30 CFR 784.18; R645-301-521, -301-526.

The road leading from the town of Scofield, Utah, up Winter Quarters Canyon approximately 2.5 miles is a private road. Although the road functions primarily as private access for the landowners up Winter Quarters Canyon, the county has committed to maintain road access and improvements to the Allred Family property. A new access road will need to be constructed by Skyline Mine for the final 1000 feet of road. This approximate 1000 feet of road will be included in the Skyline Mine permit area.

COAL RECOVERY

Regulatory Reference: 30 CFR 817.59; R645-301-522.

The ventilation facility is necessary for continued mining in the North Lease north of Winter Quarters Canyon. Without the ventilation facility, maximum recovery of the coal resource would not be possible.

SUBSIDENCE CONTROL PLAN

Regulatory Reference: 30 CFR 784.20, 817.121, 817.122; R645-301-521, -301-525, -301-724.

The Subsidence Control Plan was not modified with the addition of the Winter Quarters Ventilation Facility. No subsidence is anticipated with the addition of the facility.

FISH AND WILDLIFE INFORMATION

Regulatory Reference: 30 CFR Sec. 784.21, 817.97; R645-301-322, -301-333, -301-342, -301-358.

As listed in the Environmental Resource section, fish and wildlife will have minimal impacts due to the site. Fish baffles have been incorporated into the culvert design to accommodate resting areas for migrating fish.

VEGETATION

Regulatory Reference: R645-301-330, -301-331, -301-332.

A comprehensive vegetation survey was conducted by Mt. Nebo Scientific which categorized both the areas to be disturbed by the WQVF and also identified standards for reclamation. The survey is included in Appendix A-2, Volume 2.

SPOIL AND WASTE MATERIALS

Regulatory Reference: 30 CFR Sec. 701.5, 784.19, 784.25, 817.71, 817.72, 817.73, 817.74, 817.81, 817.83, 817.84, 817.87,817.89; R645-100-200, -301-210, -301-211, -301-212, -301-412, -301-512, -301-513, -301-514, -301-521, -301-526, -301-528, -301-535, -301-536, -301-542, -301-553, -301-745, -301-746, -301-747

Materials coming from both the shaft and slope that are stored on the surface will be used in construction of the pad necessary to accommodate the ventilation facility. At reclamation spoils and waste material will be placed back in both the shaft and slope. Engineered designs are illustrated on Plates 2.3.4-3a through2.3.4-3i, with the comprehensive engineering report located in Volume 5, Section 24 of the M&RP.

HYDROLOGIC INFORMATION

Regulatory Reference: 30 CFR Sec. 773.17, 774.13, 784.14, 784.16, 784.29, 817.41, 817.42, 817.43, 817.45, 817.49, 817.56,817.57; R645-300-140, -300-141, -300-142, -300-143, -300-144, -300-145, -300-146, -300-147, -300-147, -300-148, -301-512, -301-514, -301-521, -301-531, -301-532, -301-533, -301-536, -301-542, -301-720, -301-731, -301-732, -301-733, -301-742, -301-743, -301-750, -301-761, -301-764.

Hydrologic monitoring information includes stream monitoring both upstream (CS-20) and downstream (CS-24) of the site. Water monitoring well WQ 08-1-5 has been completed below the coal seam. Piezometers WQC-1 through WQC-8 are completed in the shallow aquifer through the pad area. All the piezometers will likely be destroyed in the construction of the WQVF pad, with the exception of WQC-2 through WQC-4. The piezometers have indicated Winter Quarters Creek in the vicinity of the ventilation facility is a gaining stream.

Stream bypass culverts, both disturbed and undisturbed ditches, runoff, and sediment control for the WQVF pad site are illustrated in Plate 3.2.4-3a through 3.2.4-3i of the M&RP. A comprehensive engineering report that provides design calculations compiled by EarthFax Engineering is located in M&RP Volume 5, Section 24. A sedimentation pond will be installed for primary runoff and sediment control at the site.

-731.100. Hydrologic-Balance Protection

-731.111; Groundwater quality will be protected by handling earth materials and runoff in a manner that minimizes acidic, toxic, and other harmful infiltration into the groundwater systems. Section 4.4.5 of the currently approved M&RP commits to sampling and analyzing the waste rock every 2000- tons. Section 4.6.4.1 commits to having a minimum of 48-inches of total non-toxic or acid forming materials over any unsatisfactory material.

-731.121; Surface-water quality will be protected by handling of earth materials , ground-water discharges and runoff in a manner that minimizes the formation of acidic or toxic drainage; prevents, to the extent possible using the best technology currently available, additional contributions of suspended solids to streamflow outside the permit area. The Runoff and Sediment Control Design report – October 2009, demonstrates that the proposed pond has adequate capacity to control and treat runoff. Acidic and toxic drainage is handled by sample analysis and burying any acidic and/or toxic materials below 4-ft of cover.

-731.200; The Water monitoring program has been modified to include stream site CS-24 located immediately downstream of the WQVF pad, and well 08-1-5 is completed and screened to approximately 7-feet below the coal seam with a screen length of 20-feet.

-731.300; Handling of Acid- and Toxic-forming materials are already addressed in Section 4.4.5 and 4.6.4.1 of the currently approved M&RP with sampling and analyzing waste rock to ensure acid- or toxic- materials are buried under 4-ft of cover.

-731.500; Discharges from the site will be covered under a future UPDES permit. The Runoff and Sediment Control Design report – October 2009, demonstrates the pond is adequately sized.

-731.600; A stream alteration permit will be acquired prior to any work taking place in the stream. Studies of the fish and macroinvertebrates have been addressed with Dr. Shiozawa – Aquatic Biologist, BYU, who indicated minimal work needed to be conducted due to the minimal habitat. See correspondence in Appendix Volume A-3, Volume 2.

-732. Sediment Control Structures

-732.100; Siltation structures are constructed and maintained to comply with the regulations. Details are outlined in Plates 3.2.4-3a through 3.2.4-3i and the Runoff and Sediment Control Design report – October 2009 in Volume 5, Section 24 of the M&RP.

-732.200. Sediment Ponds
The Runoff and Sediment Control Design report – October 2009, provides a demonstration that the proposed pond is adequately sized to control sediment and runoff from the proposed WQVF.

-733. Impoundments

-733.110; See The Runoff and Sediment Control Design report – October 2009 located in Volume 5, Section 24 of the currently approved M&RP for calculations demonstrating the proposed pond is adequately sized for the proposed WQVF.

-733.222; Water quality of the water retained in the pond will be adequate for livestock and wildlife. Water that is discharged will meet effluent limitations based on the retention time built into the design.

-742. Sediment Control Measures

- 742.111; Additional contributions of sediment to stream flow or to runoff outside the permit area is prevented, to the extent possible, through the use of silt fences, straw bales, and properly designed ditches and a sedimentation pond.

-742.112; Effluent limitations will be regulated through a UPDES discharge permit. The anticipated discharge point of the sedimentation pond is 004.

-742.123; Runoff flow reporting through ditches and reporting out of culverts were evaluated for erosive velocities in The Runoff and Sediment Control Design report – August 2009 (Volume 5, Section 24). Disturbed ditch DD-1 and undisturbed ditches UD-1 and UD-2 were determined to be non-erosive. The emergency spillway and culvert outlets for WQC-2 and WQC-3 have been determined to be erosive. Riprap designs are illustrated on Plate 3.2.4-3g. Plate 3.2.4-3f illustrates roughness ring and fish baffle designs incorporated into the plan to reduce velocities. Plate 3.2.4-3f also illustrates designs for a 'trash rack' at the inlet of WQC-2.

-742.220 Sedimentation Ponds.

-742.221.31; The pond is designed to accommodate 6.5 years of sediment storage. See the Runoff and Sediment Control Design report – October 2009 (Volume 5, Section 24 of M&RP).

-742.221.32; The pond is designed with adequate detention time. See the Runoff and Sediment Control Design report – October 2009 (Volume 5, Section 24 of M&RP).

-742.221.33; The pond is designed to contain or treat the 10-year, 24-hour precipitation event. See the Runoff and Sediment Control Design report – October 2009 (Volume 5, Section 24 of M&RP).

-742.221.34; The non-clogging dewatering device is adequately sized. See the Runoff and Sediment Control Design report – October 2009 (Volume 5, Section 24 of M&RP).

-742.221.35; Short-circuiting will be minimized based on the designed freeboard above the designed precipitation event. See the Runoff and Sediment Control Design report – October 2009 (Volume 5, Section 24 of M&RP).

-742.221.36; Sediment will be removed from the pond to maintain adequate volume by having sediment markers located at 100 percent sediment levels. The 100 percent level is the exiting discharge pipe.

-742.221.37; Excessive settlement will be avoided with quarterly inspections.

-742.223; The pond is designed to safely discharge a 25-year, 6-hour precipitation event as demonstrated in the Runoff and Sediment Control Design report – October 2009 (Volume 5, Section 24 of M&RP).

-742.223.2; The pond is earth-lined and designed to carry short-term infrequent flows at non-erosive velocities where sustained flows are not expected.

-743.100; The pond is below the size criteria of the Class B or C criteria for dams.

-743.120; The Sedimentation pond is designed, prepared, and certified as described under R645-301-512. The pond has adequate freeboard to resist overtopping by sudden increases in storage volume. See the Runoff and Sediment Control Design report – October 2009 (Volume 5, Section 24 of M&RP).

-743.130; The Sedimentation pond is designed to include a combination of both principal and emergency spillways. See the Runoff and Sediment Control Design report – October 2009 (Volume 5, Section 24 of M&RP).

-743.140; The Sedimentation pond will be inspected on a quarterly basis by a qualified person and at a minimum, annually by a registered Professional Engineer.

-744. Discharge Structures.

-744.100; The peak outflow for the primary spillway for the 25-year, 6-hour precipitation event has been calculated to be 0.06 cfs; the discharge rate for the 100-year, 24-hour precipitation event is calculated at 2.56 cfs. Flow will discharge into the native existing stream

channel. The exiting water velocity from culvert WQC-2 is treated with a combination of roughness rings, fish baffles, and riprap (D_{50} 6-inch, 12-inches thick). The exiting velocity from WQC-3 is treated with riprap (D_{50} 15-inch, 2.5 feet thick). See the Runoff and Sediment Control Design report – August 2009 (Volume 5, Section 24 of M&RP).

760. Reclamation

-763.100; The sedimentation pond will be removed during reclamation once the site is adequately roughened, seeded, and top-dressed. The site will be closely monitored for any signs of concentrated, untreated runoff from the site until re-vegetation is adequately established.

MAPS, PLANS, AND CROSS SECTIONS OF MINING OPERATIONS

Regulatory Reference: 30 CFR Sec. 784.23; R645-301-512, -301-521, -301-542, -301-632, -301-731, -302-323.

Maps, Plans, and Cross Sections for the WQVF are Plates 2.3.4-3a through2.3.4-3i. The engineering report is located in Volume 5, Section 24 of the M&RP.

RECLAMATION PLAN

GENERAL REQUIREMENTS

Regulatory Reference: PL 95-87 Sec. 515 and 516; 30 CFR Sec. 784.13, 784.14, 784.15, 784.16, 784.17, 784.18, 784.19, 784.20,784.21, 784.22, 784.23, 784.24, 784.25, 784.26; R645-301-231, -301-233, -301-322, -301-323, -301-331, -301-333, -301-341, -301-342, -301-411, -301-412, -301-422, -301-512, -301-513, -301-521, -301-522, -301-525, -301-526, -301-527, -301-528, -301-529, -301-531, -301-533, -301-534, -301-536, -301-537, -301-542, -301-623, -301-624, -301-625, -301-626, -301-631, -301-632, -301-731, -301-723, -301-724, -301-725, -301-726, -301-728, -301-729, -301-731, -301-732, -301-733, -301-746, -301-764, -301-830.

TOPSOIL AND SUBSOIL

Regulatory Reference: 30 CFR Sec. 817.22; R645-301-240.

The soil survey did not identify significant volumes of topsoil, so any additional suitable material identified during construction will be salvaged for reclamation. See Appendix A-2, Volume 2 for the soil survey. See Section 4.6 of the M&RP for the Topsoil and subsoil handling plan.

BACKFILLING AND GRADING

Regulatory Reference: 30 CFR Sec. 785.15, 817.102, 817.107; R645-301-234, -301-537, -301-552, -301-553, -302-230, -302-231, -302-232, -302-233.

Plates 4.4.2-3a and 4.4.2-3b Illustrate the backfilling and grading plan. When backfilling and grading are near AOC, the site will be gouged or deep-roughened for erosion control. See Section 4.4 of the M&RP for the backfill, soil stabilization, compaction, contouring and grading plan.

HYDROLOGIC INFORMATION

Regulatory Reference: 30 CFR Sec. 784.14, 784.29, 817.41, 817.42, 817.43, 817.45, 817.49, 817.56, 817.57; R645-301-512, -301-513, -301-514, -301-515, -301-532, -301-533, -301-542, -301-723, -301-724, -301-725, -301-726, -301-728, -301-729, -301-731, -301-733, -301-742, -301-743, -301-750, -301-751, -301-760, -301-761.

Section 4.11.7 through 4.11.9 provides a discussion on the protection of the hydrologic balance, specifically with reference to the portal locations, and underground water. The WQVF will have the lowest portal elevation at approximately 8120 feet. Due to the elevation change, a gravity discharge from the mine at reclamation is possible. It is anticipated the untreated water quality will comply with performance standards of R645-301, R645-302, and any additional UPDES permit requirements.

Section 4.19 provides a discussion on the impacts of the stream diversion and the reclamation of the stream. In summary, with the input of Dr. Shiozawa, little or no impacts to the stream with regard to placing a culvert in the stream, then eventually reclaiming the channel are anticipated.

MAPS, PLANS, AND CROSS SECTIONS OF RECLAMATION OPERATIONS

Regulatory Reference: 30 CFR Sec. 784.23; R645-301-323, -301-512, -301-521, -301-542, -301-632, -301-731.

Plates 4.4.2-3a and 4.4.2-3b Illustrate the final reclamation contours and cross sections for the WQVF pad site.

POSTMINING LAND USES

Regulatory Reference: 30 CFR Sec. 784.15, 784.200, 785.16, 817.133; R645-301-412, -301-413, -301-414, -302-270, -302-271, -302-272, -302-273, -302-274, -302-275.

No modifications to the post-mining land uses are currently proposed.

PROTECTION OF FISH, WILDLIFE, AND RELATED ENVIRONMENTAL VALUES

Regulatory Reference: 30 CFR Sec. 817.97; R645-301-333, -301-342, -301-358.

CONTEMPORANEOUS RECLAMATION

Regulatory Reference: 30 CFR Sec. 785.18, 817.100; R645-301-352, -301-553, -302-280, -302-281, -302-282, -302-283, -302-284.

No contemporaneous reclamation of the site is anticipated for the WQVF. It will all be reclaimed at one time.

REVEGETATION

Regulatory Reference: 30 CFR Sec. 785.18, 817.111, 817.113, 817.114, 817.116; R645-301-244, -301-353, -301-354, -301-355, -301-356, -302-280, -302-281, -302-282, -302-283, -302-284.

Section 4.7.9 of the M&RP and specifically Tables 4.7-8A through 4.7-8C identify the recommended seed mixes for the WQVF. Details are outlined in the Mt. Nebo Vegetation report located in Appendix A-2, Volume 2.

BONDING AND INSURANCE REQUIREMENTS

Regulatory Reference: 30 CFR Sec. 800; R645-301-800, et seq.

-830.140; the bond has been modified to include an adjustment based on the modification of constructing the WQVF. See Chapter 4 of M&RP – information included in current application. An Excel spreadsheets specifically addressing the reclamation of the Winter Quarters Ventilation Facility has been added to the bond located in Section 4.3 of the M&RP. The Demolition and Removal of structures totaled $16,600; Backfilling and Grading totaled $68,028; and Revegetation costs totaled $12,334. The WQVF increased the reclamation bond by

approximately $97,000. The current bond of $5.137 million adequately covers the addition of the reclamation costs of the WQVF pad site.

Sec. 1

114 Right-of-Entry Information

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

Federal Lease	Issued to	Date of Issuance
Utah - 020305	Emmett K. Olson	03/01/62
Utah - 044076	Armeda N. McKinnon	09/01/65
Utah - 0142235	Malcolm N. McKinnon	10/01/64
Utah - 0147570	Malcolm N. McKinnon	05/01/65
Utah - 073120	Independent Coal and Coke Company	02/01/64
Utah - 67939	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 SI/2SEI/4 of Section 17, T.13S., R.7E., SLB&M.

(5) (Future Allred Family Trust Agreement) grants the Permitee the right to use a (to be determined)acre parcel located in Winter Quarters Canyon approximately two (2) miles west of Scofield, Utah, as the Winter Quarters Ventilation Facility (WQVF).The lease also grants access to the WQVF by use of an existing road extending up the canyon from Scofield, Utah. Details of the lease is included in Appendix 118 (located at the end of Section 1 of M&RP).

(6) (Future Liodakis Ranch LLC Agreement) A Lease Agreement dated (to be deterimined), between the Liodakis Ranch, LLC and the Permittee grants the Permittee the right to use (to be determined)**** acre parcel located in Winter Quarters Canyon. The parcel encompasses the approximate south portion of the WQVF. (See Appendix 118)

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

distance of 313.62 feet; thence S78° 31' 42" E a distance of 394.22 feet; thence S67° 59' 19" a distance of 162.86 feet; thence S67° 11' 48" E a distance of 184.95 feet; thence s66° 35' 22" E a distance of 7.51 feet; thence S68° 17' 21" E a distance of 16.44 feet; thence N14° 02' 53" E a distance of 13.25 feet; thence N 17° 36' 35" W a distance of 64.21 feet; thence n19° 35' 52" W a distance of 101.75 feet; thence N04° 54' 23" W a distance 110.10 feet; N15° 34' 28" E a distance of 118.18 feet; thence N43° 46' 10" E a distance of 1,079.17 feet; thence N51° 35' 31" E a distance of 860.51 feet; thence N21° 49' 54" W a distance of 0.62 feet; S51° 35' 33" W a distance of 860.56 feet; thence S43° 45' 55" W a distance of 1,079.56 feet; thence S15° 34' 30" W a distance of 118.17 feet; S04° 54' 20" E a distance of 110.32 feet; thence s19° 32' 19" E a distance of 102.69 feet; thence S17° 39' 42" E a distance of 63.38 feet; thence S15° 04' 51" W 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	8.38
TOTAL	~~80.70~~119.34

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.

Sec. 2.1

Winter Quarters Ventilation Facility (WQVF)

In 2009 permitting for construction of a ventilation facility in Winter Quarters Canyon was initiated. An area approximately 8.38 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. The pad site will potentially impact five (5) features: four (4) dilapidated earthen foundations and remnants a small earthen reservoir. However, earlier cultural resource surveys indicate "little new evidence is expected to be found in Winter Quarters Canyon" (Cook 1981). No remnant standing structures are within 1/2-mile of the pad site. The Winter Quarters mining district is apparently eligible or qualifies for the National Historic Register, however landowners controlling the site have adamantly opposed being listed on the Registry when approached by SHPO on previous occasions.

The cultural resources survey recommended the additional investigation of one (1) of the dilapidated earthen foundations as a mitigation measure. The report detailing the initial investigation, and any report addressing the pit mitigation 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 was initiated in 2009, and consists of permitting approximately 8.38 acres located in the canyon bottom. Surveys were conducted to identify T&E species of both plants and animals. The surveys did not find any such species.

Ser. 2.7

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 a 20-foot wide slope driven at 18 degrees down. The shaft will have a 12-inch thick concrete liner, and the slope will have a 8-inch thick concrete invert with the ribs and roof having a minimum 3-inch thick shotcrete liner. When sealing at reclamation, the shaft 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.

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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)

The near surface water 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 Incline 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 Incline Slope will be driven bearing away from the creek at a negative 16-18 degree slope. Similarly, the proposed vertical shaft 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. Prior to construction, the existing stream channel will be routed through a culvert approximately 100 feet from both the shaft and incline slope openings. 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.

pending rights are: 93-3659 through 93-3667 and 93-3676 through 93-3679. These rights are listed in the water rights tables presented in Volume 4.

Surface water rights in the area are primarily for stockwatering and irrigation. Stockwatering rights are almost entirely directly on the stream. Irrigation rights are centered around the town of Scofield and in Flat Canyon, southwest of the center of the property. Irrigated lands consist almost entirely of pasture. Only stockwatering rights are present on the lease area.

2.3.5.2 Ground Water Rights

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 2 nd 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. One (1) groundwater well (08-1-5) completed below the coal seam - screened from 297-317 feet below the surface will be monitored as well. 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* 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																			
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								

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

Sample Site	1st Quarter							2nd[2] / 3rd[3] / 4th Quarters											
	Lab Analysis*[a]	Field parameters only*[1]	Monthly Flow	Dissolved Oxygen	TDS,TSS, T-P	O & G		Lab Analysis*[a]	Qtrly Field parameters* only[1]	Quarterly Flow	Monthly Flow	Monthly Seasonal Flow	Quarterly Water Level Only	Dissolved Oxygen	TDS,TSS, T-P	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)

Sample Site	1st Quarter							2nd[2] / 3rd[3] / 4th Quarters											
	Lab Analysis*[a]	Field parameters only*[1]	Monthly Flow	Dissolved Oxygen	TDS,TSS, T-P	O & G		Lab Analysis*[a]	Qtrly Field parameters* only[1]	Quarterly Flow	Monthly Flow	Monthly Seasonal Flow	Quarterly Water Level Only	Dissolved Oxygen	TDS,TSS, T-P	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.)

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.

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

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 stations were added in Winter Quarters Canyon CS-24,and UPDES-004 with the addition of the Winter Quarters Ventilation Facility. Stream site CS-24 is located downstream of the Ventilation Facility pad, with UPDES-004 representing 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 2.3.7-3~~A~~ throughout the post-mining period, unless deletions in the list of parameters is determined to be appropriate.

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

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

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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 has been encountered in the North Lease.~~Therefore, no significant inflows of ground water are anticipated as mining progresses into the North Lease area.~~ Selected surface discharges of ground water and stream flows in the areas that could be impacted by mining activities have been~~will be~~ monitored. Mining related surface impacts include subsidence and the ventilation facility in Winter Quarters Canyon (WQVF)~~is the only surface impact anticipated since no new surface facilities are currently planned for the~~ in the North Lease area. The WQVF will be permitted to encompass approximately 8.38 acres with only approxmately 7-acres of associated disturbance which will be 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

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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. 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. In general, the WQVF pad site encompasses a sagebrush and mountain brush south facing hillside, a riparian zone, and a mixed conifer/aspen north facing hillside. Both the mixed conifer/aspen and riparian habitats show signs of detrimental impacts on the vegetation from logging activities and heavy livestock use. 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.

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Huntington Creek has a diverse aquatic community with macroinvertebrate taxa representing all trophic levels. The successful cutthroat trout spawning and high number of resident trout evidence the high quality waters and habitat of Huntington Creek plus the ability of the macroinvertebrate community to support quality fisheries. Cutthroat trout, 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). An addition cursory fish study was conducted in 2008, focused on the section of the creek to be potentially impacted by a proposed ventilation facility pad. Observations by Dr. Dennis Shiozawa indicated mimimal impacts are anticipated (see Appendix A-3, Vol.2 for email consultation). 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.

The Winter Quarters Ventilation Facility (WQVF) will have minimal impact on approximately 750 feet of the creek with the installation of a culvert. Consultation with Dr. Dennis Shiozawa - BYU indicates impacts associated with the culvert are minimal due to the grade of the stream, the associated aquatic wildlife and available habitat. Skyline has photo documented the channel morphology of the section of the stream for reclamation purposes (Appendix A-3, Vol.2). Immediately preceding stream alteration activities Skyline personnel will also attempt to passively relocate any fish in the immediate vicinity. Due to the length of the culvert, Skyline has incorporated fish baffles and roughness rings into the design of the culvert to provide 'resting' pools enabling fish to migrate upstream. At reclamation, the stream reconstruction will utilize current best management practices, likely implementing a combination of both Bioengineering and Hard structural techniques. Based on Dr.Shiozawa's assessment of the existing creek and the proposed mitigation measures, minimal impacts to the fishery resource is anticipated. See Dr. Shiwizowa' comments in email correspondence located in Appendix A-3, Vol. 2.

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

Sec 2.9

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 conduted 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:

- Fish: Section 2.8, fishery consultation (Appendix A-3, Volume 2);Minimal effects.

- 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 will not be opened 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.

Sec 2.10

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.~~

Sec 2.11

SOILS OF THE NORTH LEASE TRACT AREA

No surface disturbance proposed for the North Lease Tract Area, A review of the soils in the area from the existing Soil Survey of Carbon County, Utah and USDA Forest Service The soil map units in the survey are presented on Drawing No. 2.7.7-1b.

Winter Quarters Ventilation Facility Area

A complete description of the soils 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 4 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

Sec 2.12

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~~8~~) 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.

2.12.2 Capability and Productivity of the Permit Area Affected by Surface Operations and Facilities

Portions of the permit area affected by surface operations and facilities of the underground Skyline Mines are capable of supporting limited forestry, grazing, and recreational uses. Farming in the area is prohibited by the steep and rocky terrain of Eccles Canyon.

FORESTRY AND GRAZING

Land Use Capability

Data concerning resource availability for forestry and grazing uses within the permit area affected by surface operations and facilities were collected and assimilated by Dr. Joseph R. Murdock, professor of Botany and Range Science at Brigham Young University, Provo, Utah (1979). Vegetative plot studies were made in the affected permit area within five general area classifications: the spruce-fir timber type, the aspen timber type, the sagebrush type, the riparian type and the unrecovered disturbed area type, composed of existing roads and the unrecovered site of an abandoned gas well and the abandoned Eccles Mine located on the proposed portal site. From these specific vegetative plot studies, the productivity and capability of supporting grazing and forestry uses were determined for each general area. The plot studies revealed that both the spruce-fir timber type and the unrecovered disturbed area type contained no significant herbage usable for grazing purposes.

The number of animal units and animal unit months that the other three areas are capable of supporting was determined by converting the available green plant species desirable by sheep to a dry weight basis and assuming that one 1,100 pound cow having one calf, which constitutes an animal unit, consumes 27 pounds per day. The results of this analysis are presented in Table 2.12.2-1 for the yard area, the conveyor corridor and the bypass road.

The capability of the area affected by surface operations and facilities to support forestry uses was determined from the total land area in the spruce-fir and aspen timber types and the available timber volume per area as published by the U.S. Forest Service in the "Land and Resource Management

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. 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. The area of the substation is estimated at only 300 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 has minimal 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.

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

Sec 2.14

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.

Sec 3.2

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 3.2.4-3h. 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 pad site. The pond is designed to treat the approximately 7.02 acres of disturbed area from the facility. Precipitation from a 10-year, 24-hour storm event has been calculated at 2.17 inches. The required volume to provide the retention of the runoff from the designed 10-year, 24-hour storm is calculated at 4,182 cubic feet. (See Plate 3.2.4-3h for pond designs and 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 an elevation 1-foot below the primary spillway. A 25-year, 6-hour event immediately following the 10-year, 24-hour event would reach an elevation of 8075.02. The pond would discharge at this elevation (0.02 feet above the primary spillway) at a rate of approximately 27 gpm.

With the pond at capacity, a 100-year, 6-hour rainstorm event would discharge at a rate of 0.53 cfs.

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 (8077.0 ft) prior to the occurrence of a 25-year, 6-hour storm event, the emergency spillway is designed to discharge 0.02 cfs with a velocity of 0.19 fps at the crest. This velocity is considered non-erosive.

The required volume for annual sediment storage has been estimated at 4,400 cubic feet. The 60 percent sediment volume is at an elevation of 8072.05 feet. The 100 percent sediment 'clean-out' marker is at an elevation of 8073.90 feet which corresponds to the elevation of the 6-inch diameter decant pipe. The volume of sediment at the 8073.90 feet elevation is equivalent to over 6.5 years of sediment yield at its average annual deposition rate.

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 approximately 8.38 acre disturbance consists of a 20-foot diameter vertical shaft mounted with an exhaust fan, 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 with a re-alignment of the existing road to better access 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. The approximately 8,000 cubic yards of material to be generated from the construction of the Declined Slope will be used to construct the rest of the WQVF pad.

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 the final stages of the construction of 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 become occluded with debris, which would reduce the capacity to divert undisturbed drainage past the WQVF site. Undisturbed ditches are designed to intercept the 10-year, 6-hour precipitation event divert runoff around the site and directly to Winter Quarters Creek.

Revised: 9-18-09

Sec 3.4

3.4 AREA AFFECTED BY EACH PHASE OF OPERATIONS

The area affected by the Skyline Mines project can be divided into two~~tow~~ 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.

Permitted~~Disturbed Surface~~ Acreage

The offices, bathhouse, workshop, portal, fans, and other necessary facilities utilize a site of 42.55 ~~36.40~~ 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 ~~8.7097~~ acres. The waste rock disposal site utilizes approximately 15.91 acres ~~utilizes 7.68 acres and the access road to the disposal site utilizes 315.67.55 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 8.38 acres. In total, the ~~surface acres disturbed~~ permitted area is 119.34~~100.9580.7068.13~~ acres. The ~~disturbed and~~ permitted area and bonded area for the M~~m~~ine P~~p~~ortal area, L~~l~~oadout 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 , and~~and~~ 3.2.3-3 through 3.2.3-3f, ~~and NEW MAP~~ 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.

Sec 4.1

4.1.1 Reclamation Plan - Rock Disposal Site

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

4.1.2 Reclamation Plan - Winter Quarters Ventilation Facility

Reclamation activities will include removing any existing structures such as the fan structure, 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, the 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. 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.

Sec. 4.3

Bonding Calculations

Direct Costs		
Subtotal Demolition and Removal	$1,956,444	
Subtotal Backfilling and Grading	$1,009,101	
Subtotal Revegetation	$903,492	
Direct Costs	$3,869,037	
Indirect Costs		
Mob/Demob	$386,904	10.0%
Contingency	$193,452	5.0%
Engineering Redesign	$96,726	2.5%
Main Office Expense	$263,095	6.8%
Project Management Fee	$96,726	2.5%
Subtotal Indirect Costs	$1,036,903	26.8%
Total Cost 2006	$4,905,940	
Escalation factor		3
Number of years		0.013
Escalation	$188,195	
Reclamation Cost Escalated	$5,094,135	
Bond Amount (rounded to nearest $1,000) 2009 Dollars	$5,094,000	
Posted Bond September 19, 2006	$5,137,000	
Difference Between Cost Estimate and Bond	$43,000	
Percent Difference	0.84%	

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																			16601
	Total																			1956444

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
	Substation/Transformers 42																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0012	0.29	/CF													13700	CF	3973
	Ventilation Fan																			
	Structure's Demolition Cost	Mixed Materials Bld. Large	02 41 16 13 0100	0.3	/CF													6734	CF	2020
	Mobile Field Office																			
	Structure's Demolition Cost	Steel Bld. Large	02 41 16 13 0012	0.29	/CF													6500	CF	1885
	Structure's Demolition Cost (generator)	Steel Bld. Large	02 41 16 13 0012	0.29	/CF													1000	CF	290
	subtotal																			8168
	Concrete																			
	Substation	Concrete demolition	ConcreteDemo1	9.92	/CY													60	CY	595
	Shaft Collar and Foundations	Concrete demolition	ConcreteDemo1	9.92	/CY													20	CY	198
	Drilling and Fan Pad	Concrete demolition	ConcreteDemo1	9.92	/CY													215	CY	2133
	Trailer 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													20	CY	198
	Concrete's volume demolished																1.3	468	CY	
	Loading Cost	Front end loader track 3 CY	31 23 16 42 1300	1.59	/CY													468	CY	744
	Disposal Costs	Disposal on site	02 41 16 17 4200	8.8	/CY													468	CY	4118
	subtotal																			8433
	Total																			16601

	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															68028
Total															1009101

	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
Waste Rock Disposal 15															
Backfilling and Grading															
CAT 345BL II (10-24)(2nd2006) 2005	16330	75.7	0.1	60.1	245.43	1	245.43	$/HR					32.3	HR	7927
6X4 70,000lbs 12-18 CY (20-11) (2nd2005)	3725	31.25	0.1	43.3	100.96	2	201.92	$/HR					32.3	HR	6522
988G EROPS (9-35) (2nd2007) 2005	15505	77.35	0.1	60.1	242.09	1	242.09	$/HR					32.3	HR	7820
D9R Semi-U EROPS (9-52) (2H2007)	19405	95.3	0.1	60.1	286.21	1	286.21	$/HR					32.3	HR	9245
Pickup Crew 4x4 1 ton 340 hp (20-17) (2nd2007)	1060	14.5	0.1	0	22.58	1	22.58	$/HR					32.3	HR	729
CLAB					47.05	1.5	70.58	$/HR					32.3	HR	2280
Foreman Average, Outside					64.4	1	64.4	$/HR					32.3	HR	2080
Subtotal															36603
Topsoil															
988G EROPS (9-35) (2nd2007) 2005	15505	77.35	0.1	60.1	242.09	1	242.09	$/HR					34.95	HR	8461
D9R Semi-U EROPS (9-52) (2H2007)	19405	95.3	0.1	60.1	286.21	1	286.21	$/HR					34.95	HR	10003
14H EROPS (9-11)(2H2007)	10655	45.5	0.1	60.1	176.74	1	176.74	$/HR					34.95	HR	6177
410G EROPS 4WD EXTEN. (9-28)(2nd2005)	#REF!	#REF!	0.1	60.1	60.1	1	60.1	$/HR					34.95	HR	2100
Pickup Crew 4x4 1 ton 340 hp (20-17) (2nd2007)	1060	14.5	0.1	0	22.58	1	22.58	$/HR					34.95	HR	789
CLAB					47.05	1	47.05	$/HR					34.95	HR	1644
Foreman Average, Outside					64.4	1	64.4	$/HR					34.95	HR	2251
Subtotal															31425
Total															68028

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 gentle	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	8.9	/MSF					0.04						AC		2	MSF	18
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	19.8	/MSF					0.04						AC		2	MSF	40
	Subtotal																			200
	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																			54990
	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																		
	North Facing Slopes																		
	Seeding	North Facing Slopes Seed Mix	*	161.00	/AC				2.5						AC	2.5	AC	403
	Mulch	Hay 1" material only 32 91 13 16 0350	Reveg001	56.1	/MSF				2.5						AC	2.5	ton/AC	140
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006 3201901	2.13	/MSF				2.5						AC	109	MSF	232
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	23.15	/MSF				2.5						AC	109	MSF	2523
	Tublings																	
	White Fur	Bare root seedlings, 11" to 16" med. soil	32 93 43 10 0140	1.79	Ea				2.5						AC	200	/AC	895
	Englemann Spruce	Bare root seedlings, 11" to 16" med. soil	32 93 43 10 0140	1.79	Ea				2.5						AC	400	/AC	1790
	Woody Cinquefoil	Bare root seedlings, 11" to 16" med. soil	32 93 43 10 0140	1.79	Ea				2.5						AC	100	/AC	448
	Subtotal																	6431
	South Facing Slopes																	
	Seeding	South Facing Slopes Seed Mix	*	180.00	/AC				1						AC	1	AC	180
	Mulch	Hay 1" material only 32 91 13 16 0350	Reveg001	56.1	/MSF				1						AC	1	ton/AC	56
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006 3201901	2.13	/MSF				1						AC	44	MSF	94
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	23.15	/MSF				1						AC	44	MSF	1019
	Tublings																	
	Quaking Aspen	Bare root seedlings, 11" to 16" med. soil	32 93 43 10 0140	1.79	Ea				1						AC	400	/AC	716
	Blue Elderberry	Bare root seedlings, 11" to 16" med. soil	32 93 43 10 0140	1.79	Ea				1						AC	400	/AC	716
	Subtotal																	2781
	Riparian Habitat																	
	Seeding	Riparian Habitat Seed	Skyline07053	42.25	/AC				1.5						AC	1.5	AC	63
	Mulch	Hay 1" material only 32 91 13 16 0350	Reveg001	56.1	/MSF				1.5						AC	65	MSF	3647
	Fertilizer	Fertilizer Hyrdor Spread Mat. Only	Reveg006 3201901	2.13	/MSF				1.5						AC	65	MSF	138
	Equipment	Hydro Spreader (equip. & labor) B-81	Reveg005	23.15	/MSF				1.5						AC	65	MSF	1505
	Tublings																	
	Red-oiser dogwood	Bare root seedlings, 11" to 16" med. soil	32 93 43 10 0140	1.79	Ea				1.5						AC	200	/AC	537
	Creeping oregon grape	Bare root seedlings, 11" to 16" med. soil	32 93 43 10 0140	1.79	Ea				1.5						AC	400	/AC	1074
	Willow cuttings	Bare root seedlings, 11" to 16" med. soil	32 93 43 10 0140	1.79	Ea				1.5						AC	2000	/AC	5370
	Subtotal																	12334
	Revegetation																	
	25% of Initial Seeding																	180620
	Subtotal																	180620
	Total																	903492

* = cost from Maple Leaf Seed Mix Quote

See 4.4

4.4.2 Grading and Final Contour

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

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

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

The Winter Quarters Ventilation Facility grading and final contour plan will be similar to the sites listed above. Once excess material has been used in sealing the slope and shaft as outlined in Sections 4.1.2 and 4.9, any 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 landowner provides a written request to leave a portion of the existing pad. 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

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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. 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.

Sec 4.6

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. Initial construction will likely take place on south-facing slopes dominated by sage brush and bitter brush. The brush, topsoil, and suitable subsoil will be salvaged simultaneously and temporarily stored on the north slope until construction advances to the permanently designated topsoil storage area. Topsoil and suitable subsoil had slightly thicker depths in the riparian areas adjacent to the creek.

The soils identified in the soil survey are a sandy-silty loam. A mixture of alluvial sediments in the riparian areas increase the percentage of fine sand. 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 11,366 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). 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	2.5	12	4,033 (Private)
South Slope	1.0	18	2,420 (Private)
Riparian	1.5	24	4,840 (Private)
Sub-Total	5.00		11,293

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TABLE 4.6-4 (Continued)

TOPSOIL REDISTRIBUTION

	Acreage	Planned Depth Inches	Cubic Yds
Overland Conveyor Route	.39	12	629 (Private)
			43,966 (Private)
			77,464 (USFS)
GRAND TOTAL	56.91		121,430**

*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.

Sec 4.7

4.7.9 Winter Quarters Ventilation Facility (WQVF)

Refer to both Section 2.7 and the Mt. Nebo Vegetation report located in Appendix A-2, Volume 2 for a discussion of the vegetation for the WQVF. The interim and final revegetation seed mixes for the WQVF area are listed in Tables 4.7-8A through 4.7-8C. Reclamation success standards are based on the reference area(s) identified in the Mt. Nebo report.

Table 4.7-8A

Interim Revegetation Seed Mixture for the Winter Quarters Ventilation Facility.

Species [a)]	Rate [b)] (# PLS/Ac)	Seeds/ft^2
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/ft^2
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/ft^2
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.

Sec 4.9

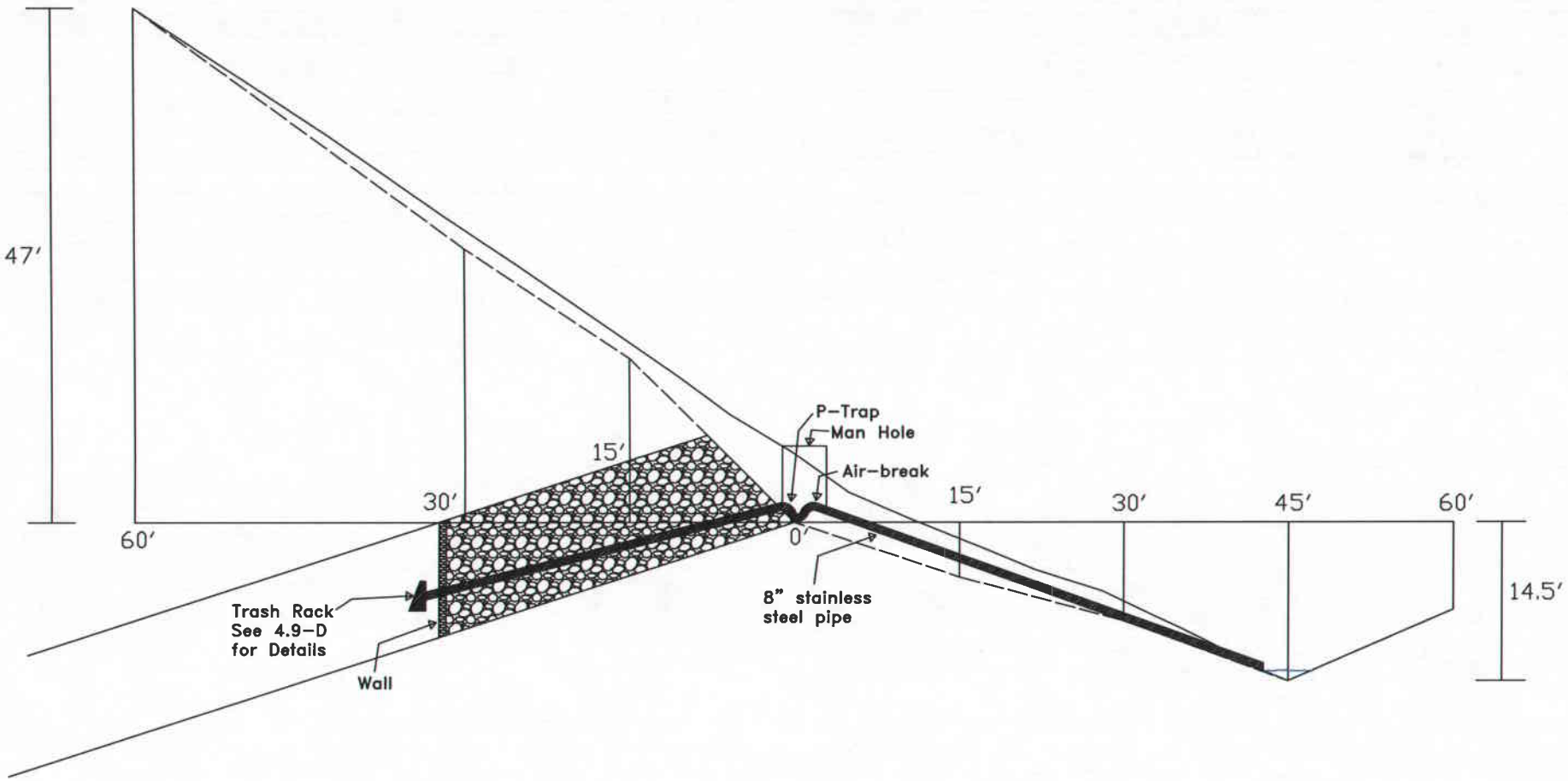
Shafts

Skyline Mine permitted the Winter Quarters Ventilation Shaft in 2009. ~~does not have any shafts~~. ~~Should any be designed in the future,~~ ~~R~~reclamation will be in compliance with State regulation R645-301-551 and consistent with MSHA, CFR 75.17 1~~7~~1-1. The ~~S~~shaft~~s~~ or other opening to the surface from an underground mine will be ~~capped~~, sealed, and will be effectively capped or b~~e and~~ 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.



Original Contour

New Contour After Reclamation

Winter Quarters Ventilation Slope
Proposed Abandonment

Canyon Fuel Company LLC
Skyline Mines

P.O. BOX 300 HELPER, UTAH 84526
435-448-8463

CAD FILE: P:\PERMITS\SKY\...4.9-B.CAD

DATE: 10/19/09

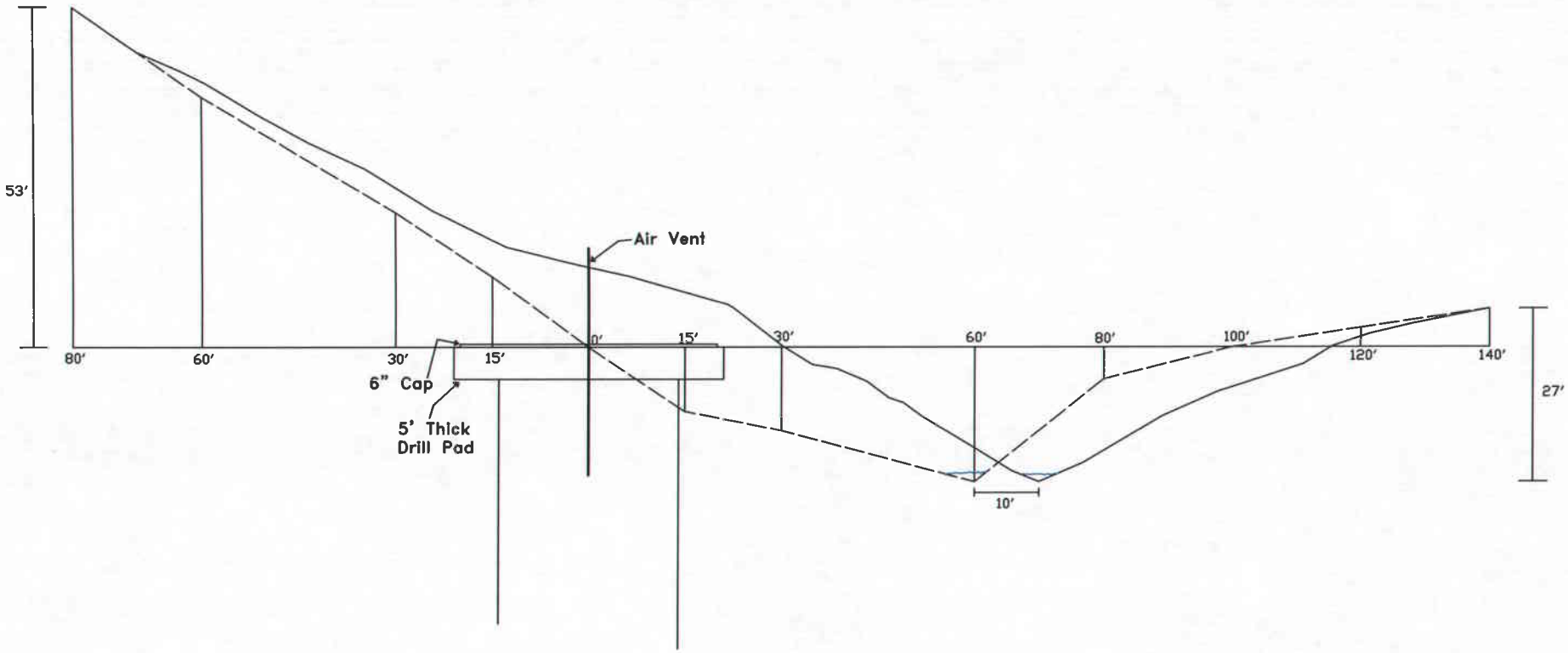
SCALE: 1" = 15'

CK.BY: [redacted]ecki

DR.BY: [redacted]her

REVISION: 0
10/19/09

DWG. NO.: 4.9-B



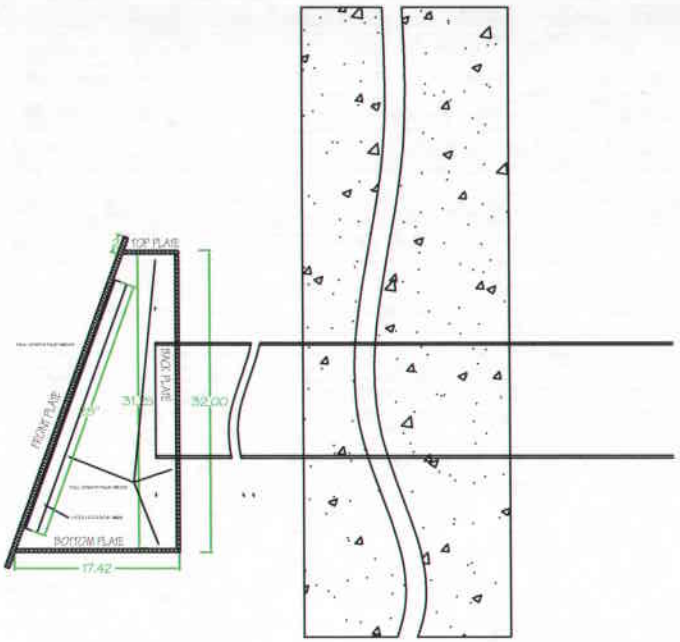
Original Contour

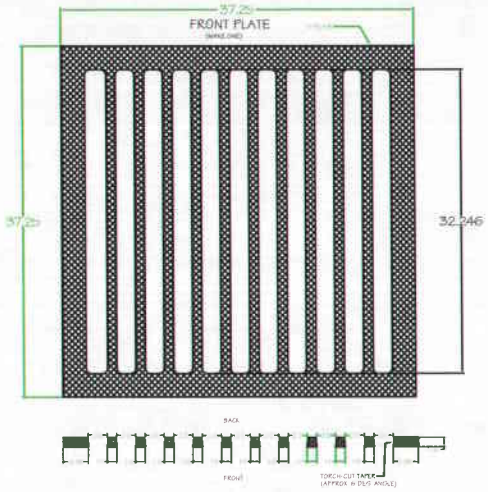
New Contour After Reclamation

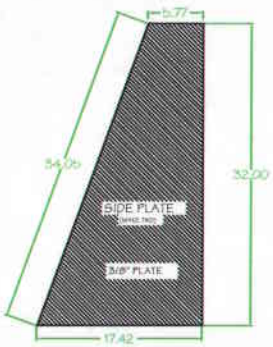
Winter Quarters Ventilation Shaft
Proposed Abandonment

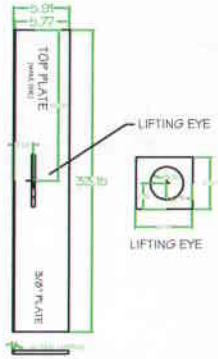
Canyon Fuel Company LLC
Skyline Mines

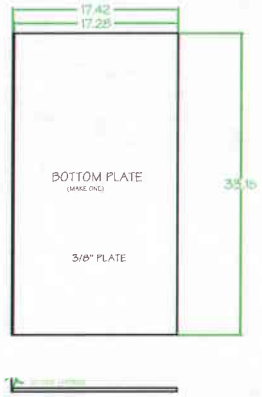
P.O. BOX 360 HELPER, UTAH 84526 435-448-6463	DATE: 10/19/09	CK: Galecki	REVISION:
CAD FILE: P:\PERMITS\SKY\...4.9-B.CAD	SCALE: 1" = 25'	DR: Belcher	0
DWG. NO.: 4.9-C			10/19/09











Winter Quarters Ventilation Shaft
Proposed Abandonment

Canyon Fuel Company LLC
Skyline Mines

P.O. BOX 360 HELPER, UTAH 84526 435-448-8463	DATE: 10/19/09	CK: Golecki	REVISION:
CAD FILE: P:\PERMITS\SKY\...4.9-B.CAD	SCALE: 1" = 20'	DR: Kenzy	0
DWG. NO.: 4.9-D			10/19/09

Sec 4.11

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 each calendar year.~~

In addition to the above outlined monitoring program, U~~N~~PDES 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 present 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, shaft, sediment pond, and drainage plan for both the disturbed and undisturbed drainage. Undisturbed drainage from Upper Winter Quarters Creek will be diverted past the site through a culvert. Both the shaft and slope are located higher on the pad so that no drainage will run into the mine. These openings to the mine are locate up dip fo the mine workings, eliminating concern of any gravity discharge during the operation of the mine. Initially, no mine water will be discharged from this location. A permit application to discharge both surface water and mine water from the WQVF pond has been submitted to the Utah Division of Environmental Quality, with anticipated permit approval by 12/1/2009.

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. 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. The groundwater intercepted and discharged into Winter Quarters Creek is consistent with the groundwater gradient information submitted in the PHC - generally to the north-northeast (PHC Volumes July 2002 and October 2002).

Revised: 10-15-09

Sec 4.12

TABLE 4.12-1

PROPOSED POSTMINING LANDUSE

Area	Present Ownership	Premining Landuse	Proposed Postmining Use	Alternative Use	Capacity To Support Proposed Use	Relationship To Existing Landuse Policies
Mine Site and Exploratory Excavations	USFS	Wildlife/Wildlife/ Grazing Habitat	Picnic Grazing Habitat	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	Wildlife Habitat	Adequate	Compatible
Waste Rock Disposal	Private	Grazing/ Wildlife Habitat	Grazing/ Wildlife Habitat	Wildlife Habitat	Adequate	Compatible
South Fork Breakout	USFS	Wildlife/Wildlife/ Grazing Habitat	Wildlife Grazing Habitat	Adequate Habitat	Compatible	
James Canyon	USFS/Private	Wildlife/Wildlife/ Grazing Habitat	Wildlife Grazing Habitat	Adequate Habitat	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. The culvert will be removed and the stream course reclaimed using a combination of bioengineering and hard structures. Once the reclamation commitments have been achieved, the pre-mining land uses will be adequately re-established.

Sec 4.13

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

4.13.1 Sedimentation Ponds

Four~~Three~~ sediment ponds for surface water runoff are required, one at the mine site, the second at the coal load-out site, ~~and~~ 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) ,~~and~~ 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, ~~and~~ Waste ~~r~~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, ~~and~~ Map 4.16.1-1B, and 3.2.4-3h respectively.

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

Division of Environmental Quality~~Health~~. The Permittee will operate the ponds in a prudent manner and will attempt to reduce the sediment loading the receiving water~~sinto 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 U~~N~~PDES 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.

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4.14 PROTECTION OF PUBLIC PARKS AND HISTORIC PLACES

No public parks or 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 and is located in the Confidential File. 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 four (4) dilapidated earthen foundations and remnants of a small earthen reservoir may possibly be impacted by the ventilation facility.

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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 10 feet above the elevation of any existing ground or surface water, with the surface water of Winter Quarters Creek being diverted past the pad site using a culvert. At reclamation, the developmental waste will be used in backfilling of the Declined Slope, Vertical Shaft and attaining the Approximate Original Contours (AOC).

Sec. 4.18

4.18 FISH AND WILDLIFE PLAN

The Permittee is conducting the Skyline project operations in a manner which minimizes disturbances and adverse impacts on fish, wildlife, and the related environmental values identified in environmental baseline studies. The design of the Skyline Project incorporates many of the suggestions and proposals of the various environmental consultants to provide acceptable environmental protection features.

4.18.1 Aquatic Resources - ~~Eccles Creek~~

During construction activities, sections of Eccles Creek~~-~~ and Winter Quarters Creek were diverted, channelized and relocated causing some disturbance of the aquatic communities. These construction activities were conducted in accordance with approved plans and were monitored for impact. The construction effort also included stream enhancement for those sections which were permanently altered. Post construction rehabilitation has included revegetation and other improvements to the riparian habitat.

A more complete discussion of the impact and plans for the aquatic community can be found in Section 2.8 - AQUATIC RESOURCES, and in Section 4.19 - STREAM DIVERSIONS. The revegetation plan is addressed in Section 4.7. Hydrologic impacts are discussed in Sections 2.3 and 2.4.

4.18.2 Terrestrial Wildlife Resources

Eccles Canyon Road, which nearly parallels the conveyor route, has a posted speed limit. This measure seems to minimize the number of animal-vehicle collisions in Eccles Canyon. Warning signs indicating animal crossings are installed at each end of the overland conveyor system. The Permittee will continue consultation with various agencies to determine additional measures to be taken to reduce road kills of big game.

Power transmission lines for underground mining and related activities in the permit area were designed and constructed to comply with the guidelines set forth in "Environmental Criteria for Electric Transmission System" (USDI, USDA (1970)). Power distribution was designed and constructed in accordance with REA Bulletin 61-10 "Powerline Contacts by Eagles and Other Large Birds".

Revised 9-30-0903/26/98

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).
- A combination of Bioengineered structures and hard structures are proposed to be used in reclamation (Plates 4.4.2-3A and -3B and Earthfax report - Volume 5, Section 24)
- Natural woody debris structures are proposed to ~~will~~ be used in reclamation as outlined by Dr. Shiozawa (Appendix A-3, Volume 2)
- Photo documentation of the pre-disturbed stream was collected for re-construction of the stream bank morphology (Appendix Volume A-3, Volume 2).
- Fish baffles and roughness rings are proposed to be installed in the steam by-pass culvert to reduce velocities and provide 'resting areas' for fish migrating upstream of the site(Plate 3.2.4-3h and Earthfax Report - Volume 5, Section 24).

See 4.19

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

During construction of the Winter Quarters Ventilation Facility, Winter Quarters Creek will be diverted, and relocated to accommodate the facility pad located in the creek bottom. A Stream Alteration permit was acquired through the Utah State Division of Water Rights prior to any work being conducted. Plates 3.2.4-3a through 3.2.4-3i illustrate the construction designs. Engineering Calculations, designs, and other maps of the facility can be found in a report titled "Winter Quarters Ventilation and Mine Slope Pad, Skyline Mine, Runoff and Sediment Control Design Report", located in Volume 5, Section 24 of the M&RP.

The drainage basin upstream of the ventilation facility encompasses approximately 3007 acres. Precipitation from a 100 year 24 hour storm event is calculated to be approximately 3.09 inches. The associated total peak runoff flow is calculated to be approximately 85.02 cubic feet/second (cfs) (see Volume 5, Section 24).

A culvert approximately 775 feet long and 60- inches in diameter is calculated to provide adequate space to pass the designed storm event, in addition to additional ice and debris. The inlet of the culvert has been fitted with a 'trash rack' (see Plate 3.2.4-3f) that is designed to prevent drift debris from clogging the inlet structure. Although the natural channel has been straightened with a culvert, baffles have been installed in the culvert to reduce water velocities and provide resting areas for any fish trying to migrate upstream. The outlet of the culvert has been armored with roughness rings and riprap to dissipate energy and minimize erosion (see Plate3.2.4-3f and -3g).

Undisturbed drainage ditches have been incorporated into the design, routing undisturbed drainage around the site to minimize sediment load from the pad. This also reduces the size of the sedimentation pond, thus reducing the size of the disturbance. Undisturbed drainage ditches were designed to carry the peak flow from a 10-year, 6-hour precipitation event (see Volume 5, Section 24).

Correspondence with Dr. Dennis Shiozawa - BYU fishery biologist indicates the status of both the macroinvertebrates and the fishery in the creek. Dr. Shiozawa suggests placing a culvert in the creek will have minimal long term impacts on Winter Quarters Creek. The portion of the creek to be disturbed is considered 'riffle habitat' which is not prime habitat for either macroinvertebrates or fish. Both the macroinvertebrate and fish communities are anticipated to 'quickly re-colonize' once the culvert is removed (see Appendix A-2, volume 2 for email correspondence).

Although the stream channel will be straightened through the pad site, the creek has migrated through the creek bottom, creating an abundance of alluvial sediments throughout the creek bottom. The culvert design will not significantly alter the grade of the stream, thus re-establishing the creek channel in appropriately sorted sediments should not be difficult.

At reclamation of the site, the culvert will be removed and the stream channel re-established. Using best management practices, a combination of soil bioengineering and hardened structure techniques will be used to stabilize the creek banks to minimize soil erosion until sufficient re-vegetation has taken place.

Prior to stream alteration construction taking place, detailed photo documentation of the creek bottom was collected (See Appendix A-1, Volume 2). The documentation includes stream morphology such as vegetation, bank overhangs, meanders, pools and riffle zones. These features combined with overall length and grade will provide adequate documentation to generally identify the pre-disturbance condition of the stream channel.

A trapezoidal riprap channel with a combination of drop pool and bank stabilizing features are outlined on Plates 4.4.2-3a and 4.4.2-3c. Discussions of the channel design and illustrations of the features are located in Chapter 6 and figures 9 and 10 of the Earthfax Report (Volume 5, Section 24) At the time of reclamation plans will likely be updated to include the best management practices at the time.

Sec. 4.20

4.20.5 Winter Quarters Ventilation Facility Road

The 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 Winter Quarters Ventilation Facility is accessed from a pre-existing ancillary road that is re-routed for a distance of approximately 1000 feet to better approach the pad site. The surface landowner (Allred Family Trust) has agreed to provide the re-routed portion of the ancillary road for the pad site. Plate 1.6-3 illustrates the portion of the site added to the permit. See Plates 3.2.4-3b and -3c for detailed road illustrations.

Appendix A-1, Vol. 2
Clements Geophys

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

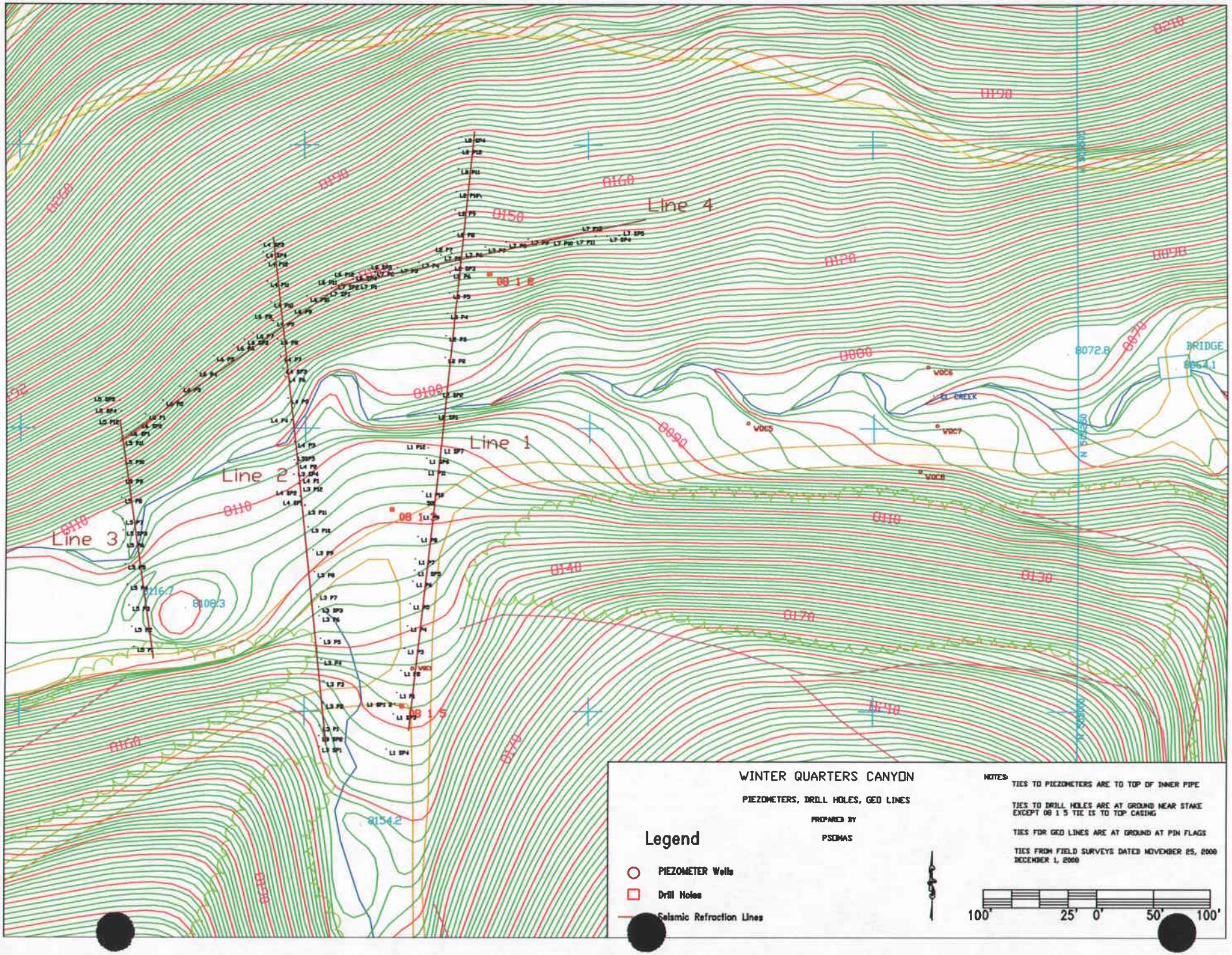
the past. The profiles of Lines 1, 2 and 3 correlate well where they cross Line 4. Based on the nature of refraction modeling there is limited data acquired on the ends of the seismic lines. This results in deeper units not showing up at the very ends of the profiles and may account for the 6,000 ft/s 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, 2008 DECEMBER 1, 2008
100' 25' 0' 50' 100'
Line 1
Line 2
Line 3
Line 4
BRIDGE
CL CREEK
08 1 2
08 1 5
8072.8
8064.1
8108.3
8154.2

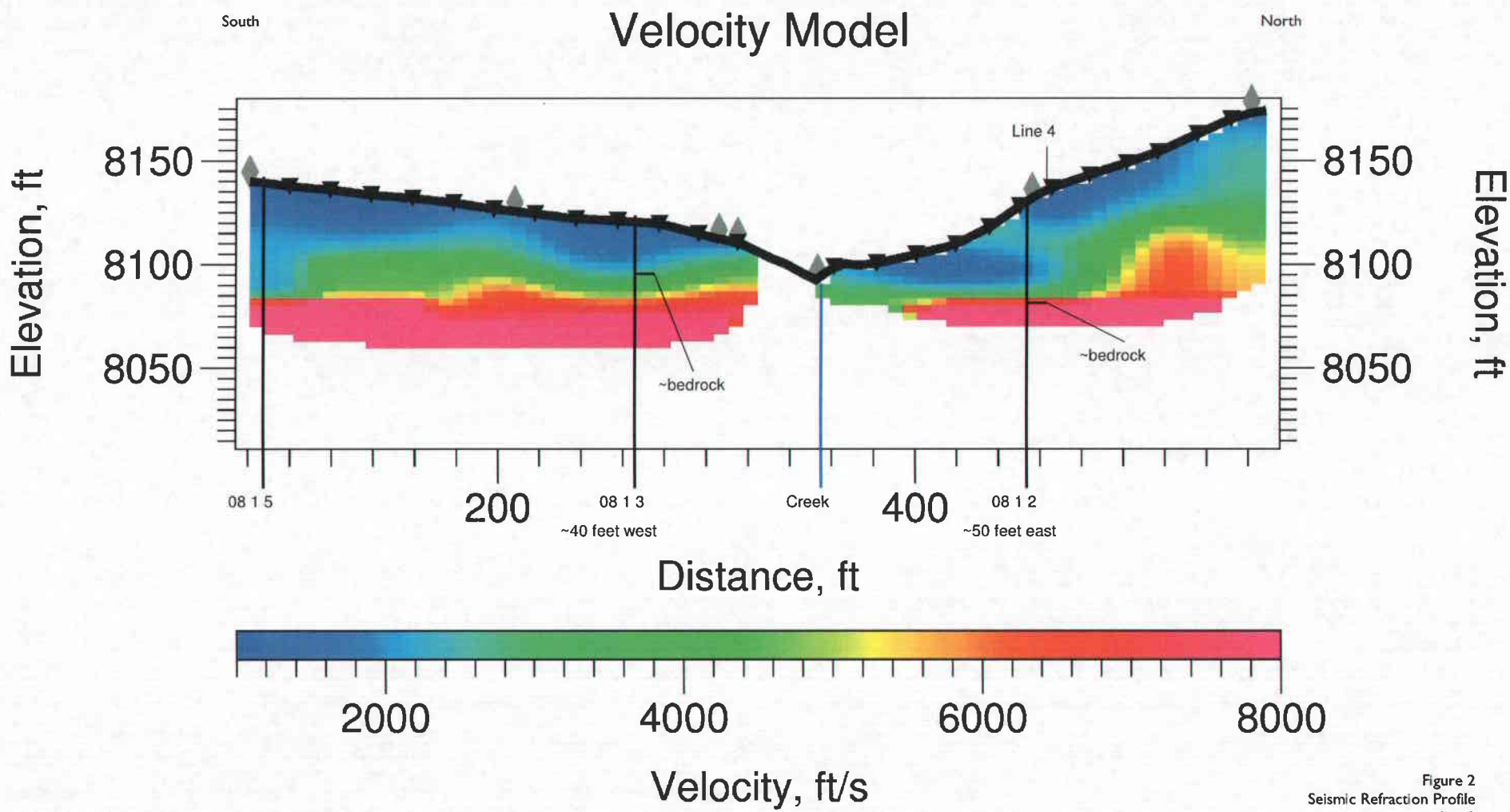


Figure 2
Seismic Refraction Profile
Line1

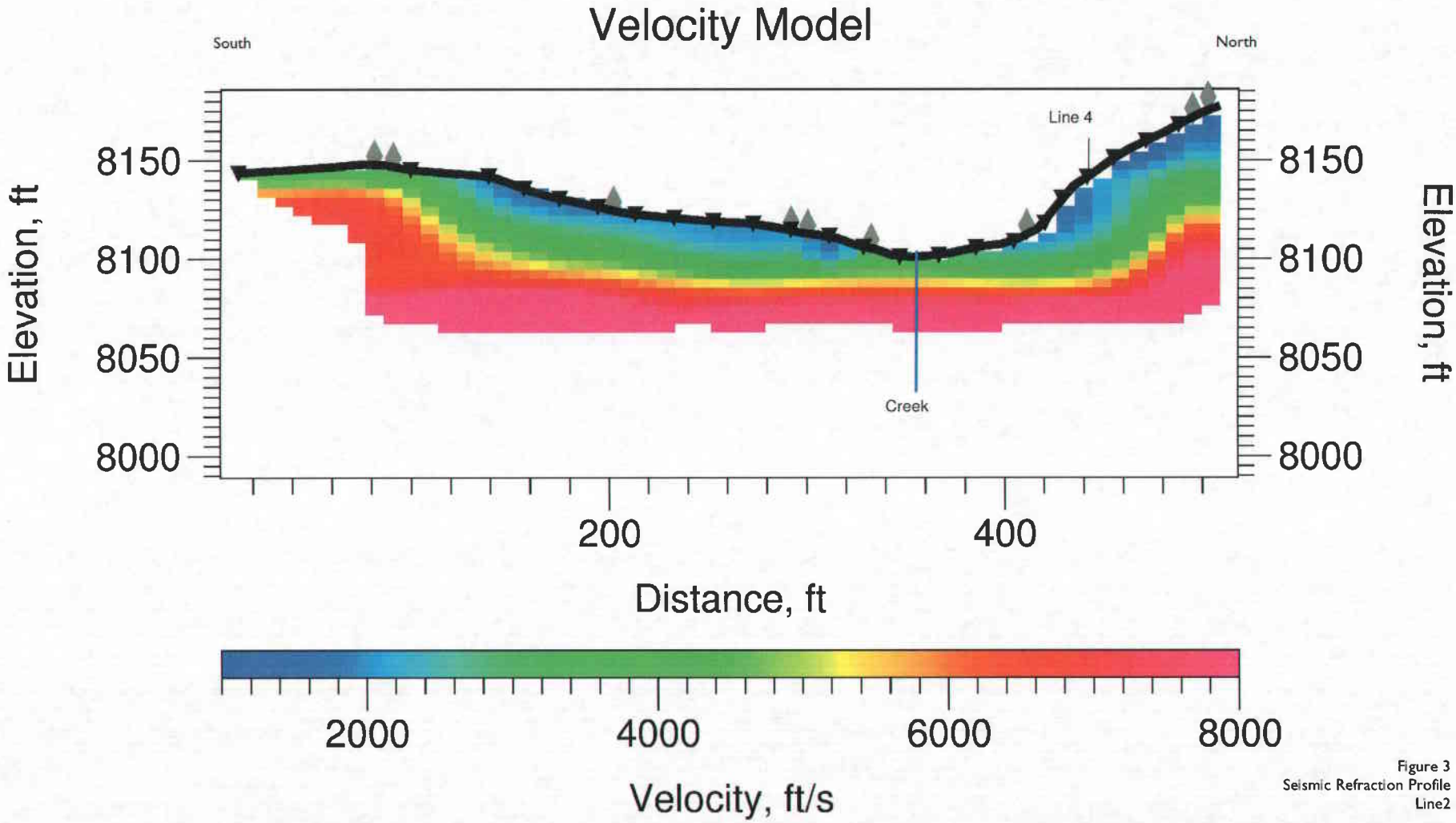


Figure 3
Seismic Refraction Profile
Line2

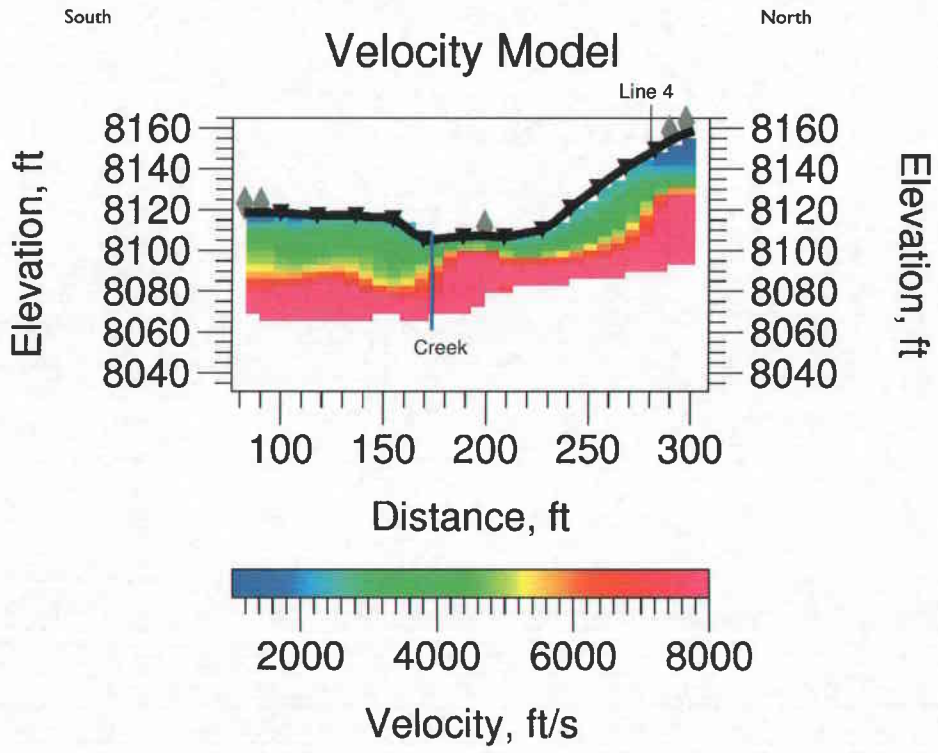


Figure 4
Seismic Refraction Profile
Line3

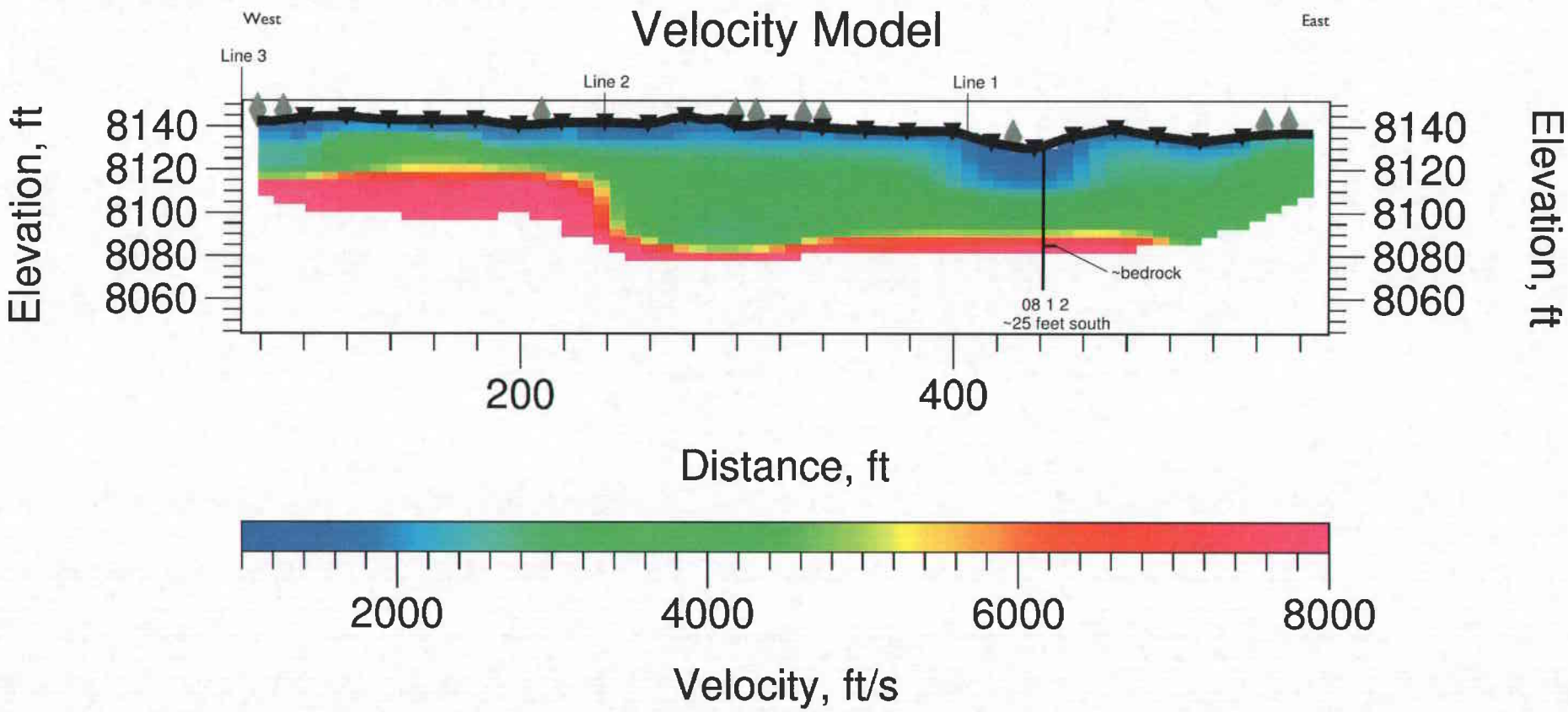


Figure 5
Seismic Refraction Profile
Line4

Append A-1, Vol-2

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

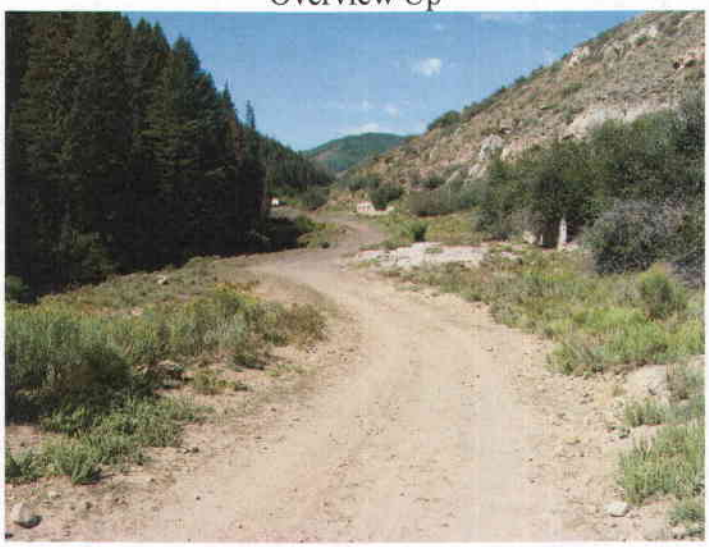
26 Up

27 Down

27 Up

Overview Down

Overview Up



Up from gate

Append A-2, Vol. 2

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}.

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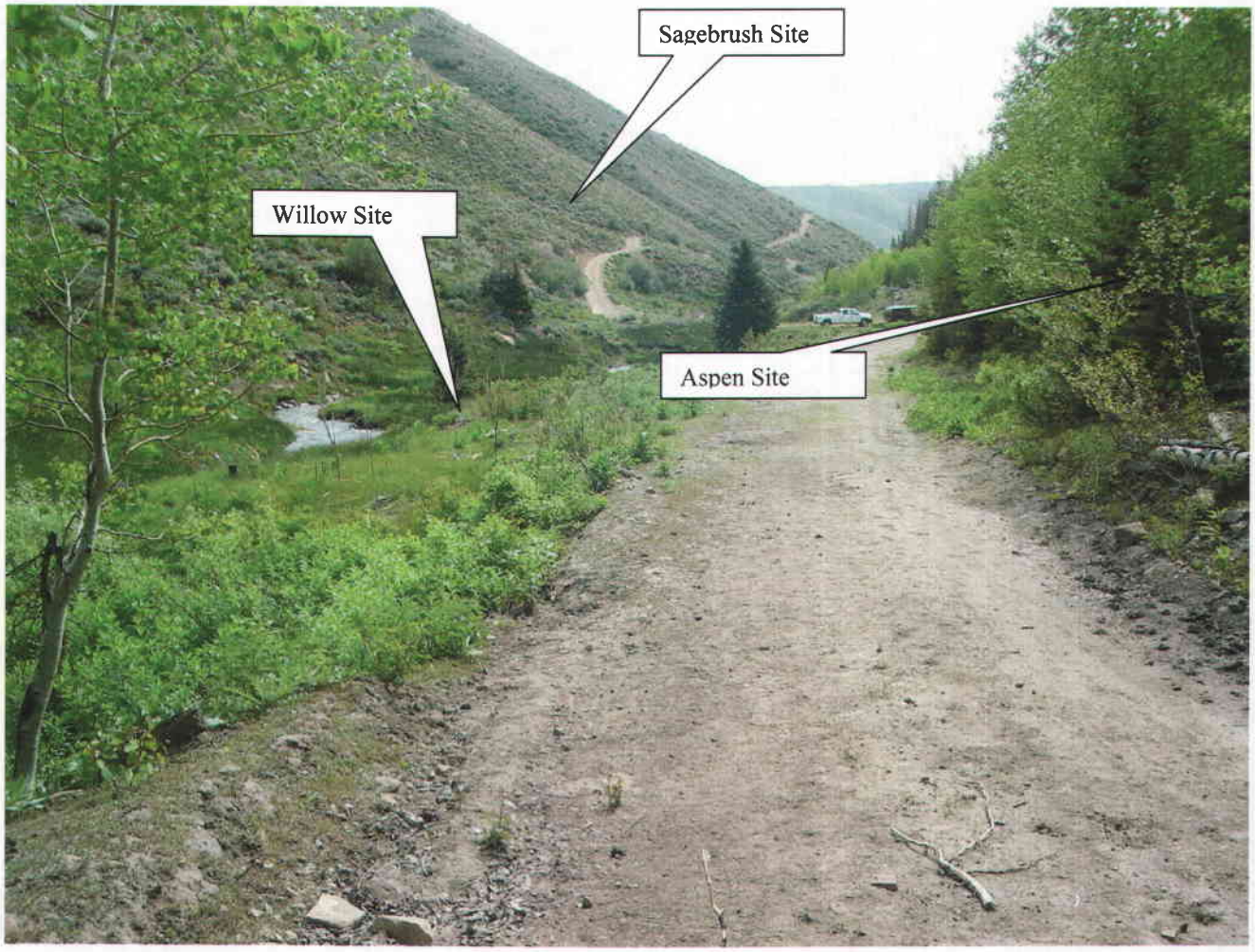

Figure 1. Visual representation of the location of the three distinct ecological sites.

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}.

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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
None to Slight	N-S
Slight to Moderate	S-M
Moderate	M
Moderate to Extreme	M-E
Extreme to Total	E-T

Instructions for Evaluation Sheet, Page 2

(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	

Attribute Rating Justification
Soil & Site Stability:

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

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

Attribute Rating Justification
Hydrologic Function:

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

H (10 indicators):
Hydrologic Function
Rating: _____

Attribute Rating Justification
Biotic Integrity:

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

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.

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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 M-E	
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.

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Aspen Site - Mainly old landing area.

Departure from Expected	Code
None to Slight	N-S
Slight to Moderate	S-M
Moderate	M
Moderate to Extreme	M-E
Extreme to Total	E-T

Instructions for Evaluation Sheet, Page 2

(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. Water-flow 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	

Attribute Rating Justification
Soil & Site Stability:

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
Hydrologic Function:

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
Biotic Integrity:

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

B (9 indicators):
Biotic Integrity
Rating: _____

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

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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

Append A-2, Vol 2

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

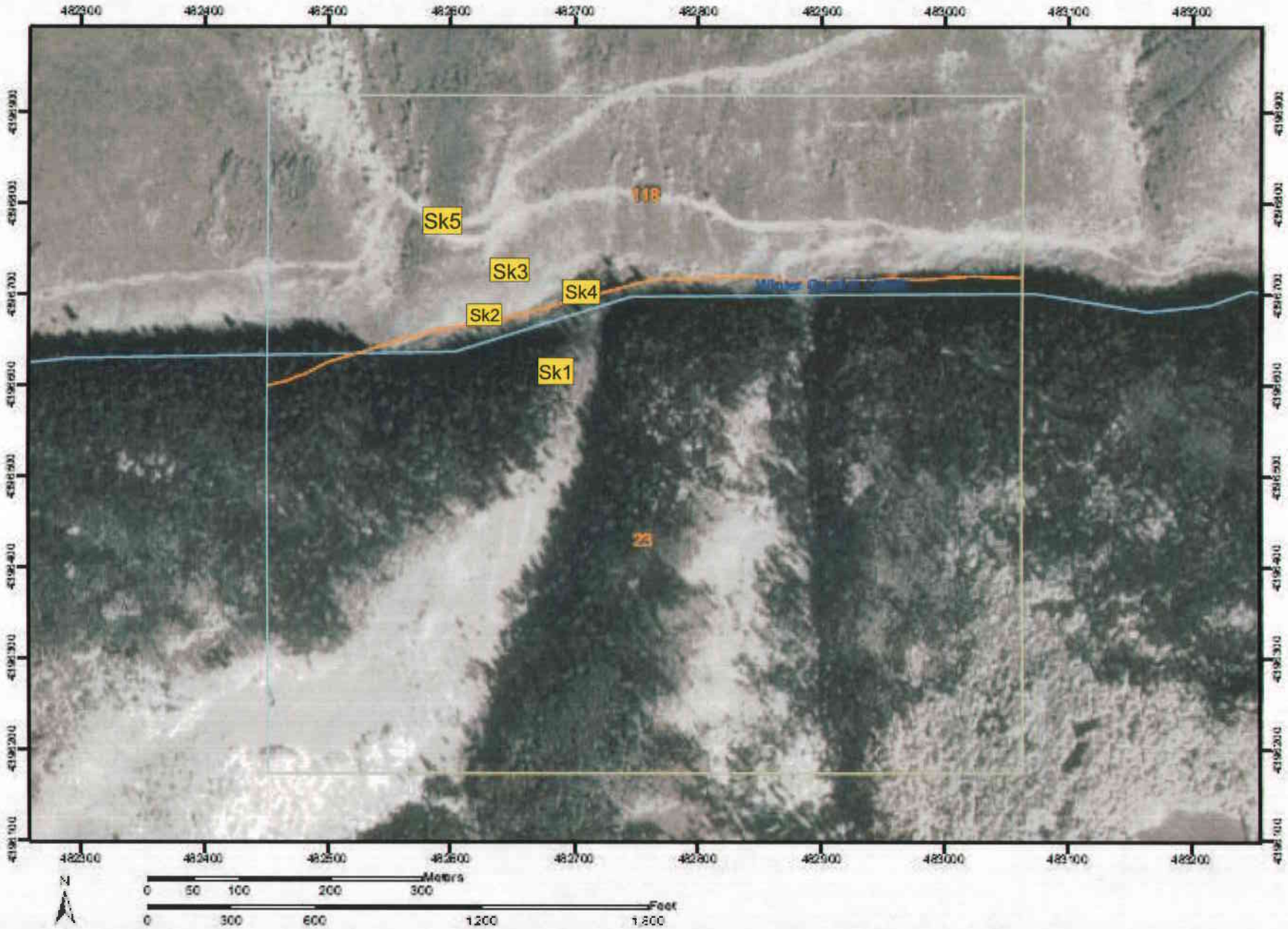
The soil series represented by SK3 and SK5 were identified on the soils map as part of the Trag-Croydon complex. Descriptions of these soils are included in Appendix A. SK3 and SK 5 were excavated from the south-facing slope of the proposed project area. SK3 was excavated from the slope above the creek 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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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.

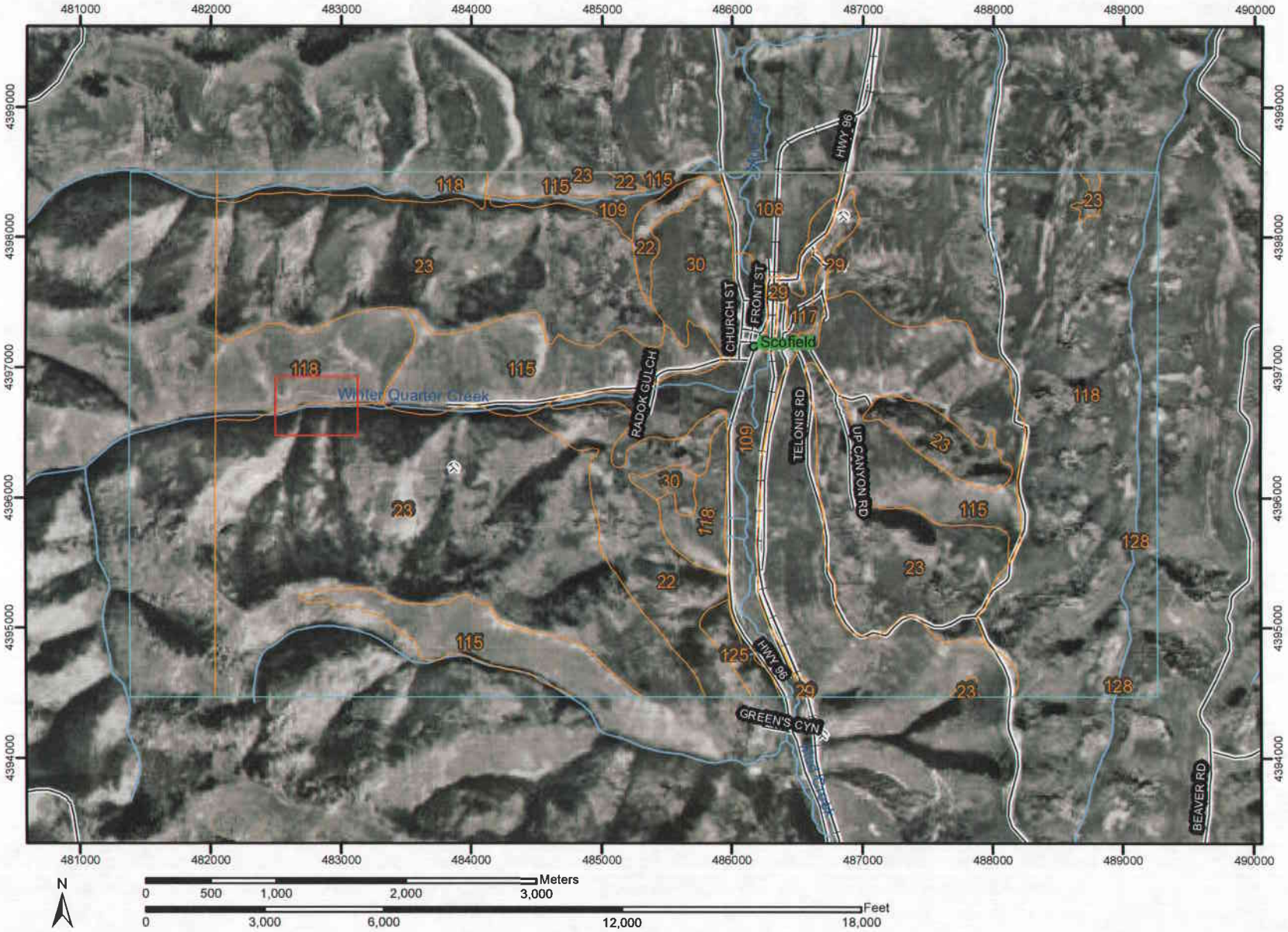
Soil Survey Area: Carbon Area, Utah, Parts of Carbon and Emery Counties
Survey Area Data: Version 4, Jul 2, 2008

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%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108
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Scofield
Winter Quarter Creek
RADOK GULCH
CHURCH ST
FRONT ST
TELONIS RD
UP CANYON RD
HWY 96
GREEN'S CYN
BEAVER RD
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2,000
3,000
Feet
0
3,000
6,000
12,000
18,000

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

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 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	Sand %	Silt %	Clay %	Texture	Coarse Fragment %	Boron ppm	Nitrogen Nitrate ppm	Selenium ppm	TKN %
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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Report ID: S0901102001

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

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

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

Append A-2, Vol. 2

Vegetation Sampling & Sensitive Species at the Ventilation Shaft Site

in

Winter Quarters Canyon

Skyline Mines

Prepared by

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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. The 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 included riparian, sagebrush/grass, aspen, mountain brush and coniferous forests. The plant communities that would be disturbed by construction of the site include native riparian and sagebrush/grass types, plus a community that had been disturbed previously by earlier activities including livestock grazing and logging operations.

This report describes the results of quantitative sampling the plant communities that will be impacted by the proposed ventilation shaft pad. It also shows results of sampling "reference areas", or areas with native plant communities 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 supplied 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.

Sampling the Upland Areas

Transect lines for sampling the upland vegetation were placed randomly within the boundaries of the proposed disturbed and reference areas. A transect placement technique was employed with the goal to adequately sample the sites entirely. 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).

Density 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. In areas where sample viability was unnaturally high (e.g. previous disturbance sites), these parameters sometimes prove to be too stringent or difficult to achieve.

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

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

Sampling the Riparian Areas

The riparian areas were sampled by basically employing two methodologies. To begin the study, a slightly modified version of the USDA Forest Service manual for a *"Level III Riparian Area Evaluation"* (Integrated Riparian Evaluation Guide, March 1992) was used. These methods have been used extensively in Winter Quarters Canyon upstream from the vent site for monitoring the riparian communities located directly above underground coal mining activities to assess potential impacts caused by subsidence. Employing these methods at the vent site make the data more comparable to these existing data sets. This may be helpful in understanding this riparian complex as well as provide valuable information for future restoration of the vent site at the time of final reclamation.

To begin, qualitative and quantitative data were recorded in a representative reach of the study area. The "Riparian Complex Data Sheet" shown on Figure 1 lists all of the qualitative and quantitative data that were recorded here.

As mentioned, USDA Forest Service protocol was employed as a model to drive part of the study plan for quantitative data. *Community Type Cover* is one method to record cover in the USFS

Level III protocol. At the sample location, a transect line was placed across (or perpendicular to) the stream channel. By design, the line transect was based on several factors but the intent was to make the transects long enough to cover the entire stream, its riparian communities, plus an additional 10 ft on each side of the stream to record the adjacent upland communities.

FIGURE 1: RIPARIAN COMPLEX DATA SHEET

CLIENT:
COMPLEX: Riverine - Number
WATERBODY NAME:
LOCATION:
DATE:
OBSERVER(S):
QUAD NAME:
GEOLOGIC PARENT MATERIAL:
ASPECT:
STREAM GRADIENT:
ELEVATION: .
ADJACENT UPLAND VEGETATION (looking downstream)
Left: Right:
VEGETATIVE DESCRIPTION (Dominance by Community Types)
SUCCESSIONAL STATUS:
APPARENT FORAGE TREND:
ESTIMATED FORAGE PRODUCTION:
BEAVER ACTIVITY:
PHOTOGRAPH TAKEN:
LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA:
SPECIES OBSERVED:
POOL ATTRIBUTES
- % area in pools:
- % pool area made up of pools > 2' deep:

AQUATIC VEGETATION
- % streambed with filamentous algae:
- % stream margin with rooted aquatic:

BANK TYPE & VEGETATION OVERHANG
- % bank length undercut (<90°):
- % bank length gently sloping (>135°):
- % bank length with overhanging vegetation:

BANK CONDITION (bankfull area only)
- % bank length vegetated, stable:
- % bank length unvegetated, stable:
- % bank length vegetated, unstable:
- % bank length unvegetated, unstable:

NOTES:
QUANTITATIVE DATA SUMMARY:
PHOTOGRAPHIC DOCUMENTATION:

Once the transect was placed, the line-intercept method was employed to measure the extent of each major plant community at the sample location. The plant communities have been named by the dominant two plant species. If only one species dominated the community by a wide margin, the plant community was named by this single species. In this report, when reference is made to the left or right side of the drainage, this means "river left" or "river right", *as characterized by looking downstream.*

[**NOTE:** Geomorphological stream channel data outlined in the Forest Service Level III protocol

were not recorded as part of this study because Canyon Fuel Company has conducted other studies that will suffice for this information. Additionally, soil information through the Natural Resources Conservation Service (NRCS) were not available for the study areas].

The next method used for sampling the riparian complex at the Winter Quarters Canyon vent site measured the aerial cover of the channel including the riparian plant community, rock, water and bareground for the length of the stream reach that is to be impacted by construction of the site. To accomplish this, transect lines were placed at exactly 50 ft intervals from the uppermost to the lowermost portion of the stream in the permit area (Map A). At each of these transects, the widths of the riparian community, rock, water and bareground cover were recorded. Color photographs were also take on the left side of the channel where the transect began.

Threatened & Endangered Species Survey

The list of federally listed 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 (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

Previously Disturbed Community

The proposed ventilation site supported an upland plant community that had been previously disturbed by other unrelated activities such as logging and heavy grazing by domestic livestock. Consequently, this area supported a host of invader, "weedy" and exotic species such as stinging nettle (*Urtica dioica*), musk thistle (*Carduus nutans*) and hounds-tongue *(Cynoglossum officinale*). However, native and less disturbance-prone species, such as snowberry (*Symphoricarpos oreophilus*), Kentucky bluegrass (*Poa pratensis*) and redtop *(Agrostis stolonifera*) were also present in this area. For a list of the plant species found here along with their total cover and frequency values, refer to Table 1. For a color photograph of the area refer to Photo 1.

The total living cover for the previously disturbed area was estimated at 48.75% (Table 2-A). This living cover was comprised of 46.35% grasses, 40.41% forbs and 13.24% woody species (Table 2-B). Woody species density in the area was estimated at only 30.22 individuals per acre (Table 3).

Proposed Disturbed Sagebrush/Grass Community

Another upland community proposed for disturbance by construction of the vent pad was a sagebrush/grass community (Map A). This community was dominated by mountain sagebrush *(Artemisia tridentata* var. *vaseyana*), Salina wildrye (*Elymus salinus*) and snowberry (Table 4). The total living cover in this community was estimated at 48.50% (Table 5-A), of which consisted of 76.18% shrubs, 20.94% grasses and 2.88% forbs (Table 5-B). The woody species density for this community was estimated at 6,303 individuals per acre (Table 6). For a color photograph of the area refer to Photo 2.

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 A). This community was dominated by mountain sagebrush, Salina wildrye, antelope bitterbrush *(Purshia tridentata*) and snowberry (Table 7). The total living cover of the area was estimated at 49.75% (Table 8-A). The living cover was comprised of 74.99% shrubs, 24.10% grasses and 0.91% forbs. The woody species density for this reference area was composed of 4,389 individuals per acre (Table 9). For a color photograph of the area refer to Photo 3.

Proposed Disturbed Riparian Area

As described in the Methods section above, two methodologies were employed to sample the proposed disturbed riparian community at the ventilation site in Winter Quarters Canyon. To begin, USDA Forest Service protocol for sampling riparian complexes was employed. Results from this study have been provided in Table 12. The data in the table provide both qualitative and quantitative data in a representative transect area within the riparian complex. Plant species present, community types and all parameters shown in Figure 1 are also provided in the table. For color photographs of the area refer to Photos 4 *thru* 26.

One of the primary goals for studying plant communities that are proposed for disturbance by mining-related activities is to provide biological information that facilitates restoration of the site to its approximate pre-disturbance condition following final reclamation. That said, one of the most important parameters to document here is the amount of riparian community that will be disturbed and temporarily lost due to the proposed operations. Or, in order to reclaim the community to its pre-disturbance condition, it should be determined how much of the riparian corridor is to be disturbed. This was accomplished by measuring the widths of the riparian complex in the vent pad area. To quantify this, the width of the riparian corridor (including riparian vegetation, water, rock and bareground width) was measured every 50 feet. The mean widths were calculated and total acreage was then derived. The average width of the riparian vegetation within the reach that has been proposed for disturbance was 19.04 ft (Table 10-A). Subsequently, the total acreage of riparian vegetation that will be disturbed during construction

of the ventilation site was 0.459 acre (Table 10-B).

Riparian Reference Area Considerations

There are a couple of considerations for areas to be used as reference areas for revegetation success standards. First, the Riparian Complex Data Sheets in Table 12 can be used for baseline information of the area. Next, and as mentioned above, there are several years of data where these same parameters were sampled to monitor potential impacts from subsidence caused by mining underneath Winter Quarters Canyon, some of which were sampled in 2008.

Another area that could be considered to be used as a reference area in place of, or in addition to the above consideration, is the area just outside the permit boundary of the ventilation site. This area is adjacent to the vent site and located just upstream from it (Map A). The widths of this area were also measured in 2008 using the same methods as were used in the proposed disturbed area. Channel geomorphology changes somewhat here resulting in the average width of the riparian zone to increase to 31.29 ft. when compared to the proposed disturbed section (Table 11-A). Acreage of the riparian vegetation of the reach measured here was 0.395 acre (Table 11-B). For a color photographs of the area refer to Photos 26 *thru* 36.

Threatened & Endangered Species

There are several federally listed plant and species that are known to occur in Carbon County,

Utah. These species are listed on Table 13 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.

Like the name suggests, the area supports a **Previously Disturbed Community** that had been disturbed earlier by activities unrelated to mining. In those areas that have been disturbed previously, state regulations require that "*at a minimum, the vegetative ground cover will be not less than the ground cover existing before redisturbance and will be adequate to control erosion*". Therefore, the standards for revegetation success in this area should be those reported for total living cover in this area (Table 2-A).

Unlike the above community, the **Proposed Disturbed Sagebrush/Grass Community** was 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 2). When woody species densities were compared between these two areas, the difference was significant (Figure 3), 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 2. 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

Revegetation standards of success for the **Proposed Disturbed Riparian Complex** in the area was less straightforward. Quantifying the size of the existing vegetation in the area has been

described in this document. Rather than relying on the most common parameters for revegetation success such as total living cover, woody species density, diversity and so on, it seems more appropriate to establish the habitat necessary for natural reestablishment of this riparian complex. In other words, reestablishment of the general geomorphology of the stream should provide suitable habitat for establishment of the riparian plants that are currently supported in this area. Propagules of plants in these areas will be naturally dispersed from those plants upstream from the ventilation site. Establishment of these plants will be accomplished by natural dispersal mechanisms if the adequate habitat has been established during the reclamation activities. The revegetation success standards here should be to establish as least 0.459 acre of riparian vegetation along the restored stream in Winter Quarter Canyon – the amount measured be disturbed as a result of construction of the ventilation shaft site.

Figure 3. 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).

Previously Disturbed Community	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Symphoricarpos oreophilus	6.25	13.86	25.00
FORBS			
Carduus nutans	4.75	6.61	40.00
Cirsium sp.	2.00	6.78	10.00
Cynoglossum officinale	2.50	4.03	30.00
Polygonum aviculare	0.50	2.18	5.00
Urtica dioica	6.25	11.50	35.00
GRASSES			
Agrostis stolonifera	3.75	11.92	10.00
Bromus carinatus	1.50	4.77	10.00
Dactylis glomeratus	0.50	2.18	5.00
Elymus spicatus	2.25	9.81	5.00
Poa pratensis	18.50	25.50	55.00

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

Previously Disturbed Community	Mean Percent	Standard Deviation	Sample Size
A. TOTAL COVER			
Total Living Cover	48.75	26.36	20
Litter	20.75	23.28	20
Bareground	25.10	25.84	20
Rock	5.40	3.77	20
B. % COMPOSITION			
Trees & Shrubs	13.24	25.58	20
Forbs	40.41	35.85	20
Grasses	46.35	38.19	20

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

Previously Disturbed Community	
SPECIES	**Individuals Per Acre**
Populus tremuloides	0.76
Ribes sp.	0.76
Rosa woodsii	1.51
Symphoricarpos oreophilus	27.20
TOTAL	**30.22**

Table 4. 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 5. 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 6. 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 7. 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 8. 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 9. 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 10: Proposed Disturbed Riparian Area

	Mean	Std. Dev.	Sample Size
A. WIDTH (ft)			
Riparian Vegetation	**19.04**	10.97	21
Water	5.76	1.27	21
Rock	1.46	1.09	21
Bareground	0.08	0.05	21
TOTAL	26.34	11.47	21
B. ACREAGE			
Riparian Vegetation	**0.459**	0.264	21
Water	0.139	0.029	21
Rock	0.035	0.025	21
Bareground	0.002	0.001	21
TOTAL	0.635		

Table 11: Riparian Reference Area

	Mean	Std. Dev.	Sample Size
A. WIDTH (ft)			
Riparian Vegetation	**31.29**	24.91	11
Water	5.81	1.69	11
Rock	1.25	1.26	11
Bareground	0.00	0.05	11
TOTAL	38.35	25.05	11
B. ACREAGE			
Riparian Vegetation	**0.395**	0.572	11
Water	0.073	0.039	11
Rock	0.016	0.029	11
Bareground	0.000	0.001	11
TOTAL	0.484		

Table 12: Winter Quarters Ventilation Site Riparian Complex Data Sheet: 2008

CLIENT: Canyon Fuel Company, Skyline Mines

COMPLEX: Winter Quarters Ventilation Facility Area

WATERBODY NAME: Winter Quarters Canyon Creek

LOCATION: Wasatch Plateau, Utah

DATE: 26 September 2008

OBSERVER(S): P.D. Collins. S. Vlietstra

QUAD NAME: Scofield, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Formation

STEAM ASPECT: E

STREAM GRADIENT: 2-3 ^{o}

ELEVATION: 8,115 ft

SIZE OF COMPLEX: (see quantitative data)

ADJACENT UPLAND VEGETATION (looking downstream)
Left: Snowberry/Willow/Disturbed Right: Blue Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data results for this information)	

SUCCESSIONAL STATUS: Climax

APPARENT FORAGE TREND: Stable

ESTIMATED FORAGE PRODUCTION: 600 lbs/acre

BEAVER ACTIVITY: Historical activity in this drainage.

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

Table 12 (continued)
Vent Site
WQ Riparian Study: 2008

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Picea pungens	*Symphoricarpos oreophilus*	*Urtica dioica*	*Agrostis stolonifera*
Populus tremuloides	*Rosa woodsii*	*Epilobium angustifolium*	*Juncus arcticus*
	Lonicera involucrata	*Geranium richardsonii*	*Carex hoodii*
	Salix spp.	*Ranunculus cymbalaria*	

POOL ATTRIBUTES

% area in pools: 20

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 90

BANK CONDITION

% bank length vegetated, stable: 85

% bank length unvegetated, stable: 5

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 5

NOTES:

1) Heavy use by livestock & wildlife; there were disturbance spp. present i.e. stinging nettle, musk thistle, etc, on upland areas about the riparian area (see photographs).

2) To choose sample area, we took a rough average of the riparian width in the area them placed the transect in that area.

3) GPS Name: WQ Rip TNST; Coordinates: UTM, NAD27, 0482790E. 4396509N.

4) A great deal of data are available from riparian monitoring upstream of this site.

Table 12 (continued)
Vent Site
WQ Riparian Study: 2008

DATA SUMMARY

Cover by community types in Winter Quarters Canyon Ventilation Site (2008).

UPLAND VEGETATION	Cover (ft)
L: *Symphoricarpos oreophilus/Salix sp./Disturbed*	10.00
R: *Picea pungens/Populus tremuloides*	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
L: Agrostis stolonifera/Carex nebrascensis/Salix sp.	10.00
R: Agrostis stolonifera	2.50
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	12.50
ROCK (channel)	1.00
WATER (channel)	6.50
BAREGROUND (channel)	0.00
LITTER	0.00
MOSS	0.00
TOTAL COVER	40.00

Table 13: 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 13: 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: Previously Disturbed

Photo 2: Proposed Disturbed Sagebrush/Grass

Photo 3: Sagebrush/Grass Reference Area

Photo 4: Proposed Disturbed Riparian (FS protocol transect)

Photo 5: PD1

Photo 6: PD2

Photo 7: PD3

Photo 8: PD4

Photo 9: PD5

Photo 10: PD6

Photo 11: PD7

Photo 12: PD8

Photo 13: PD9

Photo 14: PD10

Photo 15: PD11

Photo 16: PD12

Photo 17: PD13

Photo 18: PD14

Photo 19: PD15

Photo 20: PD16

Photo 21: PD17

Photo 22: PD18

Photo 23: PD19

Photo 24: PD20

Photo 25: PD21

Photo 26: RF1

Photo 27: RF2

Photo 28: RF3

Photo 29: RF4

Photo 30: RF5

Photo 31: RF6

Photo 32: RF7

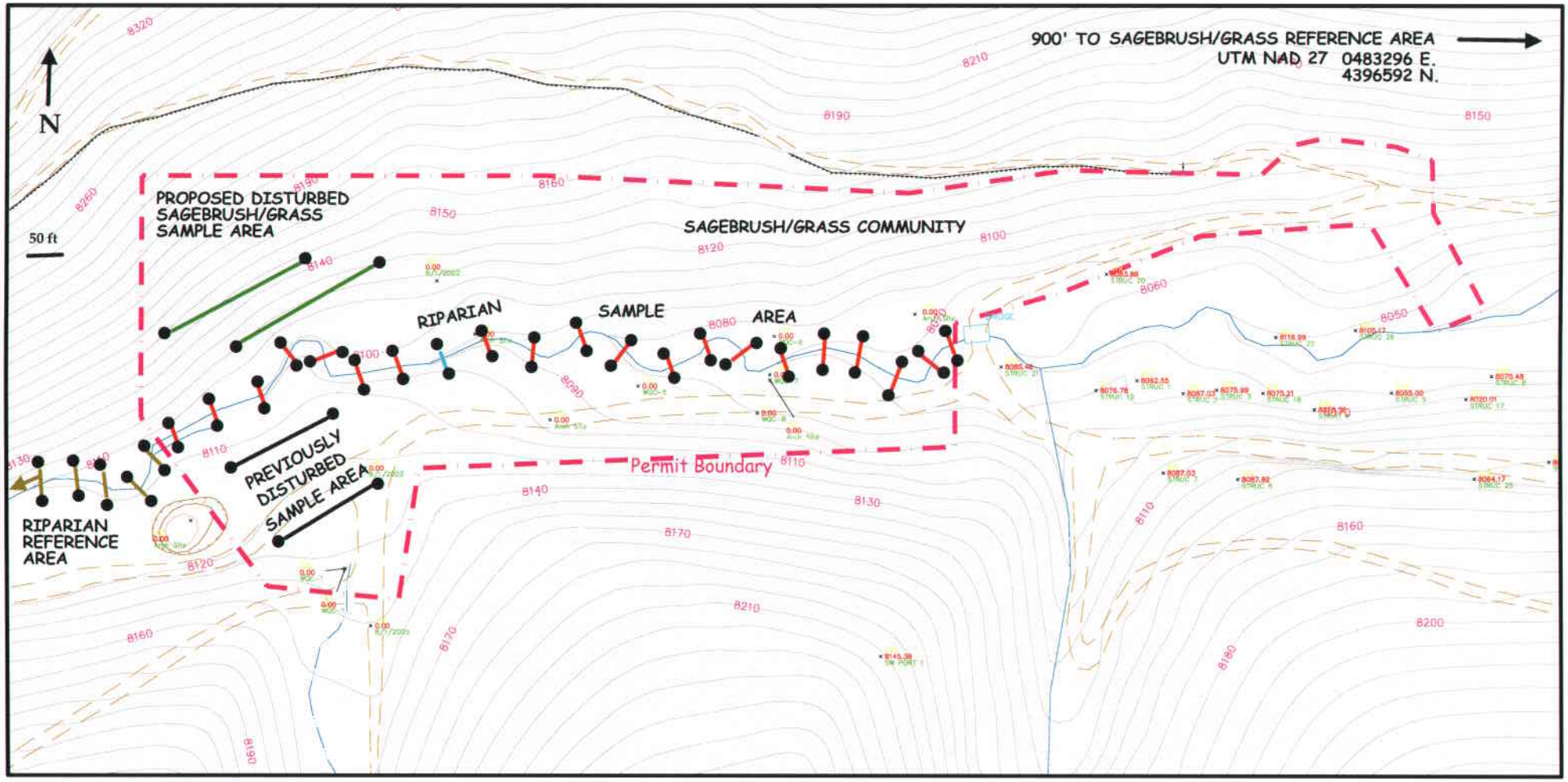
Photo 33: RF8

Photo 34: RF9

Photo 35: RF10

Photo 36: RF11

VEGETATION SAMPLE AREAS AT THE WINTER QUARTERS VENTILATION SHAFT SITE



Sample Transect Lines

Proposed Disturbed	Riparian Widths	Riparian Complex	Upland Data
Reference Area	Riparian Widths	Previously Disturbed	Upland Data

MAP A

Base map by Earthfax Engineering

MT. NEBO SCIENTIFIC, INC.
Research & Consulting
P.O. Box 337
Springville, Utah

10 July 2009

Append A-3, Vol. 2

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,

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.

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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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Append A-3, Vol. 2

TETRA TECH

March 13, 2009

Gregg Galecki
Environmental Engineer
Skyline Mines,
Canyon Fuel Company, LLC
(435) 448-2636

RE: Winter Quarter's Canyon Wildlife Studies Summary for 2006 through 2008

Dear Mr. Galecki:

Skyline Mines, Canyon Fuel Company, LLC (Skyline) is proposing to construct a ventilation shaft and pad in Township (T) 13 South (S), Range (R) 6 East (E), in Section 1 in the Northwest (NW) ¼, which is located on private land, adjacent to the Manti La Sal National Forest (**Figure 1**). The construction for this project is anticipated to take up to two years to complete. After the completion of the ventilation shaft and pad, an exhaust fan will be assembled on the pad site and operational for the life of the mine. Tetra Tech, Inc. (Tetra Tech) has been conducting Northern goshawk and Forest Service management indicator species surveys in and around this site and within adjacent locations in the Manti La Sal National Forest since 2006. The intent of these wildlife surveys was to document all special status species in the vicinity of the proposed construction and exhaust fan site. No vegetation surveys were conducted as part of these studies.

This letter addresses the results of the 2006, 2007, and 2008 wildlife baseline surveys, and any potential impacts that may be associated with construction and operation of the proposed exhaust fan. This letter also addresses the results of a sound study conducted for Canyon Fuel Company's Sufco Mine, within the Manti La Sal and Fish Lake National Forests. This study is being used as a guide for determining the potential affects of the proposed exhaust fan and construction activities on wildlife in Winter Quarter's Canyon.

Wildlife Baseline Surveys 2006 through 2008 Summary

Tetra Tech conducted Northern goshawk and related Forest Service management indicator species clearances as part of the joint agency (Forest Service and Bureau of Land Management) coal exploration activities on Forest Service Lands. Each year Northern goshawk broadcast vocalization calling surveys were conducted following U.S. Department of Agriculture (USDA) Forest Service protocol (*Northern goshawk inventory and monitoring technical guide* by B. Woodbridge and C.D. Hargis, 2006). The surveys were conducted along the designated flight paths, helicopter/equipment staging areas and existing/proposed drill hole sites.

Tetra Tech
136 E. South Temple, Suite 910, SLC, Utah 84111
Tel 801.364.1064 Fax 801.364.2021 www.tetratech.com

The Winter Quarters Canyon coal exploration area is accessed from the top by Forest Service (FS) Pack Trail 369 off the Granger Ridge Road (FS Road 221) via Highway 264 west of the existing Skyline Mine operations or from the bottom of Winter Quarter's Canyon from Highway 96 in Scofield. From FS 369 the survey area continues down into Winter Quarters Canyon through Sections 2, 3, and 4 in T13S and R6E and then continues onto private lands in Section 1 T13S and R6E. FS 369 then turns into FS Road 121 within the private lands in Sections 5 and 6 in T12S and R7E and then meets Highway 96.

The habitat along the FS 121 and FS 369 corridor at the bottom of Winter Quarter's Canyon, consists predominately of sagebrush on the north slope and mixed conifer and aspen on the south slope. Habitat changes to aspen and mixed conifer at the fork of Bob's Canyon and Winter Quarter's Canyon, in Section 2 T13S R6E (**Figure 1**). Though suitable mixed conifer habitat for Northern goshawks is located in the upper portions of Winter Quarter's Canyon within one-mile of the proposed ventilation shaft and pad, no active nests were located during the 2006, 2007, and 2008 field efforts.

Only one Northern goshawk was observed within a mile of the proposed ventilation shaft and pad at calling station wqJS05 in T13S R6E Section 2 in the SE ¼ of the NE ¼ on June 5th, 2007. The bird did not respond on the second site visit and no nest was ever located. This observation was determined to be transitory. **Figure 1** shows the locations of all the Northern goshawk calling stations located within one-mile of the proposed ventilation shaft and pad that were surveyed from 2006 through 2008. **Table 1** shows the Northern goshawk calling station locations and the results by year of these surveys within one-mile of the proposed ventilation shaft and pad. All other observations of Northern goshawks in Winter Quarter's Canyon were over a mile away from the proposed project area and are as follows (**Figure 1**):

- On June 8th, 2006 a Northern goshawk responded to calls at calling station wq17 (T13S R6E Section 15 in the SE ¼ of the NE ¼) off of FS 221. A nest search was conducted but no nest was found.
- On June 28th, 2006 a Northern goshawk responded to calls at calling station wq18 (T13S R6E Section 14 in the SW ¼ of the NW ¼) off of FS 221 and then flew away. No nest was located.
- On June 5th, 2007 a Northern goshawk responded to calls at calling station wqCT56 (T12S R6E Section 34 in the NE ¼ of the SE ¼). A nest search was conducted but no nest was found.

No nesting birds or nests have ever been documented in the area of the proposed project or within a mile of the project area from 2006 through 2008. Elk, elk calves, mule deer, and mule deer fawns have been documented at various locations throughout Winter Quarter's Canyon. No elk or mule deer calving or fawning areas have been documented in the area of the proposed project from 2006 through 2008 or throughout the Winter Quarter's Canyon area.

Based on the results of the past three year study, Tetra Tech does not foresee any impacts to wildlife associated with the construction of the ventilation shaft or pad.

Exhaust Fan Sound and the Potential Wildlife Impacts

Though Tetra Tech did not develop a sound study for the Winter Quarter's Canyon area, a comparison of possible sound impacts to wildlife in this area from the long term operation of the exhaust fan, with a sound study conducted for similar operations at Canyon Fuel Company's Sufco Mine (Sufco) was analyzed. This evaluation will be used as an example to aid in the determination of potential impacts to wildlife in Winter Quarter's Canyon.

The Sufco sound survey was conducted by Tetra Tech within the Manti La Sal and Fish Lake National Forests in July of 2008. Sound level monitoring was implemented to obtain data on sound levels around an existing ventilation fan at select sound sensitive resource locations. The intention of the sound study was to determine the possible sound impacts, of a proposed exhaust fan, based upon sound level data generated by the operational ventilation fan that was presently in use.

The Sufco sound study results showed that background outdoor sound levels for the project area were between 27.6 A-weighted decibels (dBA) and 57.9 dBA. Maximum sound levels between 75.4 dBA and 95.7 dBA were recorded at the existing ventilation fan, and decreased as the distance between the source and monitoring point locations increased. The sound generated at the source was continuous and produced ranges of plus or minus 15 dBA between MAX and MIN recordings. Ranges in decibel readings increased as distance between the source and monitoring point locations increased. These ranges were likely attributed to affects of wind, line of sight, echoing, vegetative cover, and topography on the sound level measurements. The greatest distance from which the fan was audible was determined to be plus or minus 1.43 miles away from the source. The sound levels recorded at 1.43 miles ranged between 28.4 dBA and 54.5 dBA. Though the fan was audible, the sound levels were near background noise levels (27.6 dBA and 57.9 dBA).

It is anticipated that Winter Quarter's Canyon will have unique topographical and vegetative characteristics that may aid or impede sound travel in the adjacent areas. Factors affecting sound travel such as topographic features, vegetation buffers, time of day, wind patterns, seasonal events, background noise levels, shape, power, and orientation of the fan will be key in identifying optimal conditions for sound reduction for the proposed project.

TETRA TECH

Since no sensitive resource locations, such as nesting raptors, elk calving, or mule deer fawning sites, have been located within a mile of the project site; Tetra Tech anticipates minimal impacts to wildlife in the vicinity of the exhaust fan. These impacts include temporary displacement of wildlife passing through the area, temporary avoidance due to human presence during construction activities, and wildlife avoidance caused by abrupt sounds associated with construction activities.

If you have any questions regarding our findings, please feel free to contact us.

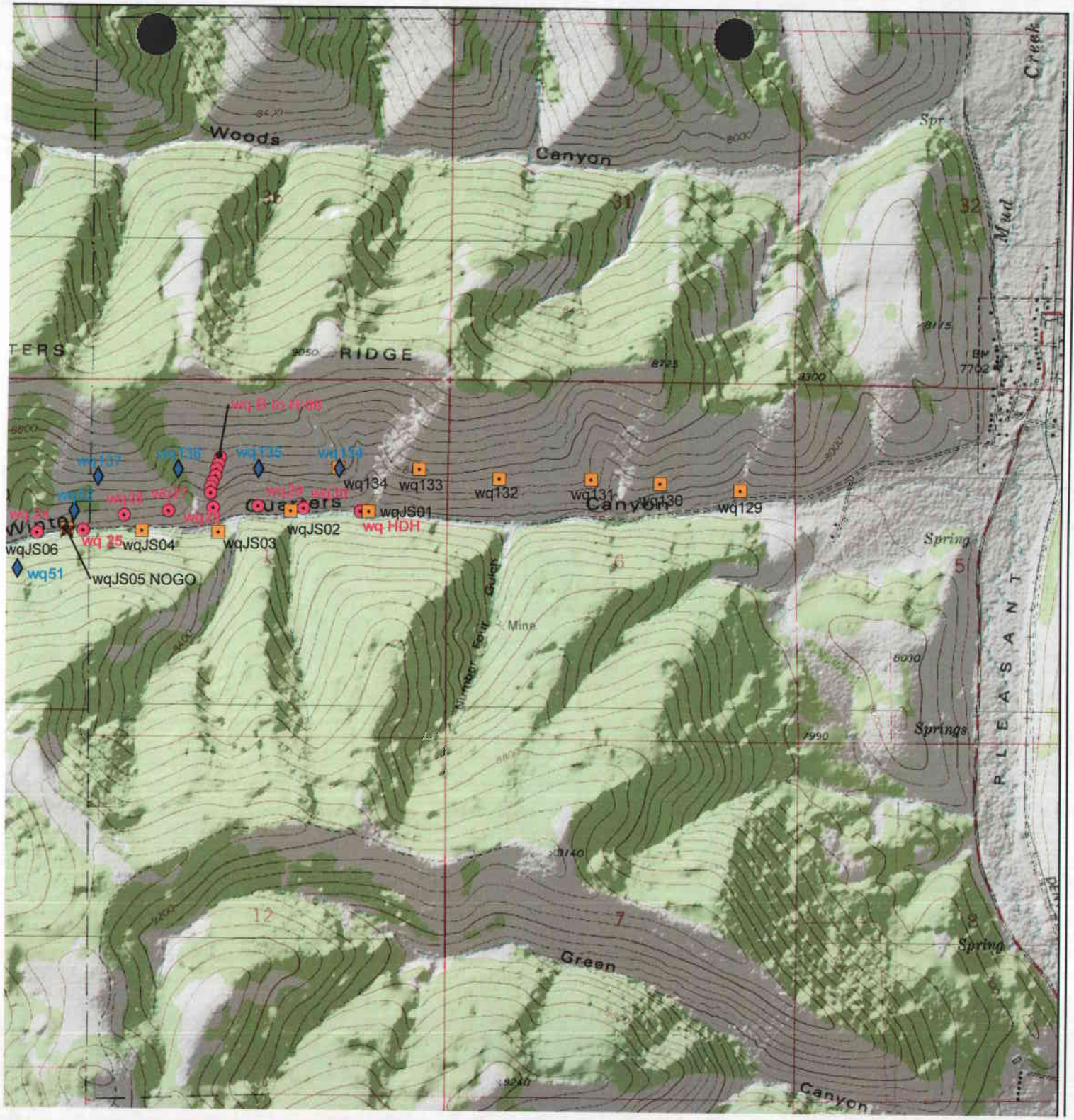
Sincerely,
Tetra Tech

David Steed
Project Manager/Resource Management Lead

Attachments: Table 1 and Figure 1

Table 1: Winter Quarters Canyon Northern goshawk calling station results 2006-2008 within one-mile of the proposed ventilation shaft and pad							
Year	Call Station	Nad 83 UTM Easting	Nad 83 UTM Northing	Township(T) Range (R) Section 1/4 1/4	Dates	Call Response	Nests or Other Wildlife Observations
2006 Northern Goshawk Calling Stations within one mile of the proposed ventilation shaft and pad							
	wq134	483151.66	4396927.05	T13S R6E Section 1 NW 1/4 NE 1/4	June 9th and 28th	none	1 green-tailed towhee (visual) and 1 olive-sided flycatcher (audio) on 6/9/06
	wq135	482791.66	4396926.25	T13S R6E Section 1 NE 1/4 NW 1/4	June 9th and 28th	none	
	wq136	482431.70	4396920.48	T13S R6E Section 1 NW 1/4 NW 1/4	June 9th and 28th	none	
	wq137	482073.72	4396882.45	T13S R6E Section 1 NW 1/4 SW 1/4	June 9th and 28th	none	
	wq52	481968.77	4396727.34	T13S R6E Section 2 SE 1/4 NE 1/4	June 9th and 28th	none	1 marten (visual) on 6/9/06
	wq51	481716.94	4396470.07	T13S R6E Section 2 SW 1/4 NE 1/4	June 9th and 28th	none	
	wq50	481363.45	4396538.22	T13S R6E Section 2 NW 1/4 SE 1/4	June 9th and 28th	none	1 red-tailed hawk (visual) on 6/9/06
	wq49	481015.26	4396629.66	T13S R6E Section 2 SW 1/4 NW 1/4	June 9th and 28th	none	
	wq48	480664.43	4396710.41	T13S R6E Section 3 SE 1/4 NE 1/4	June 9th and 28th	none	
2007 Northern Goshawk Calling Stations within one mile of the proposed ventilation shaft and pad							
	wq129	484946.00	4396843.00	T13S R6E Section 6 SE 1/4 NE 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wq130	484588.00	4396870.00	T13S R6E Section 6 SW 1/4 NE 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wq131	484277.00	4396889.00	T13S R6E Seciton 6 SE 1/4 NW 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wq132	483866.00	4396889.00	T13S R6E Section 6 NW 1/4 NW 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wq133	483509.00	4396928.00	T13S R6E Section 1 NE 1/4 NE 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wq134	483148.00	4396932.00	T13S R6E Section 1 NW 1/4 NE 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqJS01	483286.63	4396736.53	T13S R6E Section 1 SE 1/4 NE 1/4	May 24th and 25th, June 4, 5, and 12th	none	1 mule deer (visual) on 6/5/07
	wqJS02	482935.25	4396737.41	T13S R6E Section 1 SW 1/4 NE 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqJS03	482614.76	4396640.96	T13S R6E Section 1 SE 1/4 NW 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqJS04	482272.91	4396643.19	T13S R6E Section 1 SW 1/4 NW 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqJS05	481938.37	4396648.31	T13S R6E Section 2 SE 1/4 NE 1/4	May 24th and 25th, June 4, 5, and 12th	Goshawk (visual and audio) on 6/5/07	1 mule deer (visual) on 6/12/07
	wqJS06	481604.28	4396571.24	T13S R6E Section 2 SW 1/4 NE 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqJS07	481300.34	4396454.97	T13S R6E Section 2 NW 1/4 SE 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqJS08	481024.51	4396265.18	T13S R6E Section 2 SE 1/4 SW 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqJS09	480656.53	4396180.66	T13S R6E Section 2 SW 1/4 SW 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqJS10	480407.51	4396394.43	T13S R6E Section 3 NE 1/4 SE 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqCT54	480057.32	4397233.67	T13S R6E Section 3 NE 1/4 NE 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqCT53	480392.03	4397224.58	T13S R6E Section 3 NE 1/4 NE 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqCT52	480757.04	4397133.43	T13S R6E Section 2 NW 1/4 NW 1/4	May 24th and 25th, June 4, 5, and 12th	none	1 mule deer (visual) on 6/12/07
	wqCT51	481108.89	4396999.64	T13S R6E Section 2 NE 1/4 NW 1/4	May 24th and 25th, June 4, 5, and 12th	none	
	wqCT50	481394.75	4396753.01	T13S R6E Section 2 SW 1/4 NE 1/4	May 24th and 25th, June 4, 5, and 12th	none	1 elk bugle (audio) on 5/24/07
2008 Northern Goshawk Calling Stations within one mile of the proposed ventilation shaft and pad							
	wq HDH	483251.00	4396736.99	T13S R6E Section 1 SE 1/4 NE 1/4	June 11th and 27th	none	
	wq30	482992.23	4396751.33	T13S R6E Section 1 SW 1/4 NE 1/4	June 11th and 27th	none	
	wq29	482792.28	4396755.83	T13S R6E Section 1 SE 1/4 NW 1/4	June 11th and 27th	none	
	wq28	482592.44	4396747.95	T13S R6E Section 1 SE 1/4 NW 1/4	June 11th and 27th	none	
	wq B-08	482621.00	4396973.99	T13S R6E Section 1 NE 1/4 NW 1/4	June 11th and 27th	none	
	wq C-08	482610.99	4396944.99	T13S R6E Section 1 NE 1/4 NW 1/4	June 11th and 27th	none	
	wq D-08	482601.99	4396918.99	T13S R6E Section 1 SE 1/4 NW 1/4	June 11th and 27th	none	1 sharp-shinned hawk (visual) on 6/11/08
	wq E-08	482598.00	4396892.99	T13S R6E Section 1 SE 1/4 NW 1/4	June 11th and 27th	none	
	wq F-08	482588.99	4396862.99	T13S R6E Section 1 SE 1/4 NW 1/4	June 11th and 27th	none	1 sage-thrasher (visual) and 1 unidentified sparrow (visual) on 6/27/08
	wq G-08	482578.99	4396840.99	T13S R6E Section 1 SE 1/4 NW 1/4	June 11th and 27th	none	
	wq H-08	482578.99	4396812.99	T13S R6E Section 1 SE 1/4 NW 1/4	June 11th and 27th	none	1 golden eagle juvenile (visual) on 6/27/08
	wq27	482393.00	4396732.92	T13S R6E Section 1 SW 1/4 NW 1/4	June 11th and 27th	none	
	wq26	482192.85	4396712.90	T13S R6E Section 1 SW 1/4 NW 1/4	June 11th and 27th	none	1 red-tailed hawk (visual) on 6/11/08
	wq25	482010.73	4396645.68	T13S R6E Section 2 SE 1/4 NE 1/4	June 11th and 27th	none	
	wq24	481802.28	4396632.07	T13S R6E Section 2 SE 1/4 NE 1/4	June 11th and 27th	none	
	wq23	481562.17	4396560.73	T13S R6E Section 2 SW 1/4 NE 1/4	June 11th and 27th	none	1 cooper's hawk (visual) on 6/11/08
	wq22	481418.80	4396710.46	T13S R6E Section 2 SW 1/4 NE 1/4	June 11th and 27th	none	1 mule deer (visual) and 1 mule deer fawn (visual) on 6/11/08
	wq21	481286.42	4396865.70	T13S R6E Section 2 SW 1/4 NE 1/4	June 11th and 27th	none	

Table 1: Winter Quarters Canyon Northern goshawk calling station results 2006-2008 within one-mile of the proposed ventilation shaft and pad (continued)							
Year	Call Station	Nad 83 UTM Easting	Nad 83 UTM Northing	Township(T) Range (R) Section 1/4 1/4	Dates	Call Response	Nests or Other Wildlife Observations
2008 Northern Goshawk Calling Stations within one mile of the proposed ventilation shaft and pad							
	wq20	480681.74	4396699.52	T13S R6E Section 2 SW 1/4 NW 1/4	June 11th and 27th	none	
	wq19	480479.73	4396772.71	T13S R6E Section 2 SW 1/4 NW 1/4	June 11th and 27th	none	
	wq18	480302.61	4396856.70	T13S R6E Section 3 SE 1/4 NE 1/4	June 11th and 27th	none	
	wq10	480380.81	4397182.97	T13S R6E Section 3 NE 1/4 NE 1/4	June 11th and 27th	none	
	wq9	480592.69	4397146.72	T13S R6E Section 2 NW 1/4 NW 1/4	June 11th and 27th	none	
	wq8	480788.91	4397085.39	T13S R6E Section 2 NW 1/4 NW 1/4	June 11th and 27th	none	
	wq I-08B	480692.00	4397397.00	T12S R6E Section 35 SW 1/4 SW 1/4	June 11th and 27th	none	
	wq I-08	480742.99	4397282.00	T13S R6E Section 2 NW 1/4 NW 1/4	June 11th and 27th	none	1 unidentified woodpecker (audio and visual) on 6/27/08
	wq I-08C	480762.99	4397199.00	T13S R6E Section 2 NW 1/4 NW 1/4	June 11th and 27th	none	
	wq J-08B	480770.99	4396991.99	T13S R6E Section 2 NW 1/4 NW 1/4	June 11th and 27th	none	
	wq J-08	480729.00	4396854.99	T13S R6E Section 2 SW 1/4 NW 1/4	June 11th and 27th	none	1 common raven (visual) on 6/27/08
	wq J-08C	480680.00	4396792.00	T13S R6E Section 2 SW 1/4 NW 1/4	June 11th and 27th	none	1 common raven (visual) on 6/27/08



Legend

- 2006 Call Stations
- 2006 Northern Goshawk Visual-Audio
- 2007 Call Stations
- 2007 Northern Goshawk Visual-Audio
- 2008 Call Stations

0 462.5 925 1,850

Feet

1:24,000

Append A-3, Vol. 2

Vol. 5, Sec. 24

Winter Quarters
Ventilation and Mine Slope Pad,
Skyline Mine,
Runoff and Sediment Control Design Report

Canyon Fuel Company
Skyline Mine
Scofield, Utah

October 2009

EarthFax EarthFax Engineering, Inc.

Engineers / Scientists
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Attachment A – Operational Diversion Calculations
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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 to construct a vertical ventilation shaft and a sloped mine-access portal to the Skyline Mine in Winter Quarters Canyon, about 2 miles southwest of the town of Scofield in Carbon County, Utah (see Figure 1). Construction of this facility will require the installation of diversion ditches and a sedimentation pond. These structures will be constructed in accordance with the applicable criteria of the Utah Administrative Code Title R645-301.

The purpose of this document is to present design information associated with the runoff- and sediment-control measures noted above. Information contained in this document includes:

- Location and background information;
- Hydrologic analyses to determine runoff and sediment discharge for design storm events;
- Sedimentation pond sizing and design criteria;
- Slope stability analyses for sediment pond embankments; and
- Pond construction specifications.

Engineering calculations are included as appendices to this document.

CHAPTER 2
LOCATION AND BACKGROUND INFORMATION

The Winter Quarters ventilation shaft, mine slope, and associated facilities will be constructed in Winter Quarters Canyon approximately 2 miles southwest of Scofield, Utah. The south side of the canyon near the site has been disturbed by past logging and other activities, while the north side is less disturbed.

The watershed area contributing to the sedimentation pond includes the pad areas for the mine slope, ventilation shaft, power substation, topsoil storage area, and part of the site access road. Construction is planned to begin in the fourth quarter of 2009.

The sedimentation pond has been designed to contain storm runoff and sediment discharge as specified in 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 (modeled as a broad-crested weir) 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.

CHAPTER 3
OPERATIONAL HYDROLOGY

3.1 Inputs

Storm runoff from the area of the Winter Quarters facility was calculated using the curve number methodology as described in the U.S. Natural Resources Conservation Service National Engineering Handbook, Part 630 (formerly Section 4). The selection of runoff curve numbers for undisturbed areas was guided by an examination of streamflow data collected by the U.S. Geological Survey at gaging station 09310700 on Mud Creek at Scofield, Utah. Winter Quarters Canyon is a sub-basin in the Mud Creek watershed above this gaging station. Using the 26-year record of peak annual stream flow, and the Log Pearson Type III method (UDOT, 2008), the magnitude of the 100-year flow event in Mud Creek was determined to be 596 cubic feet per second ("cfs"). HydroCAD, Version 8.50 (Solutions Software, Inc.) was calibrated to generate the same approximate flow (624 cfs), by adjusting the curve number for the larger Mud Creek watershed. This curve number (57) was used to guide curve number selection for the Winter Quarters Canyon sub-basins, using soil data from the Winter Quarters watershed.

As indicated in Table 1, curve numbers for undisturbed areas varied from 48 to 61, based on soil data and typical tabulated values. Curve numbers for disturbed areas generally ranged from 85 to 98, with the area of the topsoil stockpile assumed to have a curve number of 71.

Design storm magnitudes were obtained from the National Oceanic and Atmospheric Administration Atlas 14, Point Precipitation Frequency Estimates web page (NOAA, 2006). Upstream basin area and slopes were determined using USGS 7.5-minute quadrangle topographic maps of the area. Site watershed areas and average slopes were calculated from 2-foot interval topographic data of the site using AutoCAD 2008 software. Storm runoff calculations associated with site diversions are included in Attachment A, while those associated

with the sedimentation pond are provided in Attachment C. A general description of the methods used to derive storm runoff values is included in the following sections.

3.2 Ditch and Culvert Design

All runoff calculations were performed using HydroCAD storm-water modeling software, Version 8.50. The results of these calculations are provided in Attachments A (site diversions) and C (sedimentation pond), and summarized in Table 2. Given the proposed construction of the site in the bottom of a drainage, the primary culverts (WQC-1 and WQC-2) were designed to safely convey the peak flow resulting from the 100-year, 24-hour precipitation event. The remaining diversions were designed to convey the peak flow resulting from the 10-year, 6-hour precipitation event.

The drainage area contributing to the proposed sedimentation pond is delineated in Figure 2A, with surrounding larger watersheds shown in Figure 2B. The watersheds draining to the sedimentation pond (SWQ-1 and SWQ-2) includes both disturbed and undisturbed areas. To the extent feasible, drainage ditches and culverts will be installed to divert runoff from undisturbed areas away from the pad (see Figure 2A).

The hydraulic length of each watershed was determined by measuring the length of the longest flow path on Figures 2A and 2B. This information was entered into HydroCAD storm-water modeling software. The slopes of the flow paths of the smaller watersheds (WQ3, WQ4) and the site were determined from 2 foot interval contours, with each significant change of slope tracked. The slopes for the larger basins WQ1 and WQ2 were determined from contours on USGS topographic maps.

As indicated on Figure 2A, drainage from Winter Quarters Canyon (watershed WQ1, 3007 acres) upstream from the proposed pad will be diverted beneath the pad via a new 60-inch

diameter corrugated metal culvert (WQC-2). Design information regarding this culvert is provided in Table 2. Runoff from watershed WQ2 (274 acres south of the proposed facility) will be diverted into a new 30-inch diameter culvert (WQC-1). This culvert (WQC-1) will discharge into WQC-2 at a manhole. Runoff from watershed WQ3 (48.9 acres on the north side of the canyon) will be collected in a diversion ditch (UD1) along the lowest leg of an existing dirt road north of the proposed facility. This ditch will convey runoff from basin to a new culvert (WQC-3) that will discharge in the main canyon streambed below the site. An additional undisturbed area diversion ditch (UD-2) will be installation on the south side of the existing Winter Quarters Canyon road to divert runoff from the adjacent undisturbed area away from the proposed facility.

Erosion protection was designed at the outlet of culvert WQC-2 to preclude scouring from the peak flow resulting from the 100-year, 24-hour storm event. As indicated in Attachment A, the peak flow resulting from this event was initially calculated to be 91 cfs, with an outlet velocity of 24.2 feet per second ("fps"). Using methods outlined by Thompson et al. (2006), it was determined that internal roughness rings would reduce the exit flow velocity to 7.37 fps (see Figure 3). Riprap will also be placed at the outlet of this culvert to further mitigate the potential for scour erosion (see Figure 4). The design of the roughness rings is detailed in Appendix A.

The roughness rings will be constructed from plate steel to fit the inside diameter of culvert WQC-2. They are designed to be 4 inches tall, and to cover the full inside circumference except for a 6-inch opening at the bottom and a 12-inch opening at the top. The roughness rings will be welded or bolted to the culvert. All corners will be rounded and all edges smoothed to minimize damage to fish.

To allow passage fish during conditions of normal flow, the velocity in the culvert was evaluated during the peak flow resulting from the 2-year, 24-hour event. This storm event was chosen to represent typical seasonal high flow conditions. Baffles were designed to limit the

flow velocity during this event to less than 5 fps, a value considered conducive to fish passage. The design of the fish baffles is detailed in Appendix A and summarized on Figure 3.

Fish baffles are designed to be 6 inch tall with a 6-inch opening at the bottom. They will be spaced on approximately 145-foot intervals in the culvert and will be constructed from plate steel to fit the inside diameter of culvert WQC-2. All corners of the baffles will be rounded and all edges smooth to minimize damage to the fish.

3.3 Sediment Volume Calculations

The sediment yield of the drainage area contributing to the sedimentation pond was calculated using an adaptation of the Universal Soil Loss Equation (USLE) that was developed by the Utah Water Research Laboratory (Israelsen et al., 1984). This method estimates the 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 Attachment B. This method assumes that all the soil mobilized by erosion travels down slope to the proposed sediment pond (i.e., a sediment deliver ratio of 1.0 was assumed). The predicted sediment volume used in the design of the sedimentation pond is therefore conservatively high.

To assist in calculating sediment yield from the area, the watershed was divided into four sections, based on soil type, slope angle, and cover. The average annual sediment yield, in tons per acre, for each section was then multiplied by that section's area to find the annual weight of sediment produced from the area. This value was then divided by the saturated density of the affected soil types to find a volume. Finally, the volumes for each section were summed to determine the total annual yield of the area draining into the sedimentation pond.

The locations of the four sediment yield evaluation sections are shown on Figure 5. These locations include the undisturbed slope above to the north and the area immediately above the sedimentation pond (Area 1), cut slopes above the pads and road (Area 2), and the pad and road areas proper (Area 3). The sedimentation pond, with its flat bottom, and access road around it, was modeled as Area 3. Area 4 consists of mild slopes that will be re-vegetated, such as the topsoil storage pile. Each of these four areas was further broken up to be applicable to three typical water flow paths, shown as Section Lines on Figure 5. Section Line 1 starts at the top of the topsoil pile and follows the path water would flow to the sedimentation pond. Section Line 2 starts at the existing dirt road above to the north, and ends in the disturbed-area drainage ditch (DD-1) that empties into the sedimentation pond. Section Line 3 also starts at the existing dirt road to the north but ends directly in the sedimentation pond. Section Line profiles are shown in Figure 6.

Derivation of each factor in the sediment yield equation is 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). In the undisturbed area, slopes averaged approximately 180 feet, but it was assumed that the low brush and grass vegetation (with a maximum spacing of approximately 6 to 10 feet) would reduce the maximum length of continuous

overland flow to 35 feet or less. In the disturbed areas, the slopes were divided into segments based on variations in slope angle.

- Values for VM were taken from a table provided by Israelsen et al. (1984).

The results of the sediment-yield calculations are contained in Attachment B. The calculated average sediment yield for the area draining to the proposed pond is 3,347 cubic feet per year. This includes the undisturbed land above the site but below ditch UD-1 (1,123 cf/yr), the site and road cuts, pad areas and fill slopes (2,186 cf/yr), and the topsoil storage area (38 cf/yr).

CHAPTER 4
SEDIMENTATION POND DESIGN

4.1 Hydraulic Capacity

The sedimentation pond was sized to contain, without discharging, the runoff from the 10-year, 24-hour precipitation event plus sediment. The design accommodates runoff from both the disturbed and nearby undisturbed areas that cannot be reasonably diverted. The proposed pond has been designed with a bottom length of 130 feet and a bottom width of 18 feet, with 1.5:1 side slopes and a 10-foot depth.

The stage-capacity curve for the proposed sedimentation pond is shown in Figure 7. An 18-inch diameter riser will be installed in the sedimentation pond to act as the primary spillway, with a top elevation of 8075.00 feet. The riser's flow will be through an 18-inch diameter, 64-foot long pipe attached to the riser, with an outflow elevation of 8065.00 feet. As noted, the pond will have the capacity to store sediment to an elevation of 8074.25 feet (a volume equivalent to over 7 years of sediment yielded at its average annual rate). Sediment will be cleaned out of the pond when it reaches an elevation of 8072.25 feet (the elevation corresponding to a volume of 60% of the available sediment storage volume). A 6-inch diameter decant pipe will be placed with its inlet at an elevation of 8074.25 feet, which is the elevation of the top of the sediment storage capacity. This will allow decanting of the stored water when applicable water-quality standards have been met.

An emergency spillway will be constructed on the east embankment of the pond. This spillway will be a 14-foot long broad crested weir installed at a crest elevation of 8077.00 feet. This is 2 feet above the inlet to the primary spillway, and 1 foot below the compacted maximum elevation of the embankment. The channel of the emergency spillway will be constructed with 12:1 side slopes.

Results of the inflow-outflow analyses from the 10-year, 24 hour storm and the 25-year, 6-hour storm utilizing the primary and emergency spillways are included in Attachment C. The peak stage during the 10-year, 24-hour event as calculated by HydroCAD was determined to be 0.11 foot above the design sediment storage level (8074.25) at an elevation of 8074.36 feet, still 0.64 feet below the primary spillway elevation of 8075.00 feet. The capacity of the primary spillway was verified by assuming the pond was full up to the primary spillway level of 8075.00 feet elevation at the time that the 25-year, 6-hour storm event occurred. The peak elevation for this scenario was 8075.02 feet elevation, which is below the 8077.00 foot elevation of the emergency spillway. Thus, all water for the 25-year 6-hour design event will pass safely through the primary spillway.

4.2 Erosion Protection for Pond Culvert Outflows

Inflow to the sedimentation pond will occur via ditch DD-1 and by sheet flow off the adjacent areas. As indicated in Attachment C, the peak outflow from the primary spillway was calculated to be 0.06 cfs with a velocity of 0.51 fps. This discharge is low enough to be considered non-erosive.

The emergency spillway will not normally flow during the design runoff events. However, the model was run assuming that the primary spillway was not functioning and the pond assumed full to the emergency spillway crest (8077.00 ft) prior to the occurrence of the 25-year, 6-storm event. Under this scenario, the outflow from the emergency spillway was calculated to be 0.02 cfs, with a velocity of 0.21 fps at the crest. This velocity is considered non-erosive.

Both the primary and emergency spillway outlets terminate, or release flow in proximity of the outlet of the 60-inch culvert conveying the main canyon flow for Winter Quarters Canyon

(WQC-2). Erosion protection at the outlet of this culvert is adequate to preclude scouring from the peak flow discharging from the sedimentation pond.

4.3 Sedimentation Pond Details

The embankment of the sedimentation pond will have a crest elevation of 8078.00 feet, and a crest width of approximately 10 feet. Topsoil will be removed from this area and stored nearby prior to construction of the pond. The embankment slopes on the sides of the pond will be angled at 1.5H:1V. To ensure slope stability, compacted embankment material will measure at least 5 feet in depth on the floor of the pond for at least 8 feet upstream from the base of the slope.

The embankment will be constructed from native clayey/silty 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.

CHAPTER 5
POND SLOPE STABILITY ANALYSES

5.1 Approach

The stability of the sedimentation pond was analyzed using *Slide*, Version 5.0, by RocScience. This software uses an iterative procedure to evaluate factors of safety against failure for various failure surfaces that may occur throughout 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. In this instance the factor of safety is defined as follows:

$$FS = \frac{\sum \mathrm{Re}\,sistingForces}{\sum DrivingForces}$$

Te required minimum acceptable factor of safety for the embankment is 1.3, with the pond at normal pool level and steady-state seepage saturation conditions (see R645-301-533.100).

This embankment's stability was analyzed for both the inside and outside slope failure. The inside slope was analyzed without water in the sedimentation pond. This is the more critical state since the water helps to retain the inside slope. The outside slope was analyzed with the sedimentation pond at its maximum level and seepage occurring throughout the slope. This is the most critical state for the outside slope since the water acts as a driving force against the outside slope as well as reduces the soil's effective strength by creating seepage pressures within the embankment.

5.2 Model Input Parameters

The sedimentation pond embankment was analyzed within *Slide* using Bishop's Simplified Method. 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). Separate analyses were run for each of the two main soil types expected to be used for construction of the embankment in order to find the minimum factor of safety. These soil types expected are a clay loam and sandy loam as shown on the Natural Resources Conservation Service's web soil survey (NRCS, 2008). A summary of the engineering properties used for these soil types can be found in Attachment D.

5.3 Results

Nearly 5,000 various failure surfaces were evaluated within the boundaries of the embankment fill. The minimum factor of safety for all scenarios analyzed is 1.74. This critical condition corresponds to the outside slope of the embankment constructed of clay loam with the water surface at an elevation of 8075 ft (top of riser). This factor of safety is significantly larger than the required value of 1.3, indicating that the slope will be stable under the anticipated operating conditions. See Attachment D for all output from the slope stability software.

CHAPTER 6
RECLAMATION HYDROLOGY

Natural drainage patterns will be restored during reclamation. Calculations supporting the reclamation of stream channels in Winter Quarters Canyon are provided in Attachment E. Watershed boundaries used in calculating peak flows are indicated on Figure 8. As shown on Figure 9, the following channels will be constructed during reclamation:

- RC-1: Winter Quarters channel
- RC-2: Unnamed perennial tributary channel south of the facility area

Pre-mining observations in Winter Quarters Canyon indicate that the primary channel can be classified as a Type A4 stream (using the stream classification system of Rosgen, 1996). The A in the classification indicates that this stream type is generally entrenched and is characterized by a steep gradient (typically 4 to 10 percent) with a low width-to-depth ratio and low sinuosity. The 3" in the classification indicates that the channel material is generally composed of cobbles, with lesser amounts of gravel, sand, and fines. The natural stream at bankfull stage had a width of approximately 4 to 6 feet and a depth at the thalweg of approximately 1 to 2 feet. This channel exists within flood plain that has a variable width of approximately15 to 30 feet across the valley.

To restore the natural drainage patterns, the channel in Winter Quarters Canyon will be constructed to provide protection against erosion of the site by future runoff events. To return the channel to a more natural condition, selectively-placed obstructions, such as boulders and logs, will be installed during construction of the reclamation channel. This will help mimic pre-mining conditions and provide appropriate fish habitat. These enhancement features will promote the deposition of sediment upstream from the obstructions and create a step-pool system that is typical of Type A streams. If future runoff events cause variations within the step-

pool system, these changes will be in keeping with the morphological processes which are also typical of Type A streams. However, with the stability provided by the channel, the site should be protected, even if minor local changes occur within the reclaimed reaches of the Winter Quarters reclaimed channel.

To accomplish the above morphological goals, the Winter Quarters channel will be reclaimed by first constructing a riprap-lined channel to serve as a stable base for future flows. RC-1 was designed to safely convey the peak flow resulting from the 100-year, 24-hour precipitation event, thus slightly exceeding the requirements of R645-301-742.323. This channel will be constructed with a bottom width of 5 feet, a depth of 2.5 feet, 2H:1V side slopes, and a median riprap diameter of 4 inches. Channel RC-2 was also designed to safely convey the peak flow resulting from the 100-year, 24-hour precipitation even, with a bottom width of 5 feet, a channel depth of 1.5 feet, 2.5H:1V side slopes, and a median riprap diameter of 12 inches. Larger riprap is required in RC-2 than in RC-1 due to the steepness of the RC-2 channel slope (resulting in a higher design velocity). In each case, the thickness of the installed riprap will be equal to twice the median riprap diameter or 6 inches, whichever is greater. Sand filter blankets will be installed beneath the riprap at a thickness equal to one-half the thickness of the riprap or 6 inches, whichever is greater.

Since the site materials will be reworked during construction of the facility, pre-construction samples of channel bed materials would not likely be representative of reclamation conditions. Hence, no information is presented in this plan regarding filter blanket sizing. Following regrading of the materials at the location of each reclamation channel, and prior to installation of the riprap, samples of the bed material will be collected and analyzed to determine soil gradations. The need for and composition of a filter blanket will then be determined in accordance with standard practices at the time.

According to Rosgen (1996) the following stream-channel stability enhancements are rated as fair to good when applied to an A3 stream:

- Low-stage check dams – designed to collect sediment upstream from the structure with a pool formed immediately downstream from the structure.
- Bank-placed boulders – designed to protect banks from erosion
- Rock or log spurs – designed to stabilize streambanks by breaking up eddys that add stress to the near-bank region.

Each of the structures also improve in-stream fish habitat. Figure 10 provides typical drawings of the above applications.

To restore the channel to a more natural condition, the stream-channel stability enhancements noted above will be installed during construction of RC-1 to allow for the local upstream accumulation of approximately 1 foot of natural sediment. As the stream deposits the sediment behind the obstructions, this will create a flow section which will approximate natural conditions. Vegetation which becomes established on this sediment will aid in stabilization.

According to Heede (1976), within the range of channel gradients anticipated for RC-1, the slope of sediment deposits behind a channel obstruction are approximately 70 percent of the slope of the underlying channel. Based on a typical reclaimed channel slope of about 4.3 percent, the sediment deposits will have a surface slope of approximately 3 percent. Using equations developed by Heede (1976), these channel and sediment slopes indicate that placing the obstructions at an approximate spacing of every 80 to 90 feet will keep the upstream feature from being submerged by the sediment which accumulates behind the downstream feature. This approximate spacing will be used to place the stability features in RC-1.

Figure 9 provides a plan view of the proposed layout of the main reclamation channel at the site, including potential locations of the low-stage check dams, bank-placed boulders, and rock or log spurs. The exact location and type of obstruction at any individual point may vary

from that indicated on Figure 9, depending on local conditions encountered at the time of reclamation. However, in any case, obstructions of the type noted above will be installed approximately every 80 to 90 feet within the reclaimed channel.

In general, Figure 9 indicates that the log or rock spurs noted in Figure 10 will be installed on bends in RC-1, with the spur pointing upstream at an angle of 20 to 30 degrees, as recommended by Rosgen (1996). The low-stage check dams and bank-placed boulders will be interspersed in the remaining locations of the stream. Based on a review of conditions in the natural stream channel, more bank-placed boulder enhancements will be used than low-stage check dams.

The reclamation channels will be constructed in each area as soon as regrading of the area has been completed, but prior to placement of topsoil and revegetation. Both reclamation channels will be aligned in their approximate pre-mining location. Where channel RC-2 crosses the road that will be retained following reclamation, the side slopes will be flattened to permit vehicular access across the channel. However, the minimum depths and cross sections noted above will be maintained in any case.

CHAPTER 7
REFERENCES

Anderson, L.R., Dunn, I.S., and Kiefer, F.W., 1980. Fundamentals of Geotechnical Analysis, First edition. John Wiley & Sons, New York.

Duncan, J.M., and Wright, S.G., 2005. Soil Strength and Slope Stability. John Wiley & Sons: New Jersey.

Heede, B.H. 1976. Gully Development and Control: The Status of Our Knowledge. USDA Forest Service Research Paper RM-169. Rocky Mountain Forest and Range Experiment Station. Fort Collins, Colorado.

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

National Oceanic and Atmospheric Administration, 2006. *Point Precipitation Frequency Estimates from NOAA ATLAS 14 Vol 1, Ver 4.0.* Accessed via the Internet at http://hdsc.nws.noaa.gov/hdsc/pfds/index.html

Natural Resources Conservation Service, 2008. Web Soil Survey, Carbon Area, Utah, Parts of Carbon and Emery Counties Ver. 4. Accessed via the Internet at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado.

Terzaghi, K., and Peck, R.B., 1968. Soil Mechanics in Engineering Practice. John Wiley & Sons, New York.

Thompson, P.L. and R.T. Kilgore. 2006. Hydraulic Design of Energy Dissipators for Culverts and Channels. Hydraulic Engineering Circular No. 14, 3rd Edition. U.S. Department of Transportation FHWA-NHI-06-086.

Utah Department of Transportation, 2008. *Manual of Instruction Roadway Drainage, Chapter 7: Hydrology*. Accessed via the Internet at http://www.dot.state.ut.us/main/f?p=100:pg:871857543981511::::T,V:826

TABLE 1

Runoff Curve Numbers Used in
Winter Quarters Site Design

Area	Curve Number	Source	Hydro Soil Group	Soil Type	Cover Description
Sedimentation Pond	98	(a)	B	Trag-Croyden Complex (118)	Pond surface bordered by gravel road
Roads and Pads	85	(a)	B	Trag-Croyden Complex (118)	Gravel pad areas, cut slopes, road
Topsoil Stockpile	71	(b)	B	Trag-Croyden Complex (118)	Herbaceous - predominantly grass
Undisturbed Land	48	(c, d)	B	Trag-Croyden Complex (118)	Undisturbed range, fair condition
Undisturbed Land	51	(c, d)	B	Trag stony loam (115)	Forested - pine, aspen, range, fair condition
Undisturbed Land	61	(c, d)	C	Curecanti-Pathead Complex (23)	Forested - pine, aspen, range, fair condition

(a) UDOT (2008), Table 7-12
(b) UDOT (2008), Table 7-15
(c) The soils in the entirety of the larger watershed have not been mapped. The pattern of soil types near the site was used to approximate the entire watershed.
(d) Curve numbers in the larger undisturbed area were calibrated using data obtained from the USGS gaging station located on Mud Creek near Scofield, Utah (see Section 3.1)

TABLE 2

Summary of Watershed Data
and Runoff Results

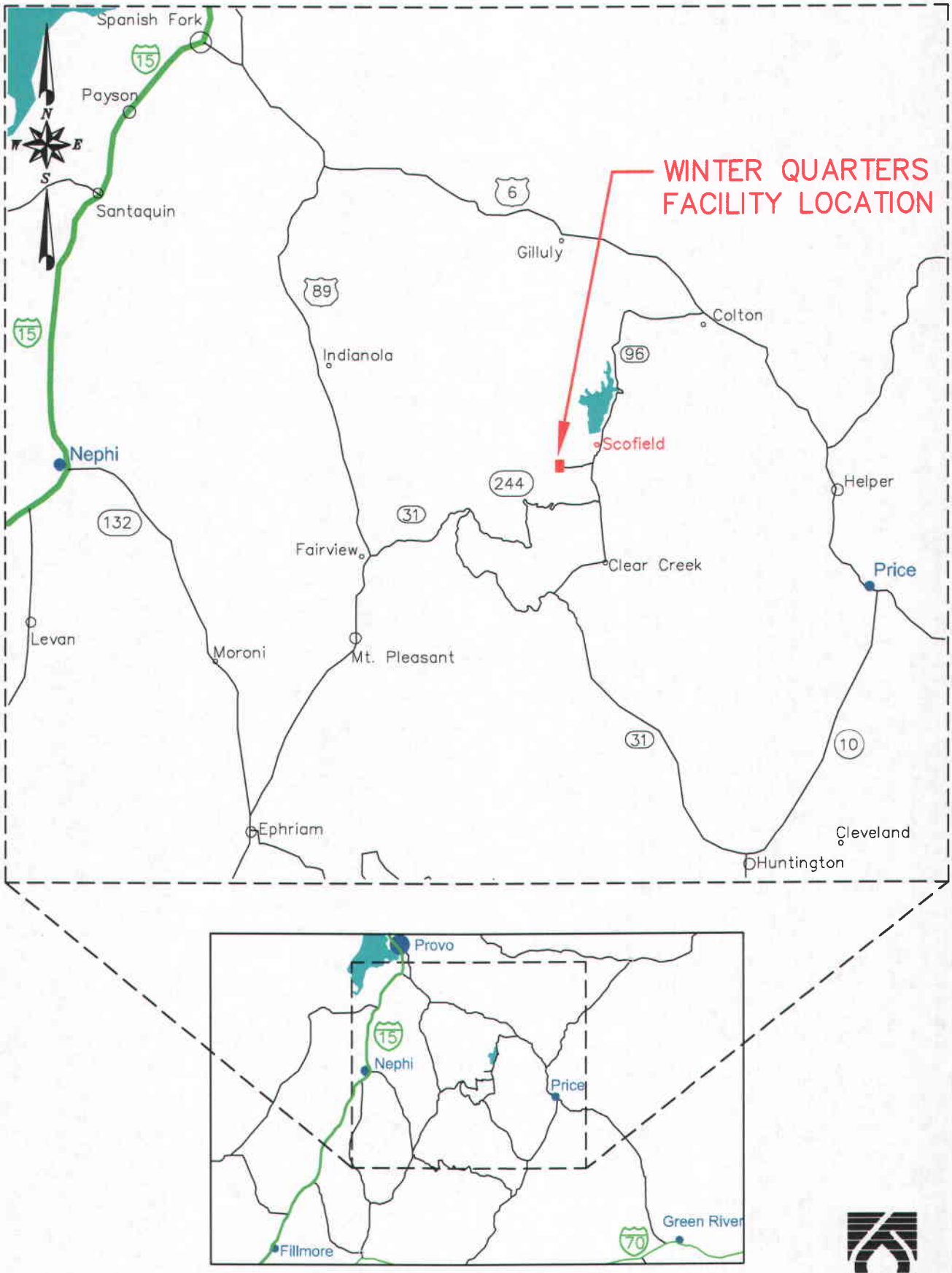
Runoff to Sedimentation Pond						
Watershed ID	Wt Avg. CN	Area (ac)	Hydraulic Length (ft)	Avg. Flow Path Slope (%)	10-yr, 24-hr Volume (ft^3)	25-yr, 6-hr Peak Flow (cfs)
SWQ1	64	4.64	810	26.5	3,092	0.18
SWQ2	64	2.38	613	23.1	1,263	0.07
Undisturbed Areas Diverted Around the Site						
Watershed ID	Wt Avg. CN	Area (ac)	Hydraulic Length (ft)	Avg. Flow Path Slope (%)	25-yr, 6-hr Peak Flow (cfs)	100-yr, 24-hr Peak Flow (cfs)
WQ1	57	3,007	17,727	5.7	9.15	85.02
WQ2	61	274	6,047	22.1	5.89	34.85
WQ3	48	48.9	3,326	29.8	0.00	0.38
WQ4	57	5.0	1,442	19.7	0.06	0.49

TABLE 3

Diversion Ditch Summary

Ditch	Basin	Peak Flow[a] (cfs)	Bottom Width (ft)	Side Slope (Z:1)	Channel Slope (ft/ft)	Channel Depth (ft)	Velocity (ft/s)	Riprap D_{50} (in)
DD-1	SWQ1	0.09	0	1	0.10	1.0	3.26	None
UD-1	WQ3	0.00	0	1	0.13	1.0	0.00	None
UD-2	WQ4	0.002	0	1	0.09	1.0	3.22	None

[a] Based on 10-yr, 6-hr precipitation event



NOT TO SCALE

FIGURE 1. GENERAL LOCATION MAP

EarthFax

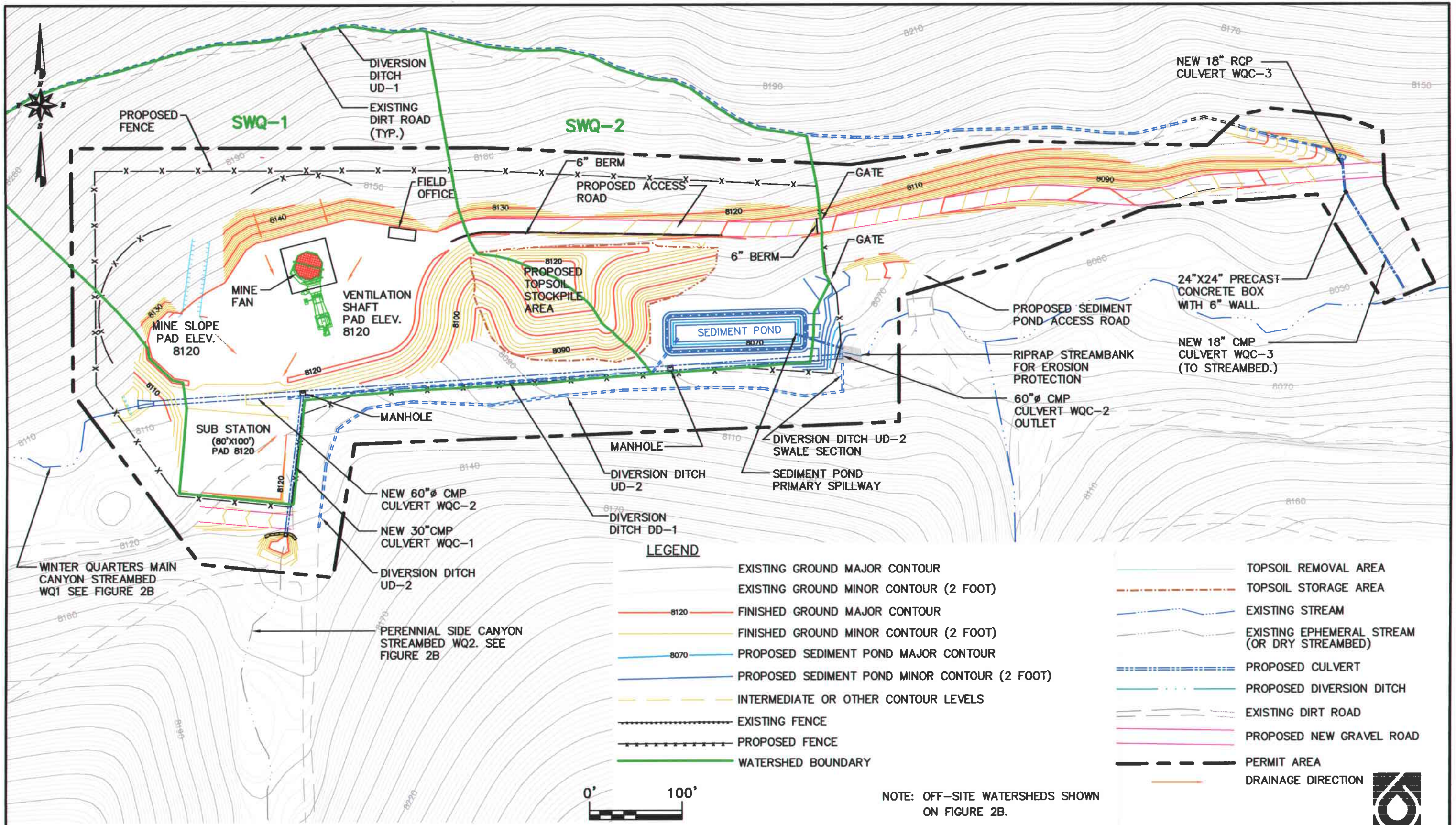


FIGURE 2A. SITE DRAINAGE MAP

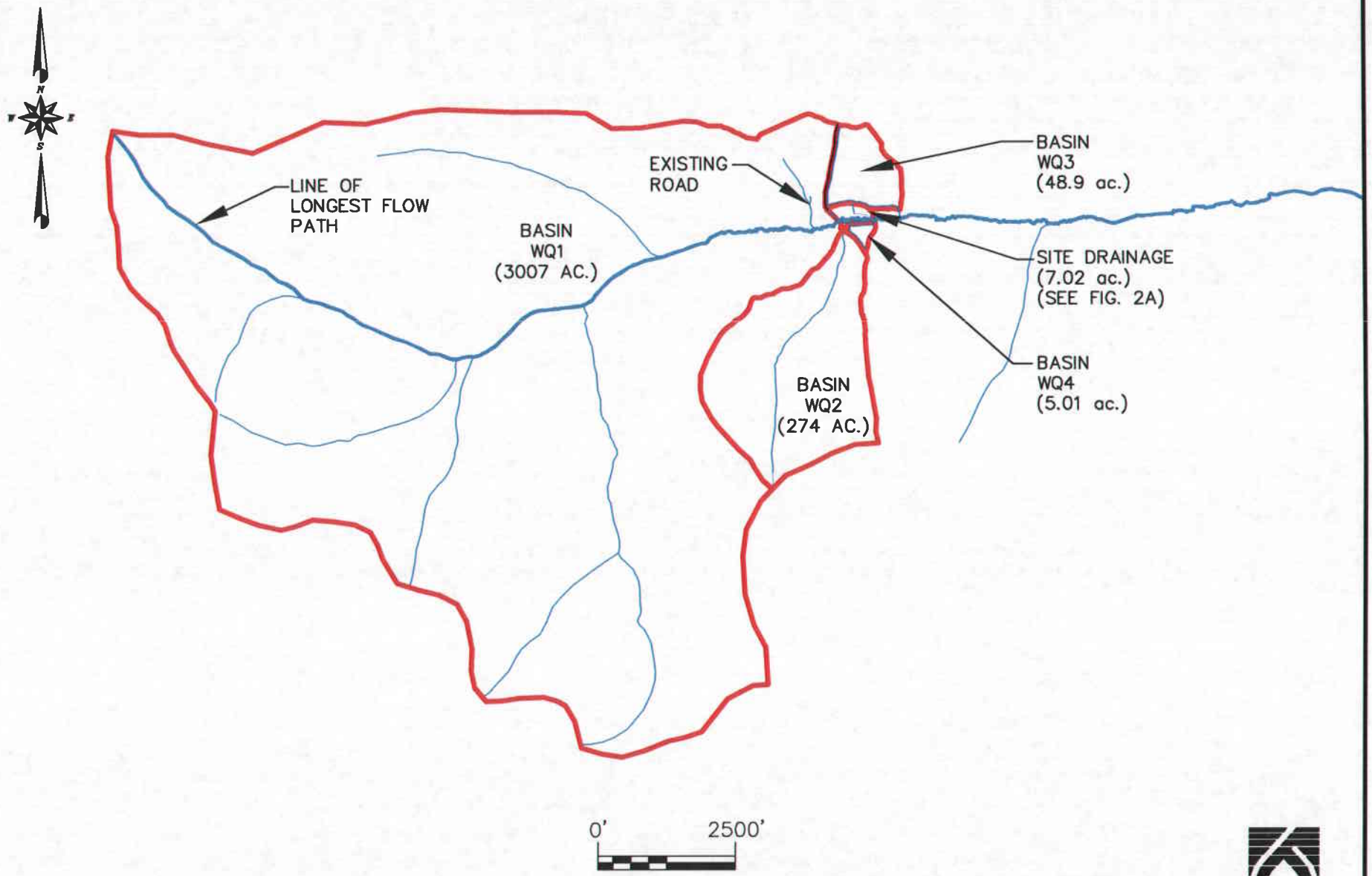
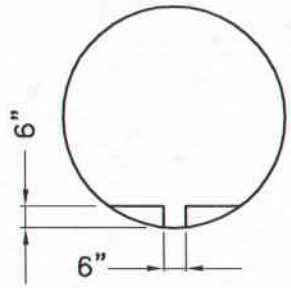
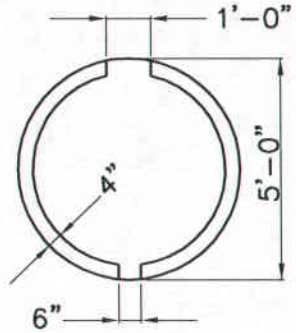


FIGURE 2B. UPSTREAM DRAINAGE BASINS

EarthFax



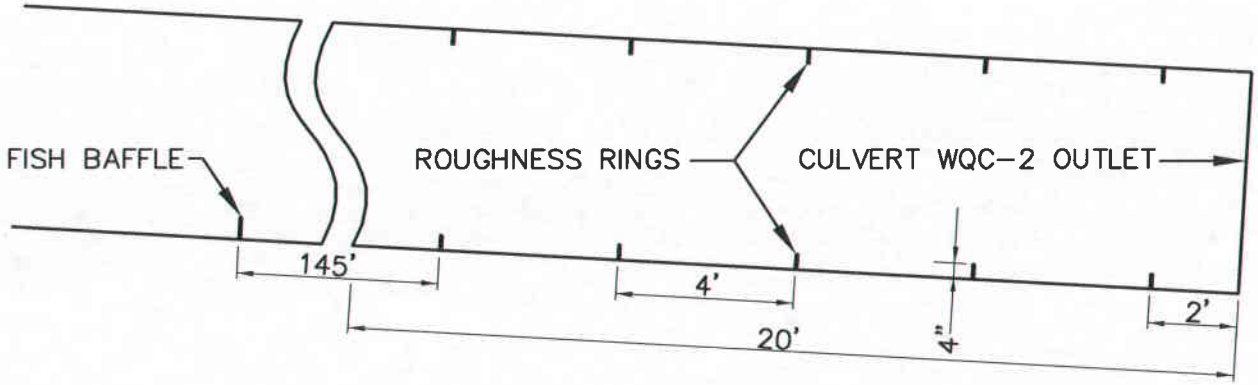
FISH BAFFLES



ROUGHNESS RINGS

NOTES:

1. ROUGHNESS RINGS AND FISH BAFFLES TO BE CUT FROM 0.25" (MIN) PLATE STEEL AND WELDED OR BOLTED TO CULVERT SIDEWALL.
2. EDGES OF ROUGHNESS RINGS AND FISH BAFFLES TO BE SMOOTHED AND CORNERS ROUNDED.
3. ALL ROUGHNESS RINGS TO BE 4" HIGH AND PLACED 4' APART.
4. FISH BAFFLES TO BE PLACED AT LOCATION SHOWN.



NTS

FIGURE 3. ROUGHNESS RING AND FISH BAFFLE DESIGN

EarthFax

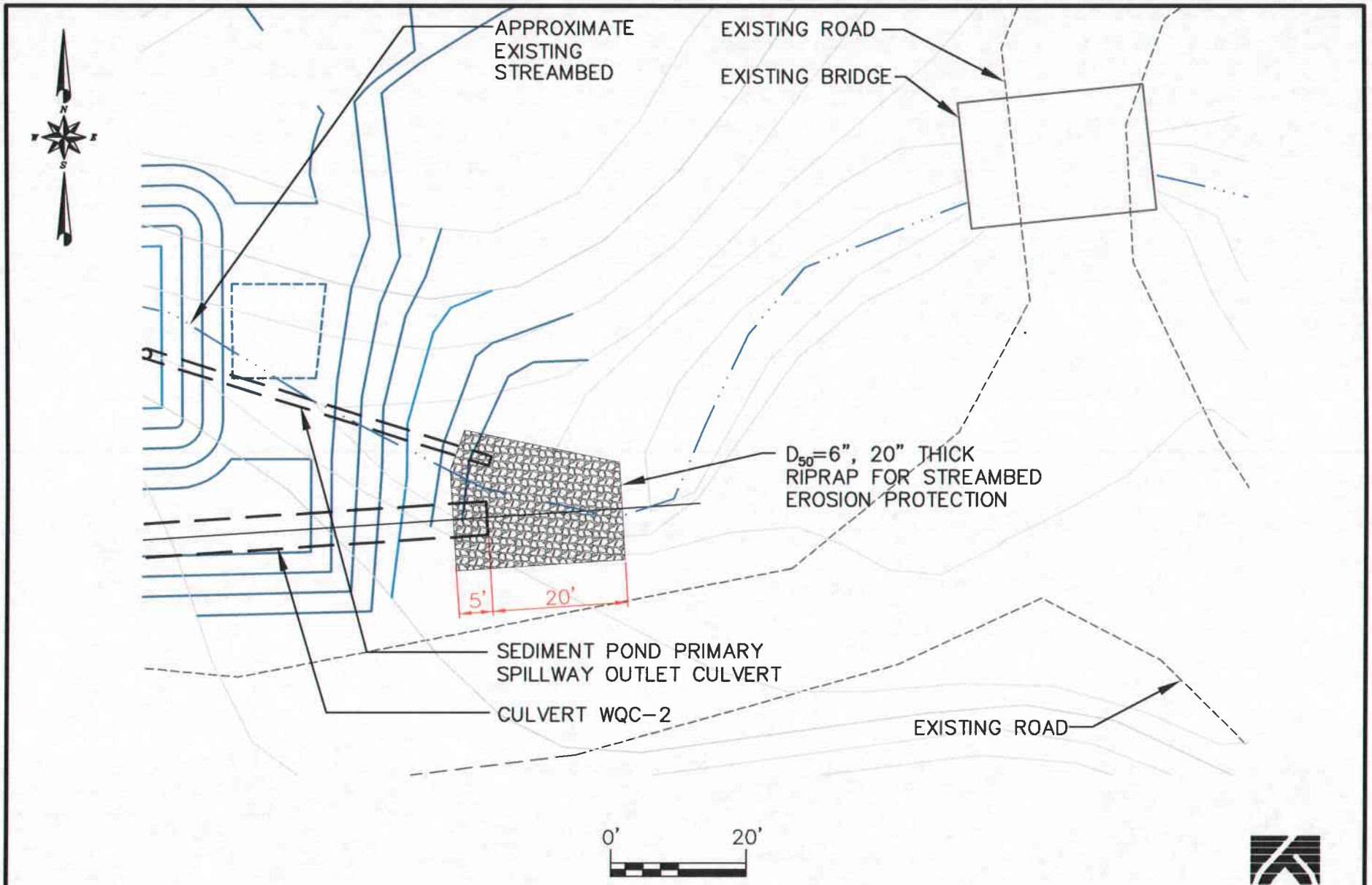


FIGURE 4. RIPRAP PLACEMENT

EarthFax

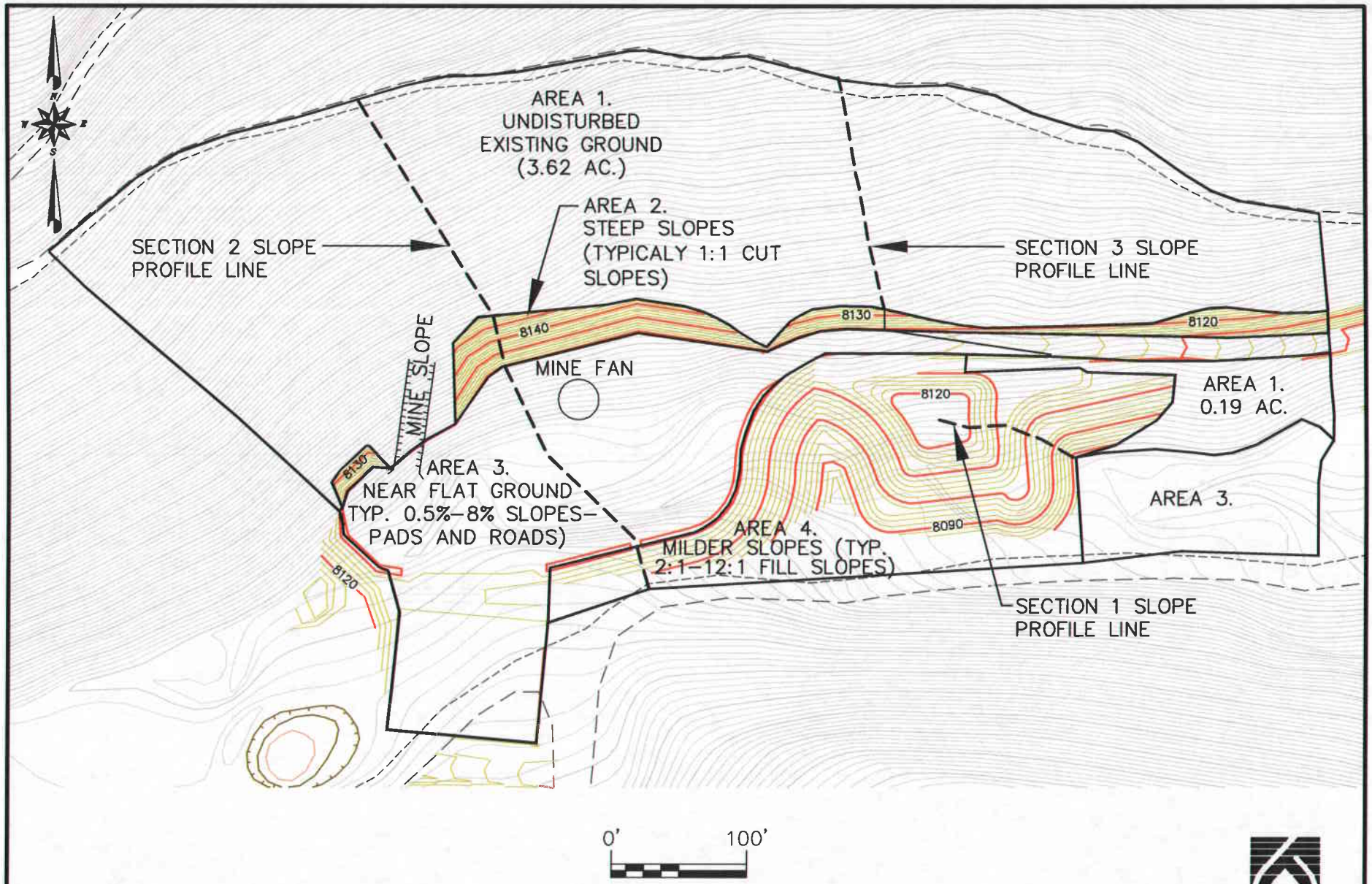
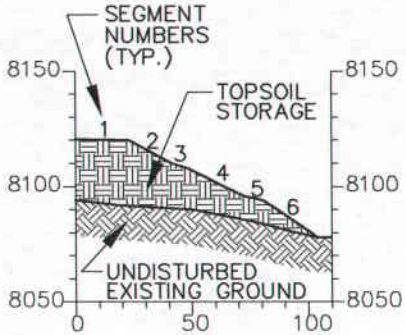


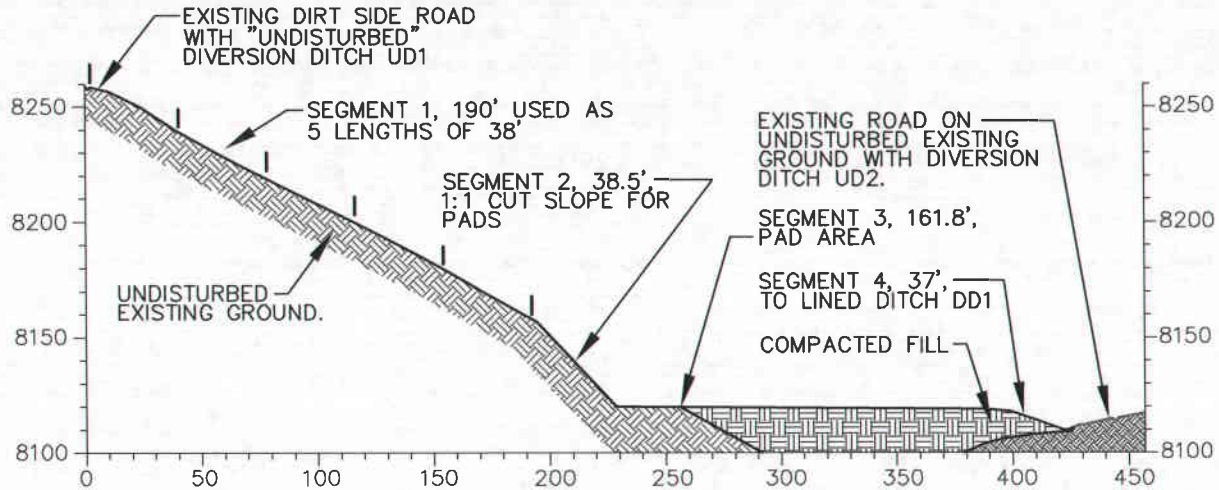
FIGURE 5. SEDIMENT EVALUATION AREAS

EarthFax

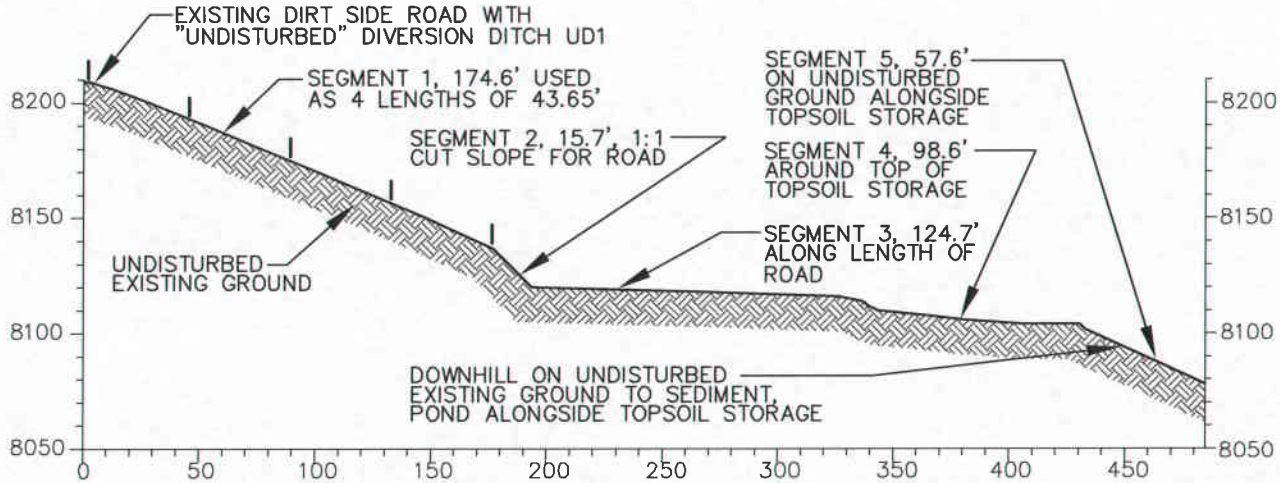


SEGMENT NUMBER	LENGTH
1	23.1
2	19.8
3	7.2
4	23.8
5	8.5
6	24.0

SECTION 1 SLOPE PROFILE



SECTION 2 SLOPE PROFILE



SECTION 3 SLOPE PROFILE

EarthFax

FIGURE 6. SEDIMENT EVALUATION SECTIONS

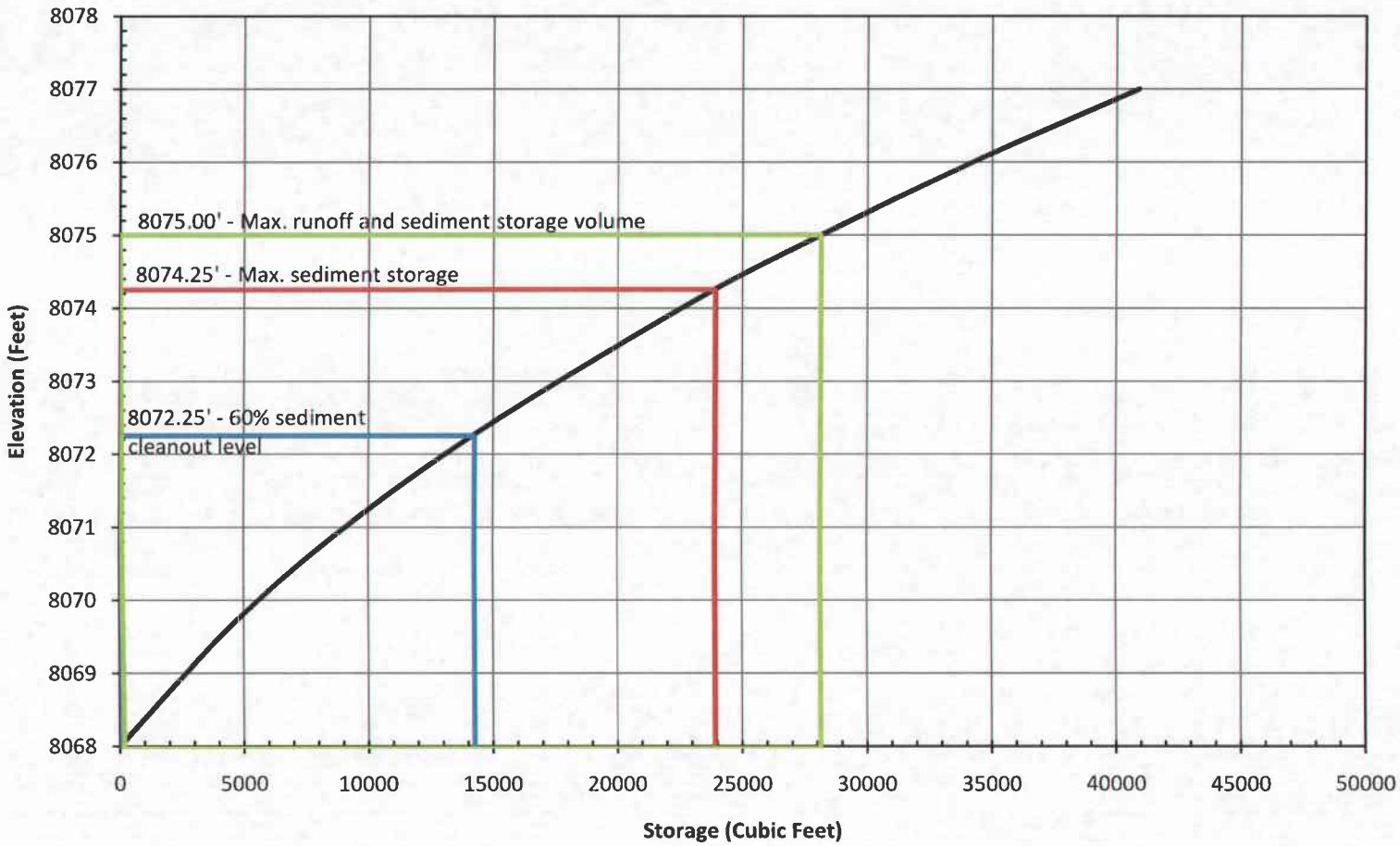


FIGURE 7. STAGE-CAPACITY CURVE FOR PROPOSED SEDIMENTATION POND

EarthFax

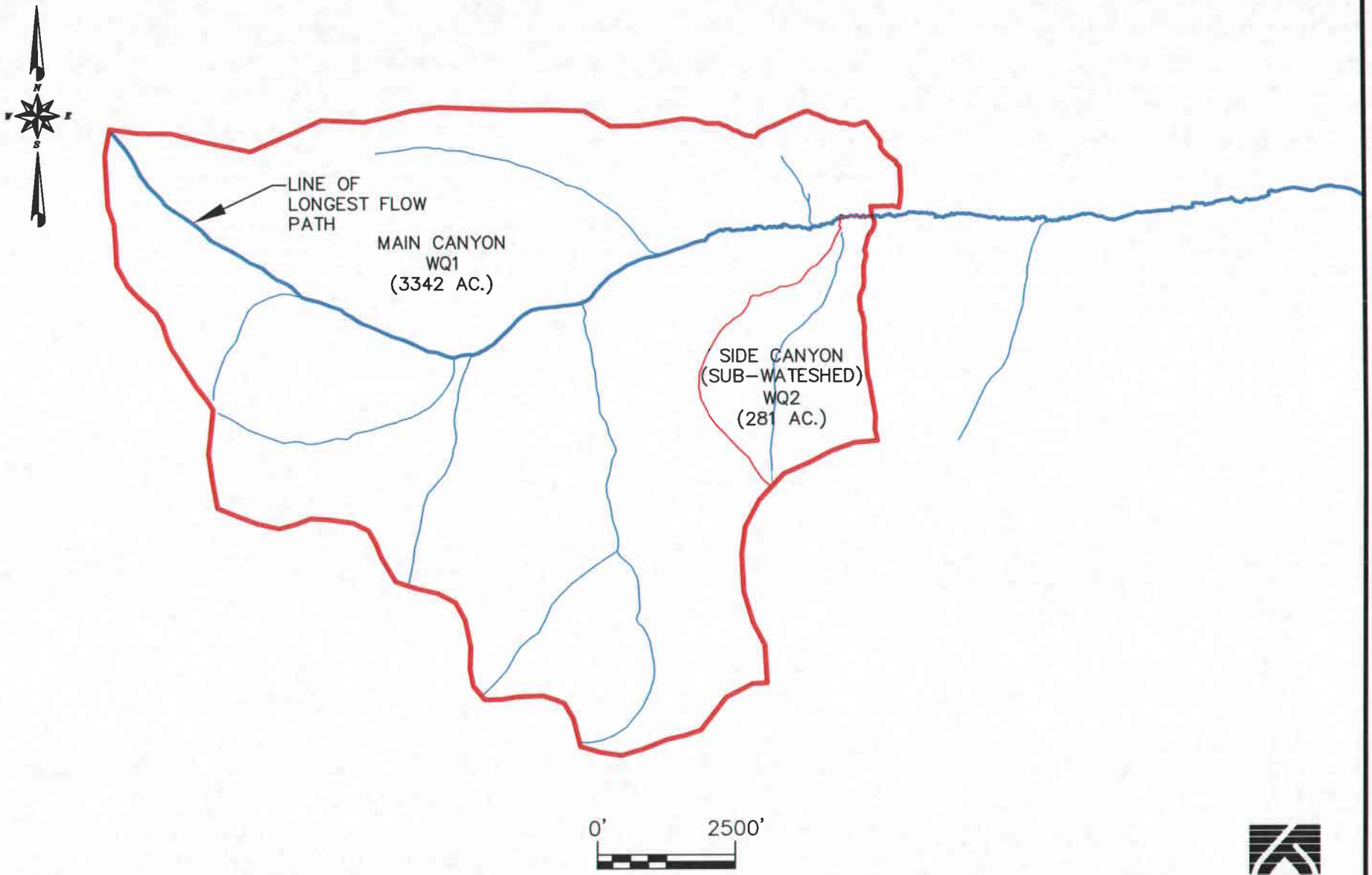


FIGURE 8. UPSTREAM RECLAIMED DRAINAGE BASINS

EarthFax

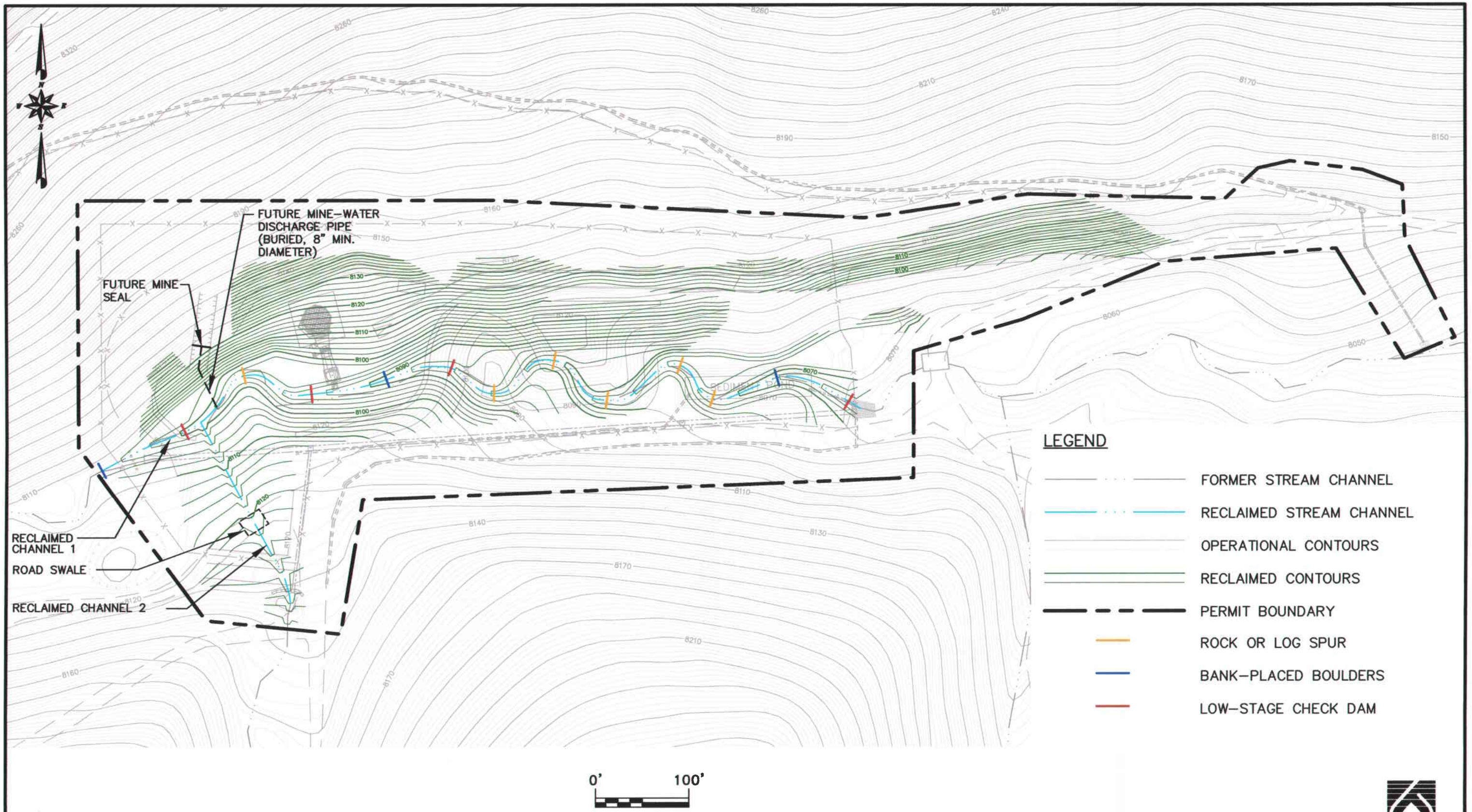
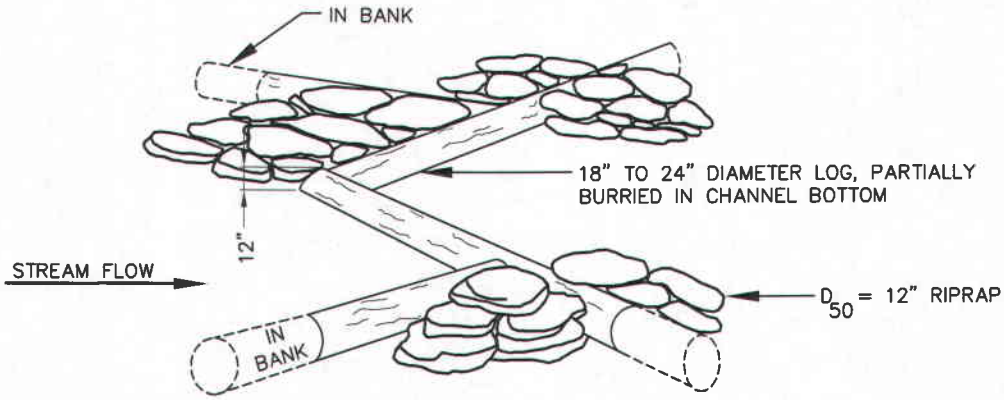


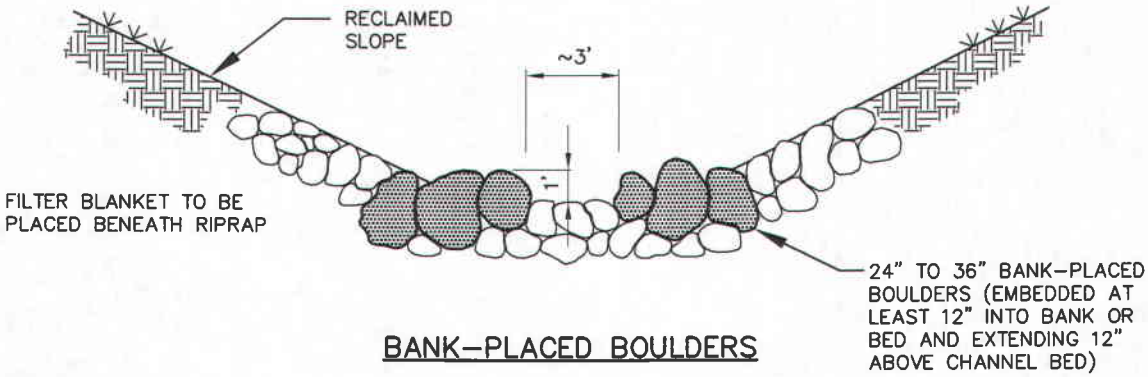
FIGURE 9. RECLAMATION DRAINAGE MAP

EarthFax

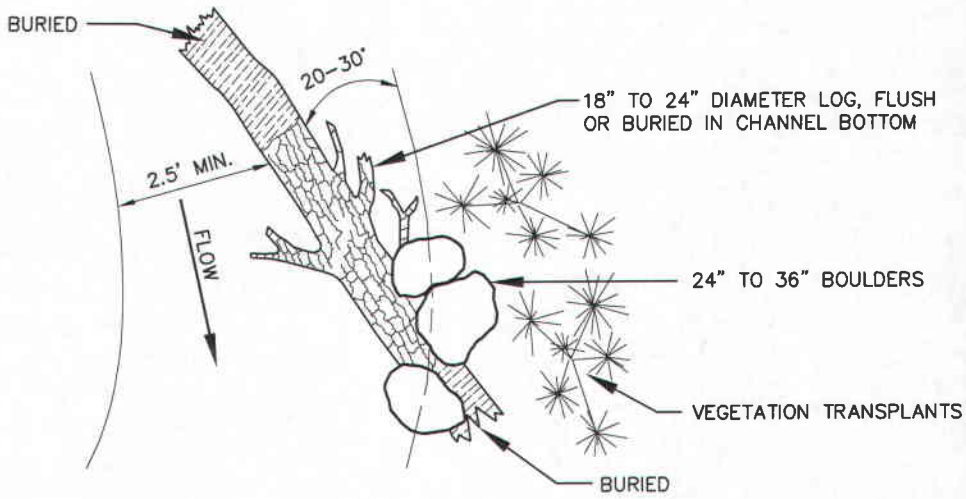


LOW-STAGE CHECK DAM

MODIFIED FROM: ROSGEN (1996)



BANK-PLACED BOULDERS



ROCK OR LOG SPURS

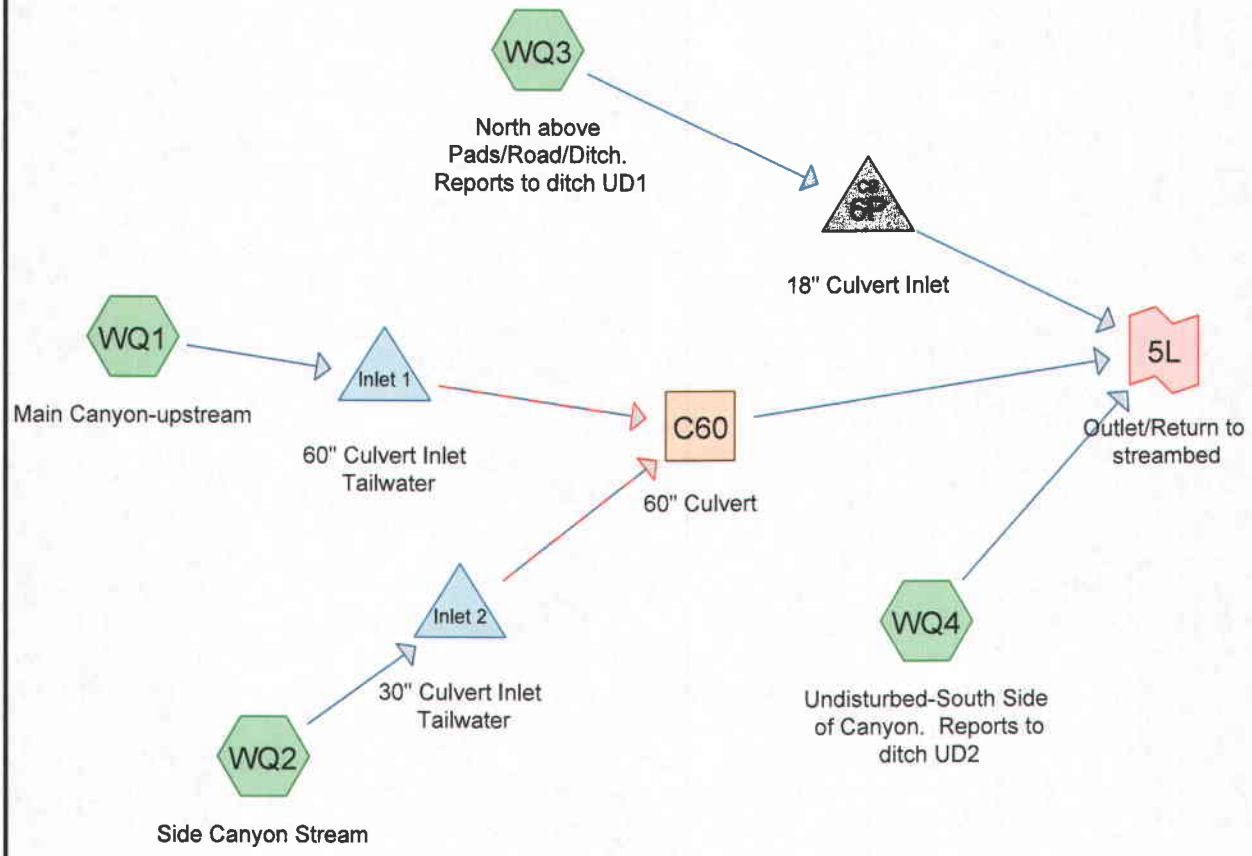
MODIFIED FROM: ROSGEN (1996)

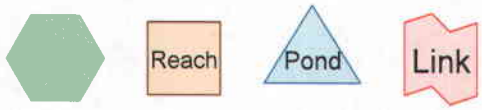
FIGURE 10. CHANNEL STABILITY ENHANCEMENT STRUCTURES

EarthFax

ATTACHMENT A

Operational Diversion Calculations





Drainage Diagram for Winter Quarters diversion design
Prepared by Earthfax Engineering, Printed 8/22/2009
HydroCAD® 8.50 s/n 004020 © 2007 HydroCAD Software Solutions LLC

Project Notes

Utah DOGM R645-301-
742.221. Sedimentation ponds, when used, will
742.221.33. Contain or treat the 10-year, 24-hour precipitation event ("design event") unless a lesser design event is approved by the Division based on terrain, climate, or other site-specific conditions and on a demonstration by the operator that the effluent limitations of R645-301-751 will be met;

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
48.878	48	Soil Type "Trag-Croydon Complex", Herbaceous range, Fair, HSG B (WQ3)
708.862	48	Soil Type "Trag-Croydon Complex", Pinyon/juniper range, Fair, HSG B (WQ1)
6.023	48	Soil Type "Unita-Toze families complex", Pinyon/juniper range, Fair, HSG B (WQ1)
274.429	51	Soil Type "Trag stony loam", Pinyon/juniper range, Poor, HSG B (WQ1)
5.014	57	Soil Type "Curecanti-Pathead Complex", Oak/aspen range, Fair, HSG C (WQ4)
274.005	61	Soil Type "Curecanti-Pathead Complex", Oak/aspen range, Poor, HSG C (WQ2)
2,017.560	61	Soil Type "Curecanti-Pathead Complex", Pinyon/juniper range, Poor, HSG C (WQ1)
3,334.771		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.000	HSG A	
1,038.192	HSG B	WQ1, WQ3
2,296.579	HSG C	WQ1, WQ2, WQ4
0.000	HSG D	
0.000	Other	
3,334.771		**TOTAL AREA**

Time span=0.00-42.00 hrs, dt=0.02 hrs, 2101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Muskingum-Cunge method - Pond routing by Dyn-Stor-Ind method

Subcatchment WQ1: Main Canyon-upstream Runoff Area=3,006.874 ac 0.00% Impervious Runoff Depth=0.27"
Flow Length=17,727' Tc=317.1 min CN=57 Runoff=85.02 cfs 68.657 af

Subcatchment WQ2: Side Canyon Stream Runoff Area=274.005 ac 0.00% Impervious Runoff Depth=0.40"
Flow Length=6,047' Tc=63.6 min CN=61 Runoff=34.85 cfs 9.131 af

Subcatchment WQ3: North above Pads/Road/Ditch. Runoff Area=48.878 ac 0.00% Impervious Runoff Depth=0.07"
Flow Length=3,326' Tc=21.9 min CN=48 Runoff=0.38 cfs 0.295 af

Subcatchment WQ4: Undisturbed-South Side of Runoff Area=5.014 ac 0.00% Impervious Runoff Depth=0.27"
Flow Length=1,442' Tc=32.9 min CN=57 Runoff=0.49 cfs 0.114 af

Reach C60: 60" Culvert Avg. Depth=1.25' Max Vel=24.17 fps Inflow=91.08 cfs 77.477 af
D=60.0" n=0.025 L=607.0' S=0.0533 '/' Capacity=312.65 cfs Outflow=91.08 cfs 77.477 af

Pond 6P: 18" Culvert Inlet Peak Elev=8,093.83' Inflow=0.38 cfs 0.295 af
18.0" x 158.0' Culvert Outflow=0.38 cfs 0.295 af

Pond Inlet 1: 60" Culvert Inlet Tailwater Peak Elev=8,107.82' Storage=8,685 cf Inflow=85.02 cfs 68.657 af
Discarded=0.39 cfs 0.299 af Primary=84.58 cfs 68.358 af Secondary=0.00 cfs 0.000 af Outflow=84.97 cfs 68.657 af

Pond Inlet 2: 30" Culvert Inlet Tailwater Peak Elev=8,132.30' Storage=695 cf Inflow=34.85 cfs 9.131 af
Discarded=0.01 cfs 0.011 af Primary=34.83 cfs 9.119 af Secondary=0.00 cfs 0.000 af Outflow=34.84 cfs 9.131 af

Link 5L: Outlet/Return to streambed Inflow=91.49 cfs 77.887 af
Primary=91.49 cfs 77.887 af

Total Runoff Area = 3,334.771 ac Runoff Volume = 78.198 af Average Runoff Depth = 0.28"
100.00% Pervious = 3,334.771 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment WQ1: Main Canyon-upstream

The soil for most of this basin has not been surveyed. The NRCS has surveyed the lower eastern portion nearest Scofield, and the proportions of soils there were used for the entire basin.

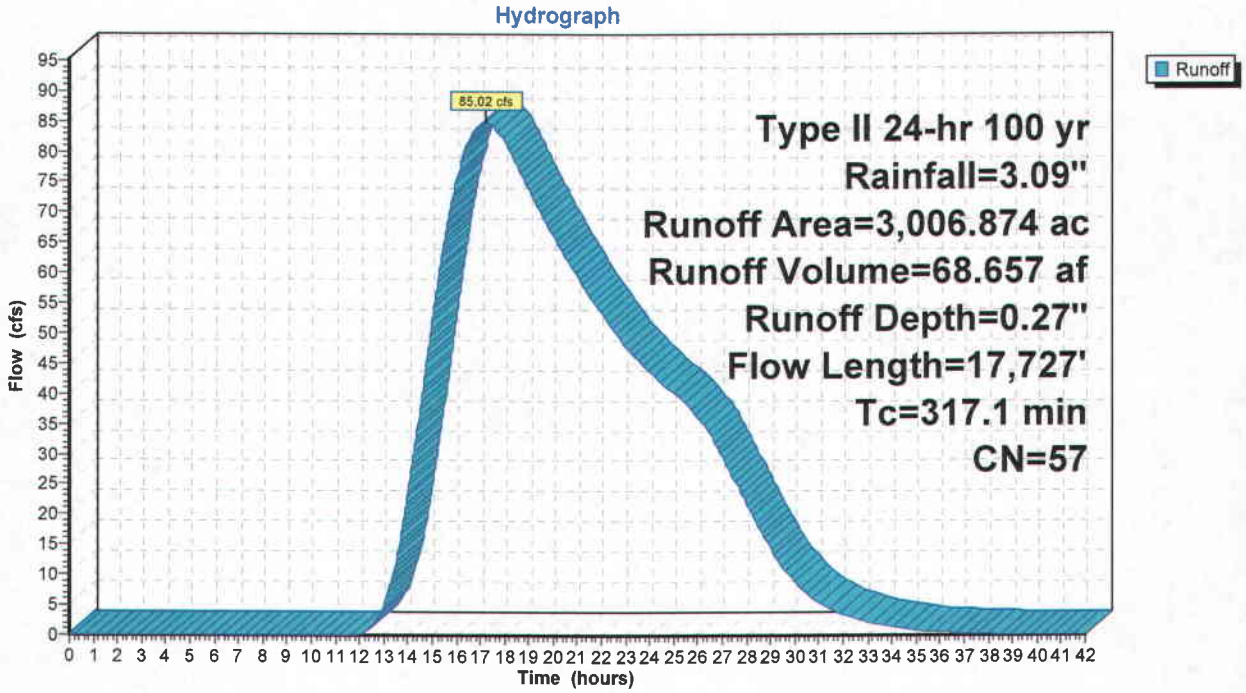
Runoff = 85.02 cfs @ 17.26 hrs, Volume= 68.657 af, Depth= 0.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 100 yr Rainfall=3.09"

	Area (ac)	CN	Description
*	2,017.560	61	Soil Type "Curecanti-Pathead Complex", Pinyon/juniper range, Poor, HSG C
*	274.429	51	Soil Type "Trag stony loam", Pinyon/juniper range, Poor, HSG B
*	708.862	48	Soil Type "Trag-Croydon Complex", Pinyon/juniper range, Fair, HSG B
*	6.023	48	Soil Type "Unita-Toze families complex", Pinyon/juniper range, Fair, HSG B
	3,006.874	57	Weighted Average
	3,006.874		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.4	300	0.0167	0.15		**Sheet Flow,** Range n= 0.130 P2= 1.56"
6.2	600	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.9	1,095	0.3835	3.10		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.6	1,256	0.0637	1.26		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.7	1,547	0.0517	1.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
130.5	7,165	0.0335	0.92		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
98.6	4,122	0.0194	0.70		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.2	1,642	0.0305	6.49	162.20	**Channel Flow,** Area= 25.0 sf Perim= 25.0' r= 1.00' n= 0.040 Winding stream, pools & shoals
317.1	17,727	Total			

Subcatchment WQ1: Main Canyon-upstream



Summary for Subcatchment WQ2: Side Canyon Stream

The soil for part of this basin has not been surveyed. The NRCS has surveyed the most eastern portion, nearest Scofield,

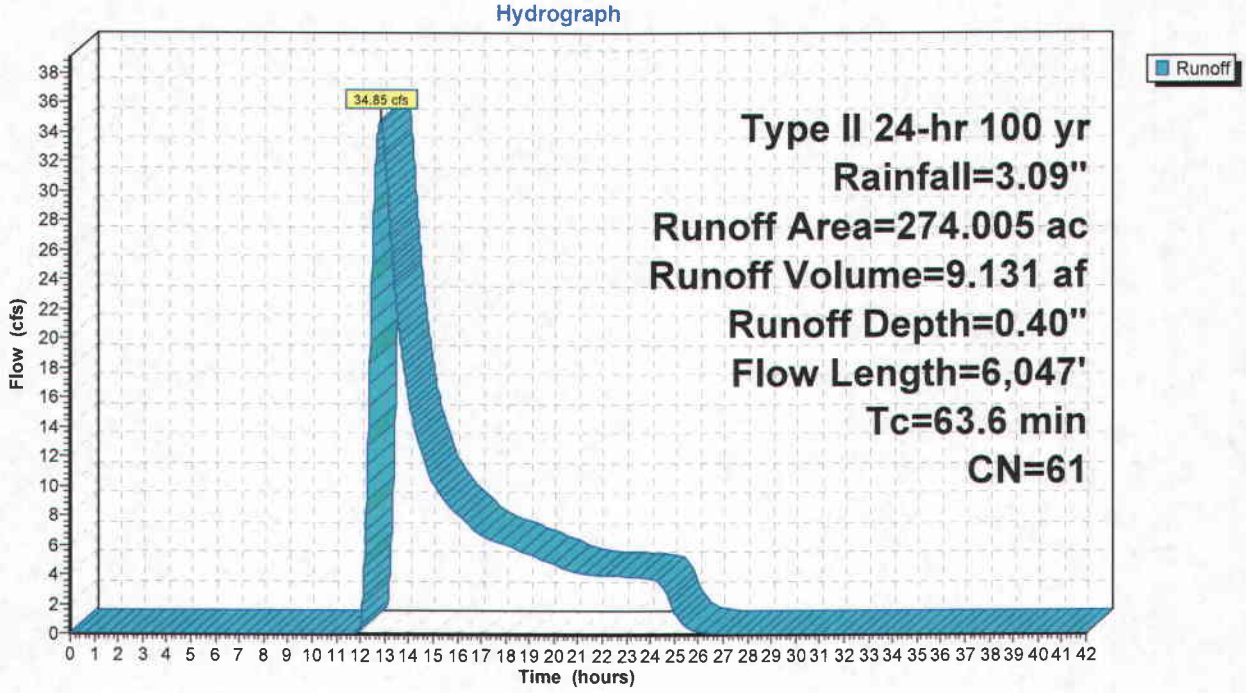
Runoff = 34.85 cfs @ 12.86 hrs, Volume= 9.131 af, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 100 yr Rainfall=3.09"

	Area (ac)	CN	Description
*	274.005	61	Soil Type "Curecanti-Pathead Complex", Oak/aspen range, Poor, HSG C
	274.005		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.9	300	0.0500	0.24		**Sheet Flow,** Range n= 0.130 P2= 1.56"
11.8	2,079	0.3463	2.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.4	1,465	0.2184	2.34		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.5	2,203	0.1280	1.79		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
63.6	6,047	Total			

Subcatchment WQ2: Side Canyon Stream



Summary for Subcatchment WQ3: North above Pads/Road/Ditch. Reports to ditch UD1

Final segment of flow path (1507 feet) is ditch UD1.

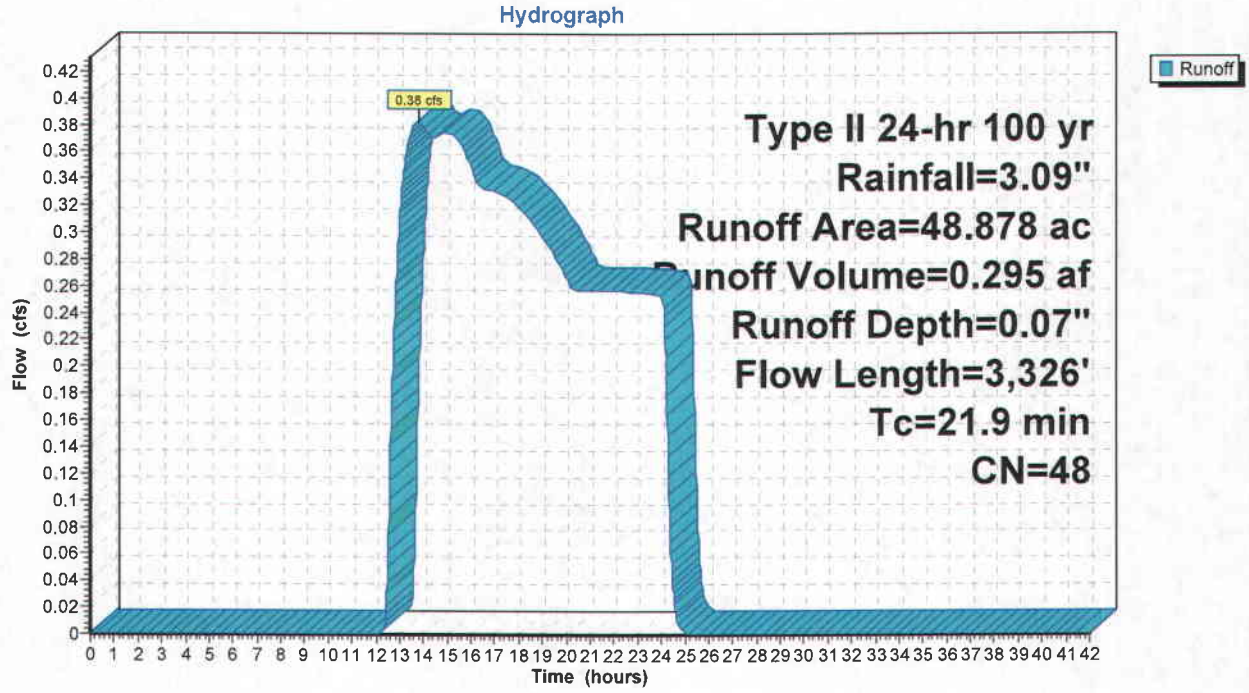
Runoff = 0.38 cfs @ 13.80 hrs, Volume= 0.295 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 100 yr Rainfall=3.09"

	Area (ac)	CN	Description
*	48.878	48	Soil Type "Trag-Croydon Complex", Herbaceous range, Fair, HSG B
	48.878		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	291	0.3333	0.51		**Sheet Flow,** Range n= 0.130 P2= 1.56"
5.1	1,430	0.4545	4.72		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	98	0.5100	5.00		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.0	1,507	0.1301	3.58	0.54	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.39' Z= 1.0 '/' Top.W=0.78' n= 0.040 Earth, cobble bottom, clean sides
21.9	3,326	Total			

Subcatchment WQ3: North above Pads/Road/Ditch. Reports to ditch UD1



Summary for Subcatchment WQ4: Undisturbed-South Side of Canyon. Reports to ditch UD2

Fianl segment of flow path (692 feet) is ditch UD2.

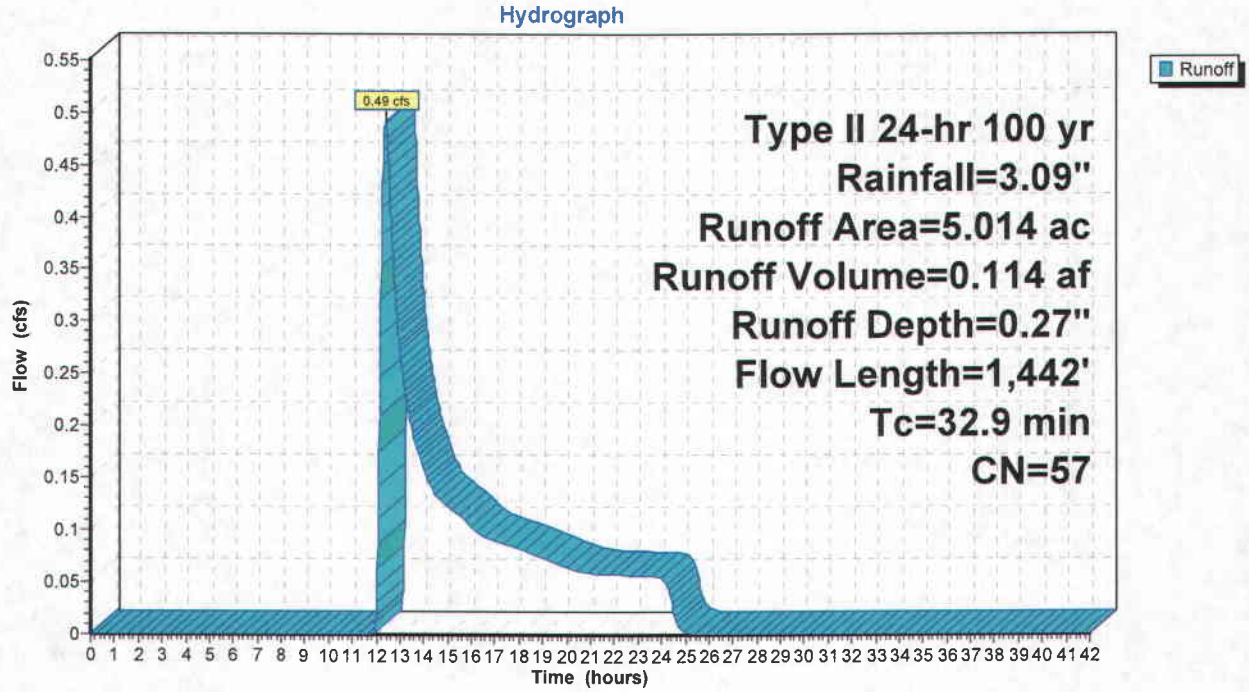
Runoff = 0.49 cfs @ 12.43 hrs, Volume= 0.114 af, Depth= 0.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 100 yr Rainfall=3.09"

	Area (ac)	CN	Description
*	5.014	57	Soil Type "Curecanti-Pathead Complex", Oak/aspen range, Fair, HSG C
	5.014		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.6	290	0.2414	0.18		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 1.56"
2.7	460	0.3300	2.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.6	692	0.0899	3.22	0.62	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.44' Z= 1.0 '/' Top.W=0.88' n= 0.040 Earth, cobble bottom, clean sides
32.9	1,442	Total			

Subcatchment WQ4: Undisturbed-South Side of Canyon. Reports to ditch UD2



Summary for Reach C60: 60" Culvert

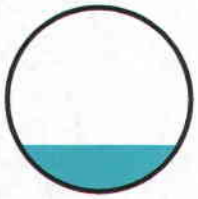
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 3,280.879 ac, 0.00% Impervious, Inflow Depth = 0.28" for 100 yr event
Inflow = 91.08 cfs @ 17.28 hrs, Volume= 77.477 af
Outflow = 91.08 cfs @ 17.29 hrs, Volume= 77.477 af, Atten= 0%, Lag= 0.5 min

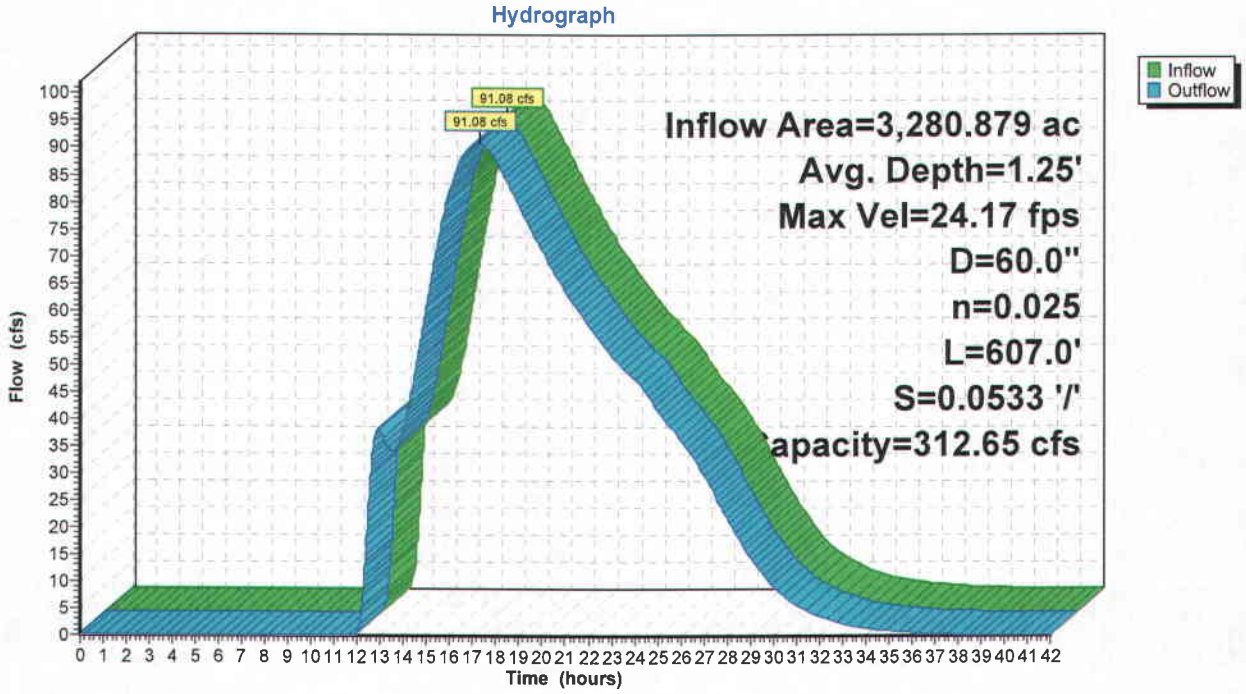
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Reference Flow= 234.49 cfs Estimated Depth= 3.23' Velocity= 17.47 fps
m= 1.355, c= 23.68 fps, dt= 1.2 min, dx= 607.0' / 1 = 607.0', K= 0.4 min, X= 0.463
Max. Velocity= 24.17 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 23.68 fps, Avg. Travel Time= 0.4 min

Peak Storage= 2,335 cf @ 17.28 hrs, Average Depth at Peak Storage= 1.25'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 312.65 cfs

60.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 607.0' Slope= 0.0533 '/'
Inlet Invert= 8,095.43', Outlet Invert= 8,063.08'



Reach C60: 60" Culvert



Summary for Pond 6P: 18" Culvert Inlet

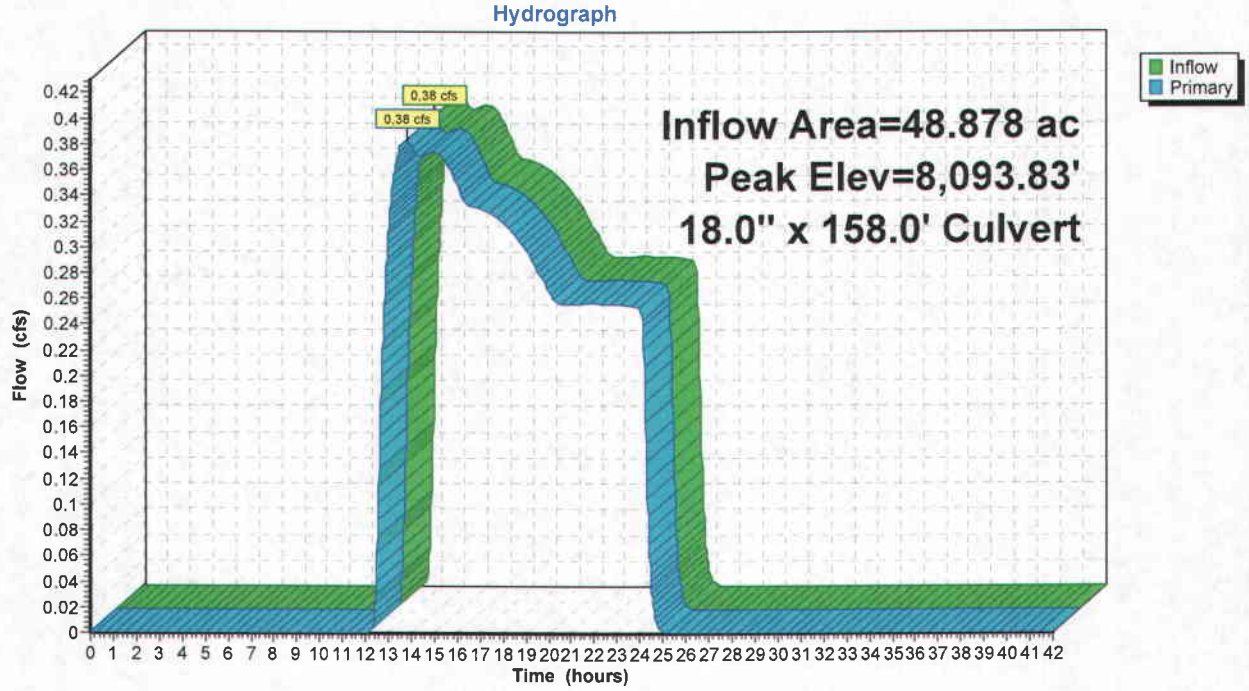
Inflow Area =	48.878 ac,	0.00% Impervious,	Inflow Depth =	0.07"	for 100 yr event
Inflow =	0.38 cfs @	13.80 hrs,	Volume=	0.295 af	
Outflow =	0.38 cfs @	13.80 hrs,	Volume=	0.295 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.38 cfs @	13.80 hrs,	Volume=	0.295 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Peak Elev= 8,093.83'@ 13.80 hrs
Flood Elev= 8,095.52'

Device	Routing	Invert	Outlet Devices
#1	Primary	8,093.56'	**18.0" x 158.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 8,041.37' S= 0.3303 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=0.38 cfs @ 13.80 hrs HW=8,093.83' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.38 cfs @ 1.77 fps)

Pond 6P: 18" Culvert Inlet



Summary for Pond Inlet 1: 60" Culvert Inlet Tailwater

Inflow Area =	3,006.874 ac,	0.00% Impervious,	Inflow Depth =	0.27"	for 100 yr event
Inflow =	85.02 cfs @	17.26 hrs, Volume=	68.657 af		
Outflow =	84.97 cfs @	17.29 hrs, Volume=	68.657 af,	Atten= 0%,	Lag= 1.6 min
Discarded =	0.39 cfs @	17.29 hrs, Volume=	0.299 af		
Primary =	84.58 cfs @	17.29 hrs, Volume=	68.358 af		
Secondary=	0.00 cfs @	0.00 hrs, Volume=	0.000 af		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Peak Elev= 8,107.82'@ 17.29 hrs Surf.Area= 4,615 sf Storage= 8,685 cf

Plug-Flow detention time=1.7 min calculated for 68.625 af (100% of inflow)
Center-of-Mass det. time=1.7 min (1,235.5 - 1,233.8)

Volume	Invert	Avail.Storage	Storage Description
#1	8,104.00'	345,874 cf	**Custom Stage Data (Irregular)** Listed below(Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,104.00	722	111.0	0	0	722
8,106.00	2,110	194.0	2,711	2,711	2,759
8,108.00	4,915	428.3	6,830	9,541	14,379
8,110.00	8,810	536.0	13,537	23,078	22,700
8,112.00	13,677	712.0	22,309	45,387	40,223
8,114.00	25,340	840.0	38,422	83,810	56,108
8,116.00	39,798	1,031.0	64,596	148,406	84,607
8,118.00	49,535	1,120.0	89,156	237,562	99,992
8,120.00	58,913	1,259.0	108,313	345,874	126,414

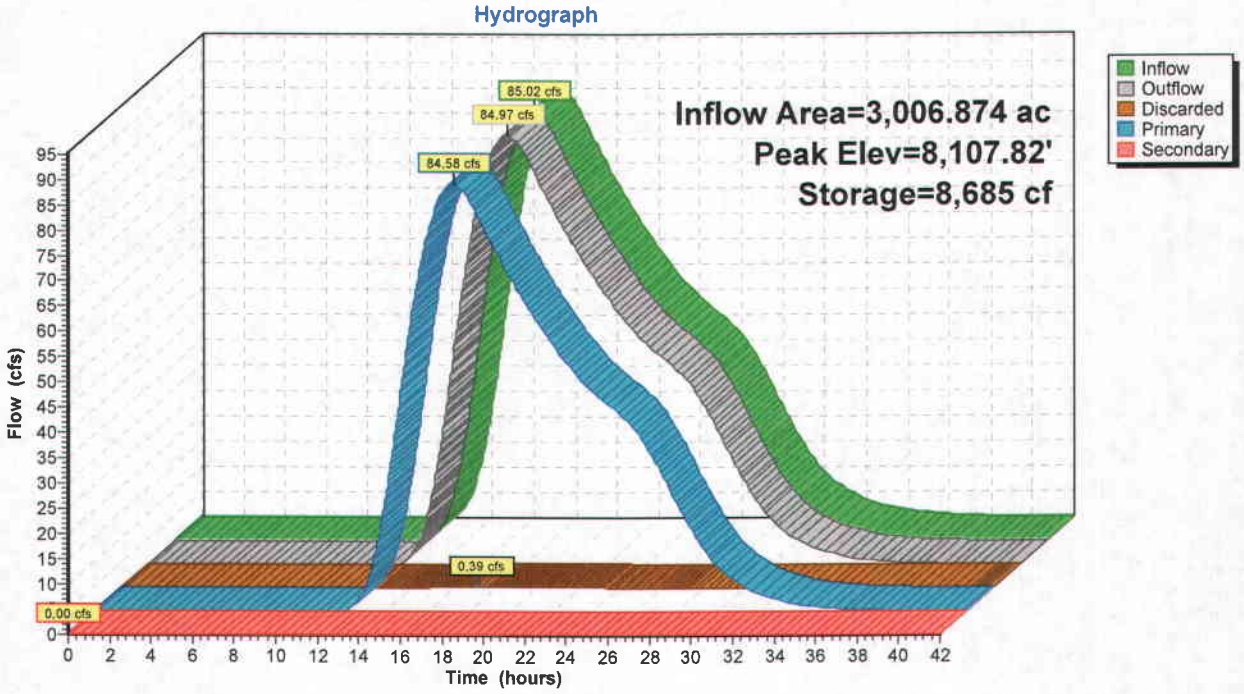
Device	Routing	Invert	Outlet Devices
#1	Secondary	8,117.00'	**10.0' long (Profile 10) Broad-Crested Rectangular Weir** Head (feet) 1.97 2.46 2.95 3.94 4.92 Coef. (English) 3.51 3.48 3.42 3.48 3.57
#2	Primary	8,104.00'	**60.0" x 162.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 8,095.43' S= 0.0529 '/' Cc= 0.900 n= 0.025 Corrugated metal
#3	Discarded	8,104.00'	**1.300 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.39 cfs @ 17.29 hrs HW=8,107.82' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.39 cfs)

Primary OutFlow Max=84.57 cfs @ 17.29 hrs HW=8,107.82' TW=8,096.68' (Dynamic Tailwater)
└**2=Culvert** (Inlet Controls 84.57 cfs @ 5.25 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=8,104.00' TW=8,095.43' (Dynamic Tailwater)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond Inlet 1: 60" Culvert Inlet Tailwater



Summary for Pond Inlet 2: 30" Culvert Inlet Tailwater

Inflow Area =	274.005 ac,	0.00% Impervious,	Inflow Depth = 0.40"	for 100 yr event
Inflow =	34.85 cfs @	12.86 hrs, Volume=	9.131 af	
Outflow =	34.84 cfs @	12.86 hrs, Volume=	9.131 af, Atten= 0%, Lag= 0.2 min	
Discarded =	0.01 cfs @	12.86 hrs, Volume=	0.011 af	
Primary =	34.83 cfs @	12.86 hrs, Volume=	9.119 af	
Secondary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Peak Elev= 8,132.30'@ 12.86 hrs Surf.Area= 382 sf Storage= 695 cf

Plug-Flow detention time=0.4 min calculated for 9.126 af (100% of inflow)
Center-of-Mass det. time=0.4 min (972.2 - 971.7)

Volume	Invert	Avail.Storage	Storage Description
#1	8,130.00'	2,872 cf	**Custom Stage Data (Irregular)** Listed below(Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,130.00	227	59.3	0	0	227
8,132.00	360	73.0	582	582	423
8,134.00	520	87.0	875	1,457	662
8,136.00	913	115.0	1,415	2,872	1,156

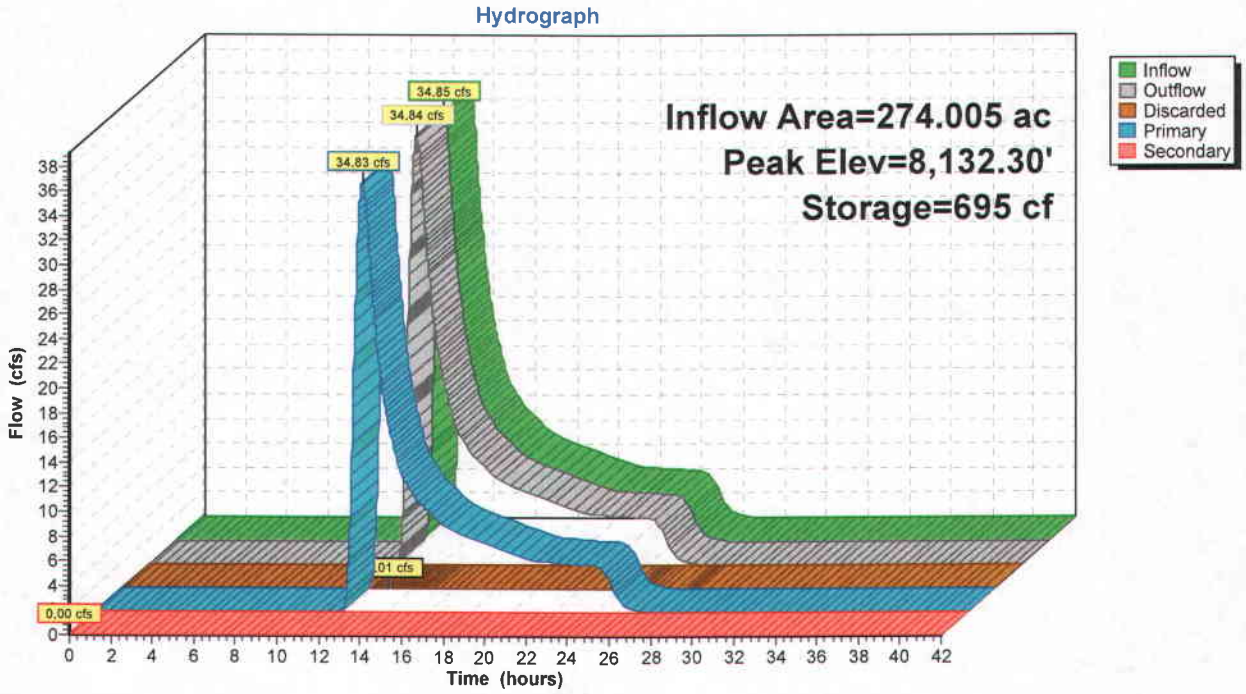
Device	Routing	Invert	Outlet Devices
#1	Device 2	8,130.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Primary	8,128.00'	**30.0" x 158.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 8,095.43' S= 0.2061 '/' Cc= 0.900 n= 0.025 Corrugated metal
#3	Secondary	8,137.75'	**18.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#4	Discarded	8,130.00'	**1.300 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.01 cfs @ 12.86 hrs HW=8,132.30' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=34.83 cfs @ 12.86 hrs HW=8,132.30' TW=8,096.11' (Dynamic Tailwater)
└─**2=Culvert** (Passes 34.83 cfs of 41.30 cfs potential flow)
  └─**1=Broad-Crested Rectangular Weir** (Weir Controls 34.83 cfs @ 5.04 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=8,130.00' TW=8,095.43' (Dynamic Tailwater)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond Inlet 2: 30" Culvert Inlet Tailwater

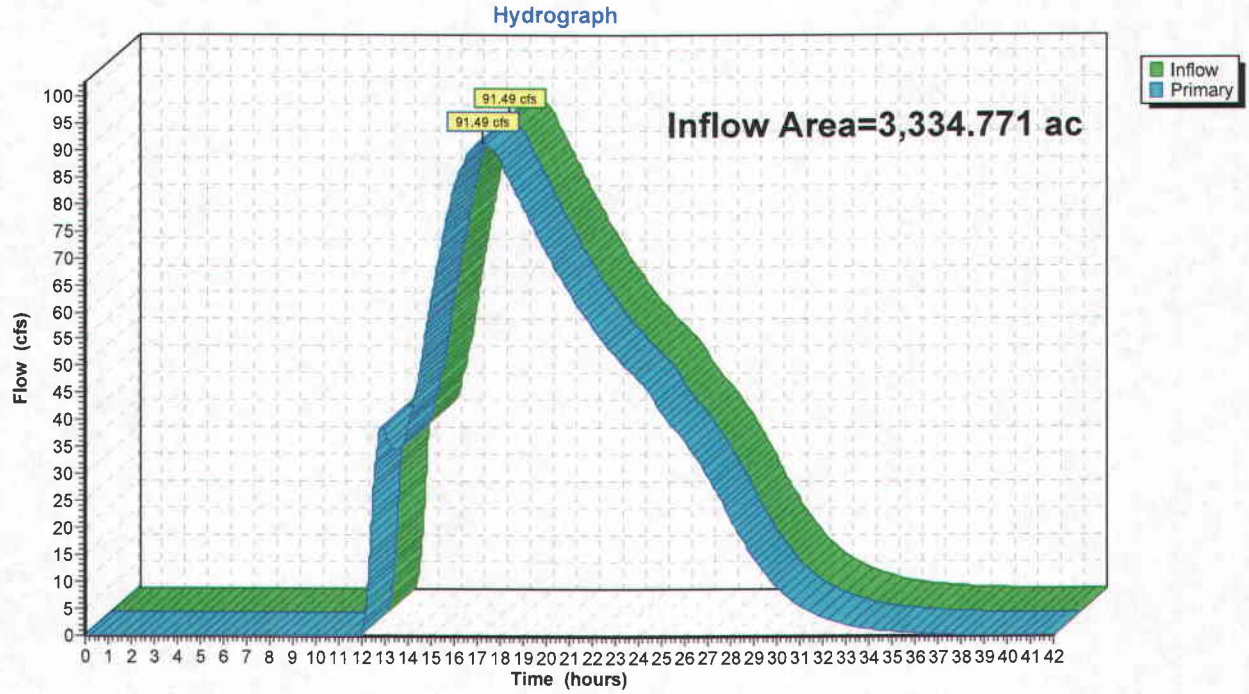


Summary for Link 5L: Outlet/Return to streambed

Inflow Area = 3,334.771 ac, 0.00% Impervious, Inflow Depth = 0.28" for 100 yr event
Inflow = 91.49 cfs @ 17.29 hrs, Volume= 77.887 af
Primary = 91.49 cfs @ 17.29 hrs, Volume= 77.887 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs

Link 5L: Outlet/Return to streambed



Canyon Fuels Co. Skyline Mine
WQ1 and WQ2, Winter Quarters Basin 1 and 2
100 year 24 hour storm flow in 60" culvert.

Attachment A

Culvert outlet page 1
Roughness Rings

Calculations according to US DOT HEC 14 ch.7 energy dissipation
Increased resistance in a Circular Culvert, (page 7-22)

Step 1, culvert is inlet controled

Step 2, normal flow conditions by trial & error; adust depth Yn until flow matches

100yr 24hr Q (cfs)	Culvert Diam ft	Plain CMP Mannings n	Main Channel slope (ft/ft)	Set depth Yn - (ft)	Angle θ (radians)	Angle θ (degrees)	Area ft^2	Wetted Perimeter ft	R (ft)	Top Width (ft)	Calc Flow Q (cfs)	Vel Q/A Vn - ft/s
91.07	5	0.024	0.099	1.558	2.37	135.73	5.22	5.92	0.882	3.49	93.78	17.44

Step 3, initial design scale ratios, roughened Manning's n

L/Di	C, or h/Di	h	Di	L	Lr/P	Cd	α
0.923	0.0909	0.333	4.333	4.0	0.905	1.900	0.0737

Note- roughness ring to have 6" gap at bottom and 1' gap at top, for 1.5' total, thus Lr/P is less than 1.

0.07638	n_{IR} [Manning's n for isolated roughness]
0.07729	n_{HT} [Manning's n for hyperturbulent]

Recommended design limits are 0.5< L/Di <1.5
Recommended design limits are 0.05< C <0.10
HEC 14, page 7-19

Use the smallest value, 0.0764, Isolated roughness regime flow.

0.07638

Step 4, recalc for roughened Depth & Velocity (by trial & error; adust depth Yn until flow matches)

100yr 24hr Q (cfs)	Rough Culvert Diam ft	Rough CMP Mannings n	Main Channel slope (ft/ft)	Set depth Yn - (ft)	Angle θ (radians)	Angle θ (degrees)	Area ft^2	Wetted Perimeter ft	R (ft)	Top Width (ft)	Calc Flow Q (cfs)	Vel Q/A Vn - ft/s
91.07	4.333	0.07638	0.099	3.385	4.34	248.43	12.36	9.39	1.316	-4.03	91.09	7.37

(Continued)

Canyon Fuels Co. Skyline Mine
WQ1 and WQ2, Winter Quarters Basin 1 and 2
100 year 24 hour storm flow out 60" culvert.

Culvert outlet page 2
Roughness Rings

Check Full culvert capacity

91.07	cfs, Design event flow
95.48	cfs. Q max excedes design event, OK

(Note that this flow calc assumes a solid ring, but the ring actually has gaps at top and bottom, thus the maximum flow will be greater than this number indicates.)

Step 5, Design summary

0.333	feet, h, roughness height
4.000	feet, L, roughness spacing
7.37	ft/sec, Outlet velocity, a 57.8% reduction

Use 5 rows of roughness elements, h = 4 inches high
Total length of roughened section 20 feet long
(with L/2 in front of first element, and L/2 minimum after last element)

Use Values from Roughened culvert for riprap Apron design per US DOT HEC 14 Ch. 10 (Next Sheet)

(Continued)

Canyon Fuels Co. Skyline Mine
WQ1 and WQ2, Winter Quarters Basin 1 and 2
100 year 24 hour storm flow out 60" culvert.

Use Values from Roughened culvert above for Riprap Apron design per US DOT HEC 14 Ch. 10

Riprap Aprons at Culvert outlets
Equation 10.4, D_{50} = 0.2*D*(Q/(g^.5*D^2.5))^(4/3)*(D/TW)

Culvert Diam ft	100yr 24hr Q (cfs)	Tailwater Depth (ft) [depth in culvert]
5	91.07	3.385

0.280	D50, feet

Riprap Aprons after Energy Dissapators
Equation 10.6, D_{50} = 0.692/(S-1)*(V^2/(2*g))

Vel Q/A	Rock Density (lbs/ft^3)	Rock Sp Gr
7.37	165	2.64

0.355	D50, feet

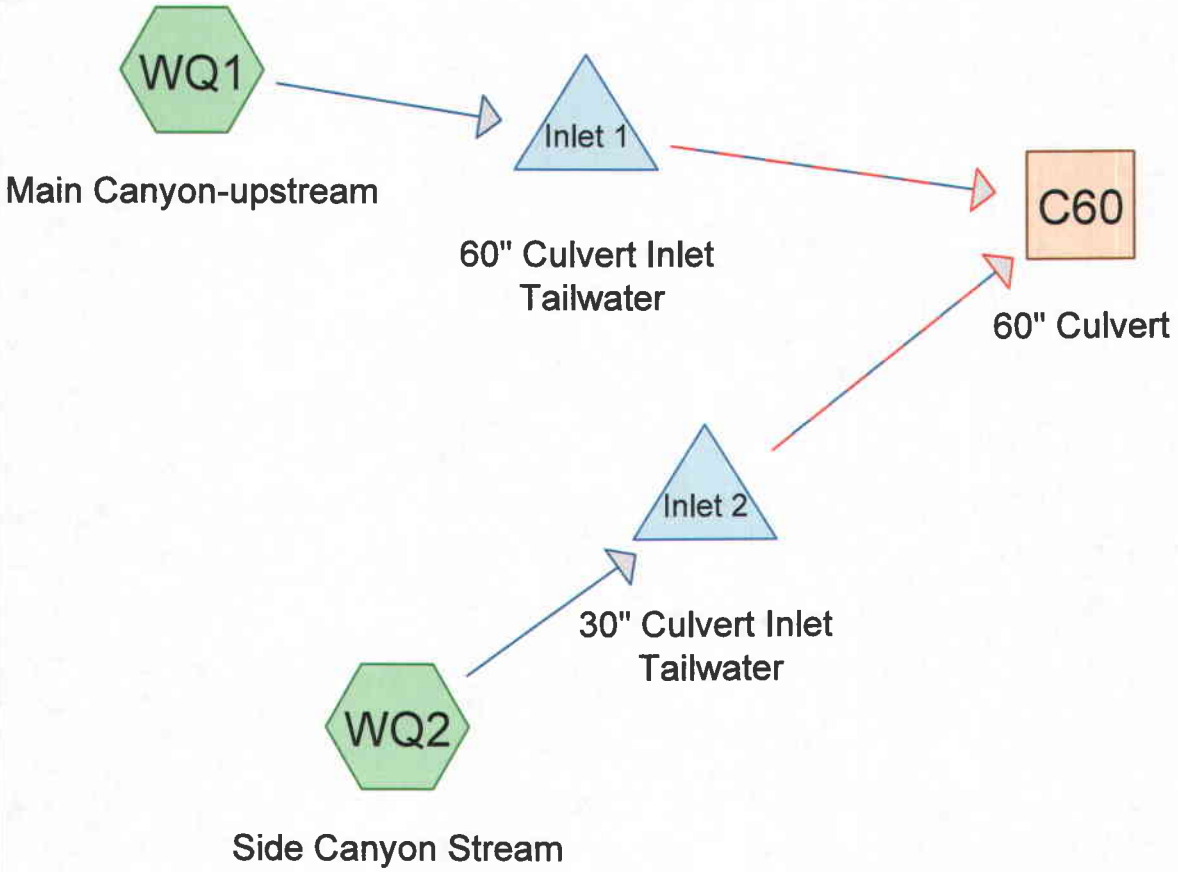
Use largest size,

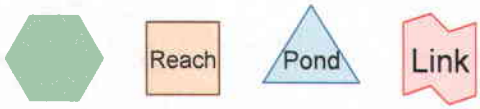
0.355	D50, feet
4.26	D50, inches

Use 6" riprap

From table 10.1,
Apron length = 4*D
Apron depth = 3.3*D50

20.00	feet Apron length
19.80	inches, Apron Depth





Drainage Diagram for Winter Quarters diversion design
Prepared by Earthfax Engineering, Printed 8/22/2009
HydroCAD® 8.50 s/n 004020 © 2007 HydroCAD Software Solutions LLC

Project Notes

Utah DOGM R645-301-
742.221. Sedimentation ponds, when used, will
742.221.33. Contain or treat the 10-year, 24-hour precipitation event ("design event") unless a lesser design event is approved by the Division based on terrain, climate, or other site-specific conditions and on a demonstration by the operator that the effluent limitations of R645-301-751 will be met;

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
708.862	48	Soil Type "Trag-Croydon Complex", Pinyon/juniper range, Fair, HSG B (WQ1)
6.023	48	Soil Type "Unita-Toze families complex", Pinyon/juniper range, Fair, HSG B (WQ1)
274.429	51	Soil Type "Trag stony loam", Pinyon/juniper range, Poor, HSG B (WQ1)
274.005	61	Soil Type "Curecanti-Pathead Complex", Oak/aspen range, Poor, HSG C (WQ2)
2,017.560	61	Soil Type "Curecanti-Pathead Complex", Pinyon/juniper range, Poor, HSG C (WQ1)
3,280.879		**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.000	HSG A	
989.314	HSG B	WQ1
2,291.565	HSG C	WQ1, WQ2
0.000	HSG D	
0.000	Other	
3,280.879		**TOTAL AREA**

Time span=0.00-42.00 hrs, dt=0.02 hrs, 2101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Muskingum-Cunge method - Pond routing by Dyn-Stor-Ind method

Subcatchment WQ1: Main Canyon-upstream Runoff Area=3,006.874 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=17,727' Tc=317.1 min CN=57 Runoff=0.21 cfs 0.087 af

Subcatchment WQ2: Side Canyon Stream Runoff Area=274.005 ac 0.00% Impervious Runoff Depth=0.01"
Flow Length=6,047' Tc=63.6 min CN=61 Runoff=0.39 cfs 0.271 af

Reach C60: 60" Culvert Avg. Depth=0.02' Max Vel=23.90 fps Inflow=0.38 cfs 0.327 af
D=60.0" n=0.025 L=607.0' S=0.0533 '/' Capacity=312.65 cfs Outflow=0.38 cfs 0.327 af

Pond Inlet 1: 60" Culvert Inlet Tailwater Peak Elev=8,104.15' Storage=116 cf Inflow=0.21 cfs 0.087 af
Discarded=0.03 cfs 0.023 af Primary=0.18 cfs 0.064 af Secondary=0.00 cfs 0.000 af Outflow=0.21 cfs 0.087 af

Pond Inlet 2: 30" Culvert Inlet Tailwater Peak Elev=8,130.13' Storage=29 cf Inflow=0.39 cfs 0.271 af
Discarded=0.01 cfs 0.007 af Primary=0.38 cfs 0.264 af Secondary=0.00 cfs 0.000 af Outflow=0.39 cfs 0.271 af

Total Runoff Area = 3,280.879 ac Runoff Volume = 0.357 af Average Runoff Depth = 0.00"
100.00% Pervious = 3,280.879 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment WQ1: Main Canyon-upstream

The soil for most of this basin has not been surveyed. The NRCS has surveyed the lower eastern portion nearest Scofield, and the proportions of soils there were used for the entire basin.

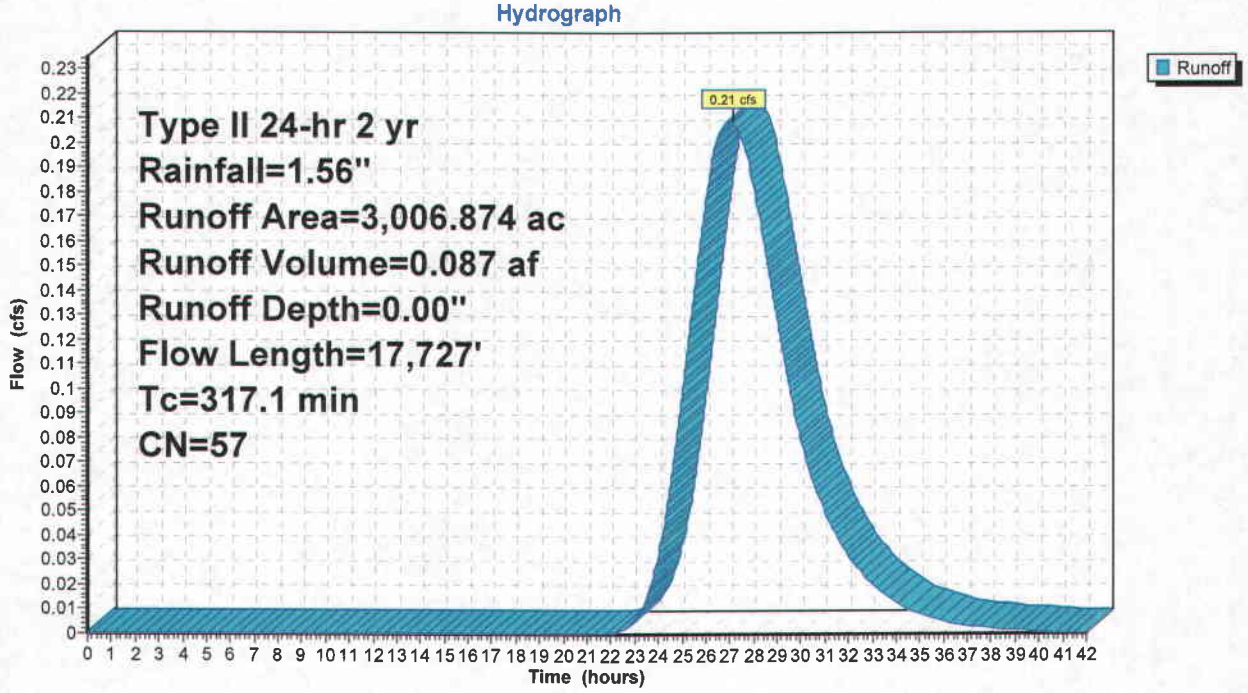
Runoff = 0.21 cfs @ 27.12 hrs, Volume= 0.087 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 2 yr Rainfall=1.56"

	Area (ac)	CN	Description
*	2,017.560	61	Soil Type "Curecanti-Pathead Complex", Pinyon/juniper range, Poor, HSG C
*	274.429	51	Soil Type "Trag stony loam", Pinyon/juniper range, Poor, HSG B
*	708.862	48	Soil Type "Trag-Croydon Complex", Pinyon/juniper range, Fair, HSG B
*	6.023	48	Soil Type "Unita-Toze families complex", Pinyon/juniper range, Fair, HSG B
	3,006.874	57	Weighted Average
	3,006.874		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.4	300	0.0167	0.15		**Sheet Flow,** Range n= 0.130 P2= 1.56"
6.2	600	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.9	1,095	0.3835	3.10		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.6	1,256	0.0637	1.26		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.7	1,547	0.0517	1.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
130.5	7,165	0.0335	0.92		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
98.6	4,122	0.0194	0.70		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.2	1,642	0.0305	6.49	162.20	**Channel Flow,** Area= 25.0 sf Perim= 25.0' r= 1.00' n= 0.040 Winding stream, pools & shoals
317.1	17,727	Total			

Subcatchment WQ1: Main Canyon-upstream



Summary for Subcatchment WQ2: Side Canyon Stream

The soil for part of this basin has not been surveyed. The NRCS has surveyed the most eastern portion, nearest Scofield,

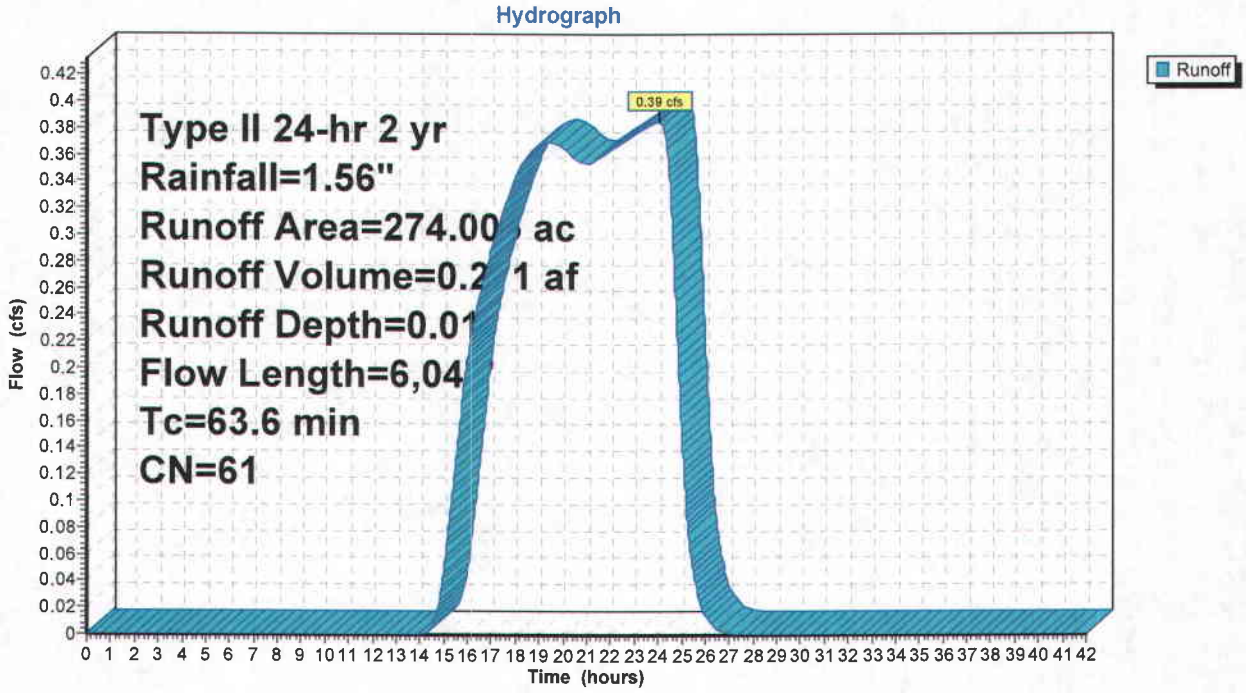
Runoff = 0.39 cfs @ 24.10 hrs, Volume= 0.271 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 2 yr Rainfall=1.56"

	Area (ac)	CN	Description
*	274.005	61	Soil Type "Curecanti-Pathead Complex", Oak/aspen range, Poor, HSG C
	274.005		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.9	300	0.0500	0.24		**Sheet Flow,** Range n= 0.130 P2= 1.56"
11.8	2,079	0.3463	2.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.4	1,465	0.2184	2.34		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.5	2,203	0.1280	1.79		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
63.6	6,047	Total			

Subcatchment WQ2: Side Canyon Stream



Summary for Reach C60: 60" Culvert

[52] Hint: Inlet/Outlet conditions not evaluated

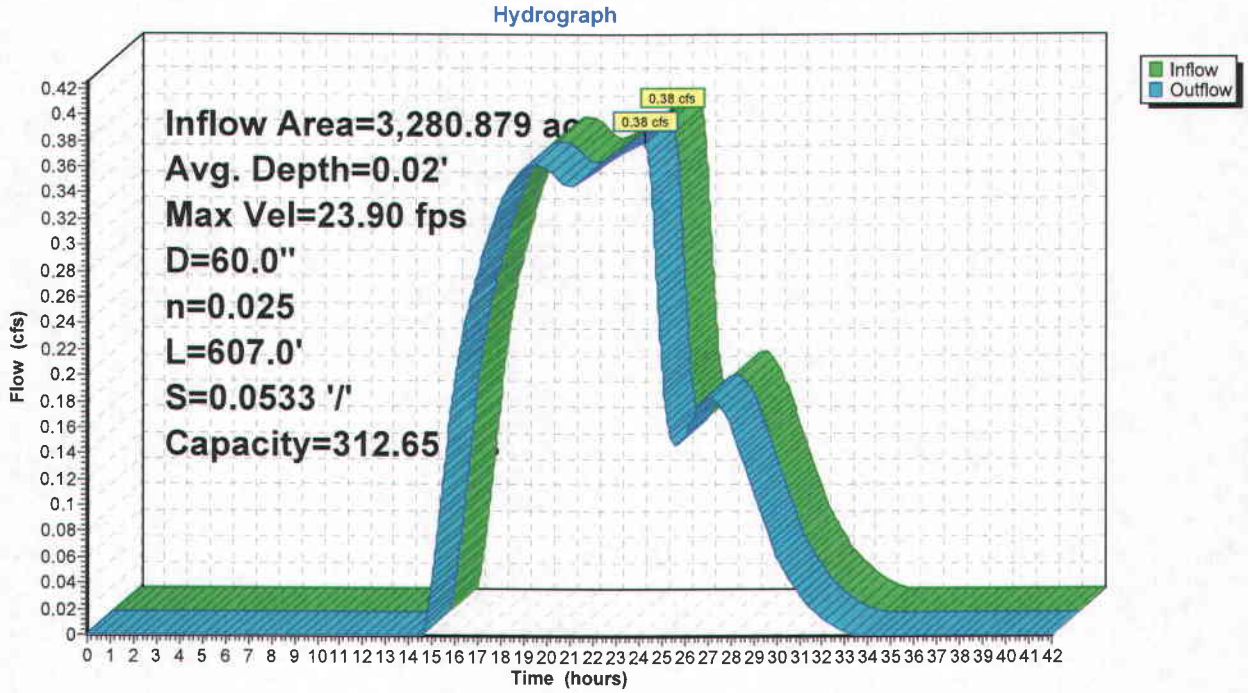
Inflow Area = 3,280.879 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2 yr event
Inflow = 0.38 cfs @ 24.24 hrs, Volume= 0.327 af
Outflow = 0.38 cfs @ 24.23 hrs, Volume= 0.327 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Reference Flow= 234.49 cfs Estimated Depth= 3.23' Velocity= 17.47 fps
m= 1.355, c= 23.68 fps, dt= 1.2 min, dx= 607.0' / 1 = 607.0', K= 0.4 min, X= 0.463
Max. Velocity= 23.90 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 23.68 fps, Avg. Travel Time= 0.4 min

Peak Storage= 10 cf @ 24.23 hrs, Average Depth at Peak Storage= 0.02'
Bank-Full Depth= 5.00', Capacity at Bank-Full= 312.65 cfs

60.0" Diameter Pipe, n= 0.025 Corrugated metal
Length= 607.0' Slope= 0.0533 '/'
Inlet Invert= 8,095.43', Outlet Invert= 8,063.08'

Reach C60: 60" Culvert



Summary for Pond Inlet 1: 60" Culvert Inlet Tailwater

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 3,006.874 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2 yr event
Inflow = 0.21 cfs @ 27.12 hrs, Volume= 0.087 af
Outflow = 0.21 cfs @ 27.15 hrs, Volume= 0.087 af, Atten= 0%, Lag= 2.0 min
Discarded = 0.03 cfs @ 27.15 hrs, Volume= 0.023 af
Primary = 0.18 cfs @ 27.15 hrs, Volume= 0.064 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Peak Elev= 8,104.15'@ 27.15 hrs Surf.Area= 802 sf Storage= 116 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=10.2 min (1,685.2 - 1,675.0)

Volume	Invert	Avail.Storage	Storage Description
#1	8,104.00'	345,874 cf	**Custom Stage Data (Irregular)** Listed below(Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,104.00	722	111.0	0	0	722
8,106.00	2,110	194.0	2,711	2,711	2,759
8,108.00	4,915	428.3	6,830	9,541	14,379
8,110.00	8,810	536.0	13,537	23,078	22,700
8,112.00	13,677	712.0	22,309	45,387	40,223
8,114.00	25,340	840.0	38,422	83,810	56,108
8,116.00	39,798	1,031.0	64,596	148,406	84,607
8,118.00	49,535	1,120.0	89,156	237,562	99,992
8,120.00	58,913	1,259.0	108,313	345,874	126,414

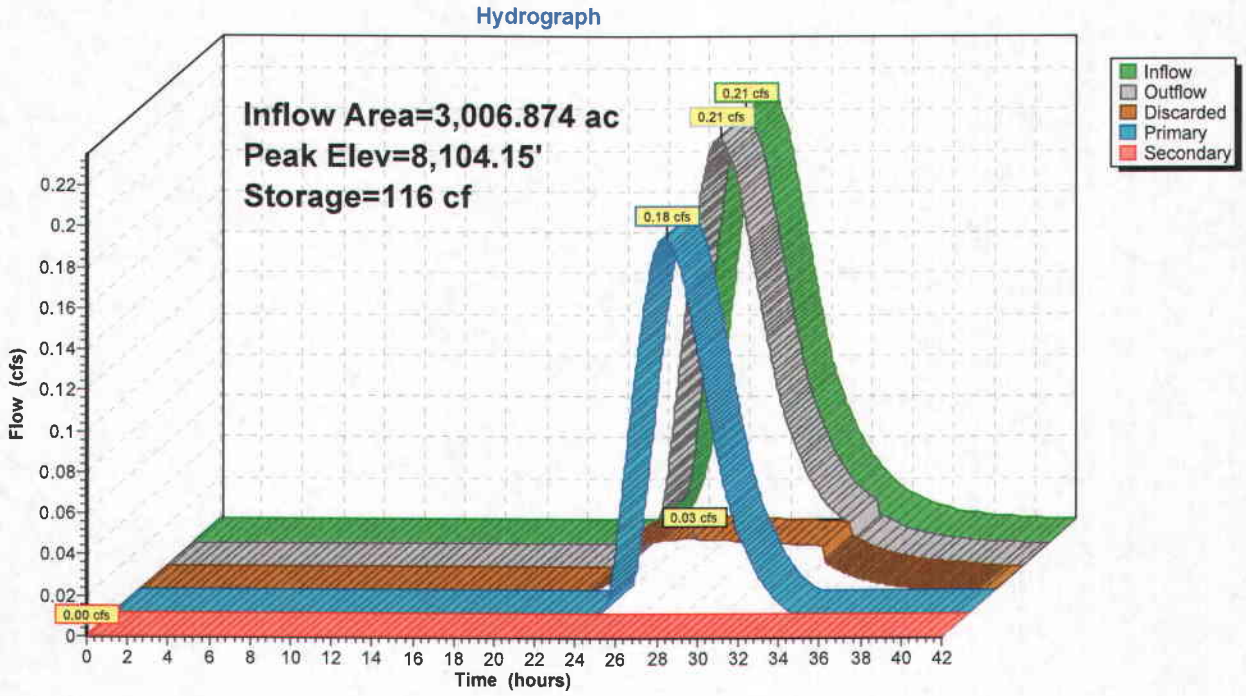
Device	Routing	Invert	Outlet Devices
#1	Secondary	8,117.00'	**10.0' long (Profile 10) Broad-Crested Rectangular Weir** Head (feet) 1.97 2.46 2.95 3.94 4.92 Coef. (English) 3.51 3.48 3.42 3.48 3.57
#2	Primary	8,104.00'	**60.0" x 162.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 8,095.43' S= 0.0529 '/' Cc= 0.900 n= 0.025 Corrugated metal
#3	Discarded	8,104.00'	**1.300 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.03 cfs @ 27.15 hrs HW=8,104.15' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.18 cfs @ 27.15 hrs HW=8,104.15' TW=8,095.44' (Dynamic Tailwater)
└**2=Culvert** (Inlet Controls 0.18 cfs @ 1.05 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=8,104.00' TW=8,095.43' (Dynamic Tailwater)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond Inlet 1: 60" Culvert Inlet Tailwater



Summary for Pond Inlet 2: 30" Culvert Inlet Tailwater

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area =	274.005 ac,	0.00% Impervious,	Inflow Depth = 0.01"	for 2 yr event
Inflow =	0.39 cfs @	24.10 hrs, Volume=	0.271 af	
Outflow =	0.39 cfs @	24.11 hrs, Volume=	0.271 af, Atten= 0%, Lag= 0.8 min	
Discarded =	0.01 cfs @	24.11 hrs, Volume=	0.007 af	
Primary =	0.38 cfs @	24.11 hrs, Volume=	0.264 af	
Secondary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Peak Elev= 8,130.13'@ 24.11 hrs Surf.Area= 235 sf Storage= 29 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=1.3 min (1,233.0 - 1,231.7)

Volume	Invert	Avail.Storage	Storage Description
#1	8,130.00'	2,872 cf	**Custom Stage Data (Irregular)** Listed below(Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,130.00	227	59.3	0	0	227
8,132.00	360	73.0	582	582	423
8,134.00	520	87.0	875	1,457	662
8,136.00	913	115.0	1,415	2,872	1,156

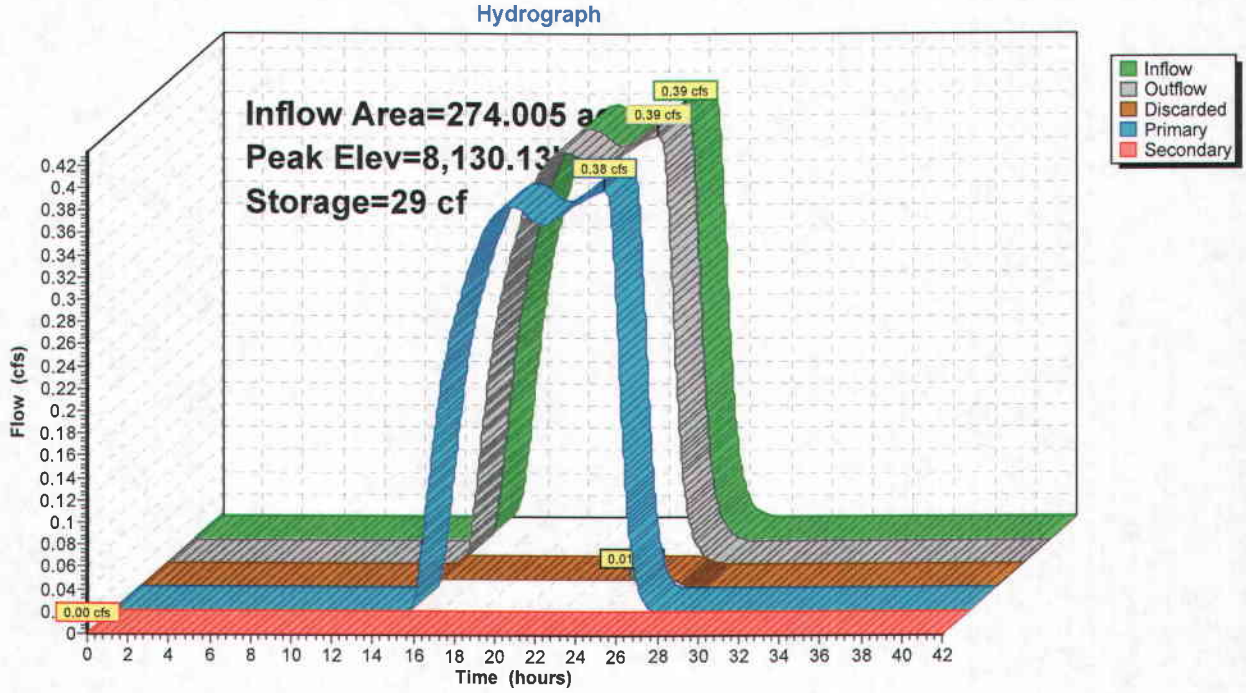
Device	Routing	Invert	Outlet Devices
#1	Device 2	8,130.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Primary	8,128.00'	**30.0" x 158.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 8,095.43' S= 0.2061 '/' Cc= 0.900 n= 0.025 Corrugated metal
#3	Secondary	8,137.75'	**18.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#4	Discarded	8,130.00'	**1.300 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.01 cfs @ 24.11 hrs HW=8,130.13' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.38 cfs @ 24.11 hrs HW=8,130.13' TW=8,095.45' (Dynamic Tailwater)
└**2=Culvert** (Passes 0.38 cfs of 22.09 cfs potential flow)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.38 cfs @ 1.00 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=8,130.00' TW=8,095.43' (Dynamic Tailwater)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond Inlet 2: 30" Culvert Inlet Tailwater



Canyon Fuels Co. Skyline Mine

Attachment A

WQ1 and WQ2, Winter Quarters Basin 1 and 2

2 year 24 hour storm flow out 60" culvert.

Baffles to reduce velocity under 6 fps for fish

Calculations according to US DOT HEC 14 ch.7 energy dissipation

Increased resistance in a Circular Culvert, (7-22)

Step 1, culvert is inlet controled

Step 2, normal flow conditions by trial & error; adust Yn until flow matches

2yr 24hr Q (cfs)	Culvert Diam ft	Plain CMP Mannings n	Main Channel slope (ft/ft)	Set depth Yn - (ft)	Angle θ (radians)	Angle θ (degrees)	Area ft^2	Wetted Perimeter ft	R (ft)	Top Width (ft)	Calc Flow Q (cfs)	Vel Q/A Vn - ft/s
0.38	5	0.024	0.099	0.112	0.60	34.43	0.11	1.50	0.074	2.83	0.38	3.42

Water velocity in the culvert is already at an acceptable value, 3.42 feet per second.

Based on the Table provided by Mr Larry Dalton, Utah Division of Wildlife Resources (6/28/1989),

fish could be expected to swim at least 174 feet, thus baffles to create resting pools with a maximum spacing of 174 feet

will allow fish to pass through the culvert.

Fish baffles will be placed approximately 145' apart.

Maximum swimming distance for adult trout (Salmo sp.) at a speed (6.5 ft./sec.) that could be sustained for a short period of time (60 seconds) inorder to pass through a difficult area. These data reflect optimum water temperatures. Note, a 50 percent reduction in swimming capability can occur at temperatures proximal to the upper or lower lethal water temperatures for trout.

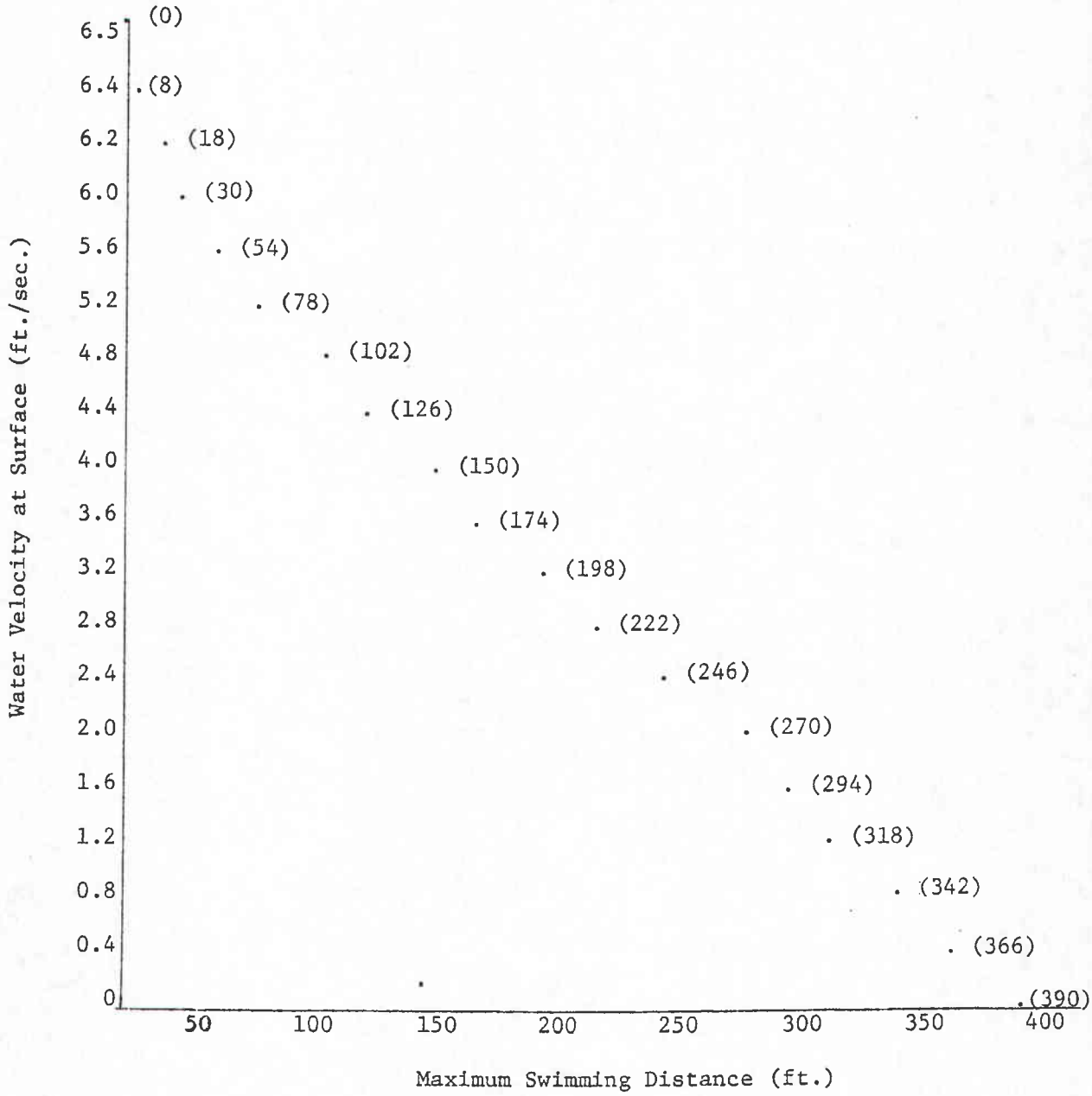


Table obtained from Mr. Larry Dalton of Division of Wildlife Resources, 6/28/89

USGS Home
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National Water Information System: Web Interface

USGS Water Resources

Data Category: Surface Water | Geographic Area: Utah | GO

News: Recent changes

Peak Streamflow for Utah

USGS 09310700 MUD CRK BL WINTER QUARTERS CYN @ SCOFIELD, UT

Available data for this site: Surface-water: Peak streamflow | GO

Carbon County, Utah
Hydrologic Unit Code 14060007
Latitude 39°43'18",
Longitude 111°09'38" NAD27
Drainage area 29.1 square miles
Gage datum 7,720.0 feet above sea level NGVD29

Output formats

- Table
- Graph
- Tab-separated file
- peakfq (watstore) format
- Reselect output format

Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
1979	May 24, 1979	1.61	98
1980	May 23, 1980		145[1]
1981	Aug. 10, 1981	1.34	74
1982	May 28, 1982	2.11	186
1983	May 30, 1983		291[1]
1984	May 21, 1984	3.30	389
1985	May 10, 1985	1.58	126
1986	May 29, 1986		170[1]
1991	Jun. 01, 1991	2.56	63
1992	May 09, 1992	2.06	22
1993	May 18, 1993	3.33	140
1994	May 13, 1994	2.19	32
1995	Jun. 13, 1995	3.31	165
1996	May 17, 1996	3.04	115
1997	May 19, 1997	3.48	171
1998	May 28, 1998	2.59	63
1999	May 28, 1999	3.01	115
2000	May 24, 2000	2.46	50
2001	May 17, 2001	2.51	55
2002	Jun. 08, 2002	2.27	35
2003	May 25, 2003		56[1,2]
2004	Sep. 30, 2004	2.85	93
2005	May 22, 2005		290[2]
2006	May 19, 2006	3.69	244
2007	May 14, 2007	2.45	50
2008	May 20, 2008	3.63	231

Peak Streamflow Qualification Codes.

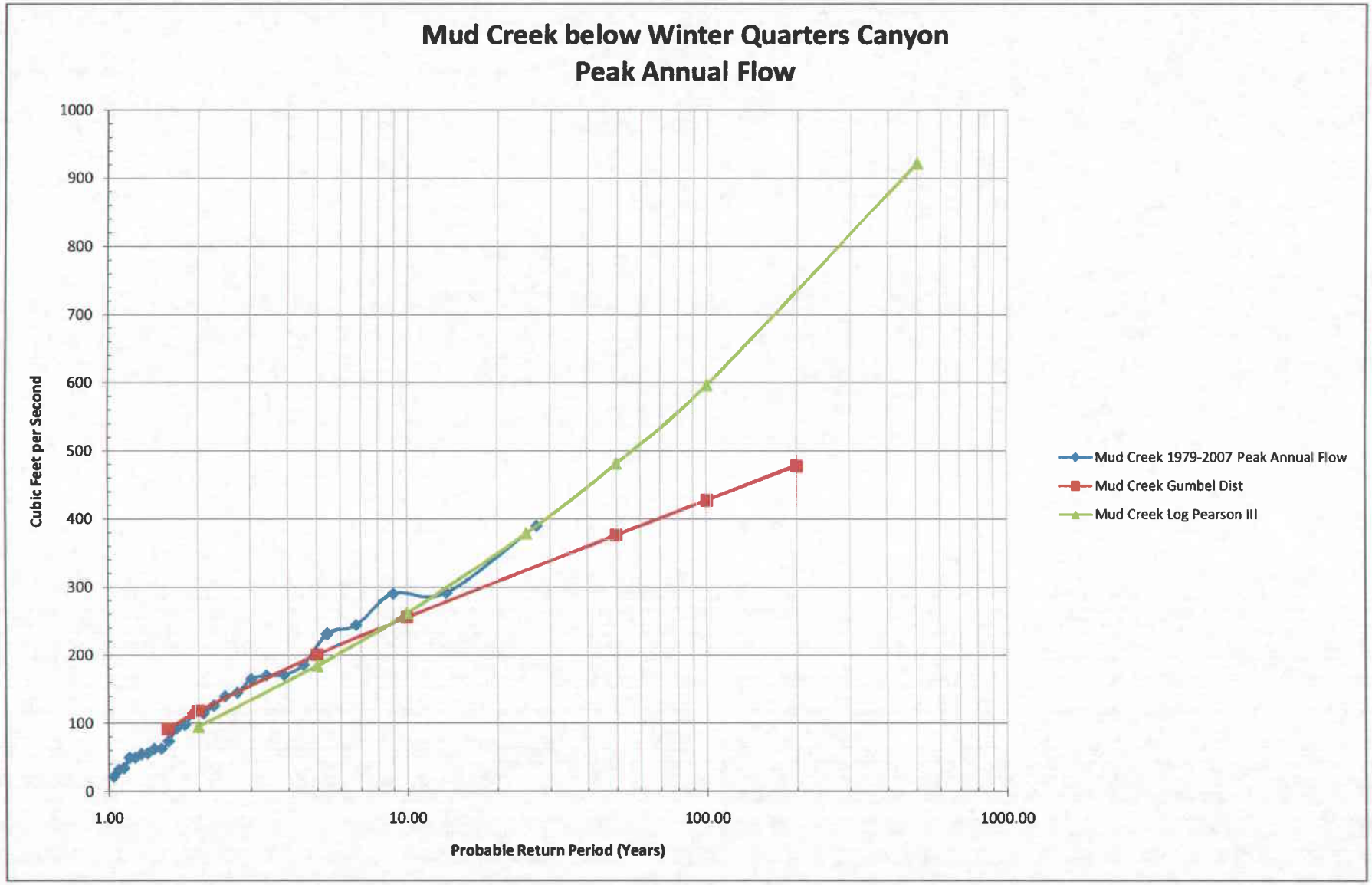
- 1 -- Discharge is a Maximum Daily Average
- 2 -- Discharge is an Estimate

Log pearson III - Mud Creek, Carbon County Utah

	CFS	Date	Rank	Mud Creek C CFS	Log CFS	log - mean of logs
1	389	5/21/1984	27.00	389	2.590	0.612
2	291	5/30/1983	13.50	291	2.464	0.486
3	290	5/22/2005	9.00	290	2.462	0.484
4	244	5/19/2006	6.75	244	2.387	0.409
5	231	5/20/2008	5.40	231	2.270	0.291
6	186	5/28/1982	4.50	186	2.233	0.255
7	171	5/19/1997	3.86	171	2.230	0.252
8	170	5/29/1986	3.38	170	2.217	0.239
9	165	6/13/1995	3.00	165	2.161	0.183
10	145	5/23/1980	2.70	145	2.146	0.168
11	140	5/18/1993	2.45	140	2.100	0.122
12	126	5/10/1985	2.25	126	2.061	0.083
13	115	5/17/1996	2.08	115	2.061	0.083
14	115	5/28/1999	1.93	115	1.991	0.013
15	98	5/24/1979	1.80	98	1.968	-0.010
16	93	9/30/2004	1.69	93	1.869	-0.109
17	74	8/10/1981	1.59	74	1.799	-0.179
18	63	6/1/1991	1.50	63	1.799	-0.179
19	63	5/28/1998	1.42	63	1.748	-0.230
20	56	5/25/2003	1.35	56	1.740	-0.238
21	55	5/17/2001	1.29	55	1.699	-0.279
22	50	5/24/2000	1.23	50	1.699	-0.279
23	50	5/14/2007	1.17	50	1.544	-0.434
24	35	6/8/2002	1.13	35	1.505	-0.473
25	32	5/13/1994	1.08	32	1.342	-0.636
26	22	5/9/1992	1.04	22	1.342	-0.636

133.4231	mean cfs		
93.52	SDEV cfs		
26	N		
1.978	Mean of logs		
0.343	Sdev of logs		
2.321E-43	Skew	flow	
2.8782	Log Pearson K, 500 year event	921.2	500
2.3264	Log Pearson K, 100 year event	596.0	100
2.0538	Log Pearson K, 50 year event	480.7	50
1.7507	Log Pearson K, 25 year event	378.4	25
1.2816	Log Pearson K, 10 year event	261.4	10
0.8416	Log Pearson K, 5 year event	184.7	5
0	Log Pearson K, 2 year event	95.1	2

coef per UDOT Manual of Instruction for Drainage - 2008


Mud Creek below Winter Quarters Canyon
Peak Annual Flow
Cubic Feet per Second
1000
900
800
700
600
500
400
300
200
100
0
1.00
10.00
100.00
1000.00
Probable Return Period (Years)
Mud Creek 1979-2007 Peak Annual Flow
Mud Creek Gumbel Dist
Mud Creek Log Pearson III

Appendix A. MUD CREEK BASIN
WITH WINTER QUARTERS CANYON BASIN

EarthFax

0 5000
1" = 5000'

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 39.712627 N 111.225968 W 8690 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: Wed Jul 22 2009

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Docs | Return to State Map

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	0.15	0.23	0.29	0.39	0.49	0.60	0.67	0.88	1.14	1.26	1.55	1.99	2.47	2.86	3.90	4.83	6.05	7.23
2	0.20	0.30	0.38	0.51	0.62	0.76	0.84	1.09	1.40	1.56	1.92	2.47	3.06	3.55	4.87	6.00	7.52	9.02
5	0.27	0.42	0.52	0.69	0.86	1.00	1.07	1.33	1.70	1.90	2.34	3.02	3.77	4.36	5.99	7.32	9.18	11.00
10	0.34	0.51	0.64	0.86	1.06	1.22	1.29	1.55	1.95	2.17	2.68	3.47	4.33	4.99	6.87	8.35	10.45	12.52
25	0.43	0.66	0.82	1.10	1.37	1.56	1.62	1.85	2.30	2.53	3.14	4.09	5.10	5.84	8.04	9.69	12.13	14.49
50	0.52	0.79	0.98	1.32	1.63	1.86	1.92	2.14	2.58	2.81	3.49	4.56	5.70	6.50	8.93	10.70	13.38	15.95
100	0.62	0.94	1.17	1.57	1.94	2.21	2.26	2.47	2.88	3.09	3.85	5.05	6.32	7.16	9.84	11.71	14.65	17.40
200	0.73	1.11	1.38	1.85	2.30	2.61	2.65	2.85	3.25	3.37	4.22	5.55	6.95	7.82	10.75	12.70	15.90	18.83
500	0.91	1.38	1.72	2.31	2.86	3.23	3.29	3.47	3.88	3.92	4.71	6.22	7.79	8.71	11.95	14.00	17.54	20.68
1000	1.07	1.63	2.02	2.72	3.37	3.82	3.87	4.04	4.46	4.50	5.09	6.75	8.45	9.39	12.88	14.97	18.80	22.08

* 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	0.18	0.28	0.35	0.47	0.58	0.71	0.79	1.00	1.27	1.43	1.76	2.30	2.87	3.33	4.56	5.59	7.05	8.33
2	0.24	0.36	0.45	0.60	0.75	0.90	0.99	1.24	1.56	1.77	2.19	2.86	3.56	4.13	5.68	6.96	8.79	10.40
5	0.33	0.50	0.61	0.83	1.02	1.19	1.27	1.52	1.90	2.15	2.67	3.50	4.38	5.08	7.01	8.52	10.74	12.70
10	0.40	0.61	0.76	1.02	1.27	1.46	1.52	1.77	2.18	2.45	3.05	4.02	5.04	5.82	8.05	9.71	12.24	14.45
25	0.52	0.79	0.98	1.32	1.64	1.87	1.92	2.12	2.58	2.86	3.58	4.72	5.95	6.82	9.45	11.27	14.22	16.75
50	0.63	0.95	1.18	1.59	1.97	2.24	2.28	2.47	2.91	3.18	3.98	5.28	6.66	7.60	10.52	12.45	15.71	18.49
100	0.75	1.14	1.41	1.90	2.35	2.67	2.70	2.88	3.27	3.50	4.41	5.86	7.40	8.39	11.60	13.64	17.21	20.20
200	0.89	1.35	1.68	2.26	2.80	3.18	3.20	3.34	3.73	3.83	4.86	6.43	8.15	9.19	12.71	14.85	18.73	21.92
500	1.13	1.72	2.13	2.86	3.54	4.00	4.04	4.14	4.52	4.56	5.45	7.26	9.22	10.29	14.21	16.45	20.76	24.19
1000	1.35	2.06	2.55	3.44	4.25	4.82	4.83	4.89	5.26	5.31	5.92	7.91	10.06	11.14	15.37	17.66	22.37	25.95

* 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	0.13	0.20	0.25	0.34	0.42	0.52	0.59	0.78	1.03	1.13	1.37	1.74	2.16	2.49	3.41	4.20	5.27	6.33

n, Parts of Carbon and Emery Counties; and Manti-Lasal National Forest, Manti Division - Parts of Sanpete and Emery Counties
(Winter Quarters Canyon)

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

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**
23	Curecanti family-Pathead complex	2,030.6	24.7%
115	Trag stony loam, 30 to 60 percent slopes	259.7	3.2%
118	Trag-Croydon complex	550.2	6.7%
125	Uinta-Toze families complex	5.7	0.1%
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)		8,217.0	100.0%

ATTACHMENT B

Sediment-Yield Calculations

1. Location

	Lat			Long		
Site Decimal Location	39.720768			111.200611		
	Lat			Long		
	degree	minute	second	degree	minute	second
Site Angle Location	39	43	14.76	111	12	2.20

2. Isoerodent Value

From map R= 19

Location is between lines of 15 and 19, closer to 19
19 is conservatively higher
See Figure 5

3. Time exposed to erosion

Assume March 1st to December 1st

Months 9

4. Determine adjusted erosion value using Figure 1 and Figure 9

In Carbon County near border of Zone II/Zone III
From Figure 1

Zone II 90.00%
Zone III 93.00%

Conservatively use Zone III 93.00%

Figure 9
For 25 year recurrence interval, from Figure 9,

EI/R = 2.02

R adjusted = R*.93*2.02 = 35.693

Sediment calculation follows the procedures given in *Erosion and Sedimentation in Utah: A guide for Control* by C. Earl Israelen, Joel E. Fletcher, FrankW. Haws and Eugene K. Israelsen.
Utah Water Research Laboratory, Logan, UT 1984

5. Soil Erodability - K factor

From NRCS Web Soil Survey

Use 0.10

6 & 7. Slope angle and length determined using AutoCad 2008

See Figures 3 and 4. (Continued)

Skyline Mine - Winter Quarters Canyon Portals

Sediment from Erosion Calculations

8. LS Calculations (Continued)

LS for Section Line 1

Path from top of Topsoil storage pile to Sediment pond

Mild slopes, 2:1 - 12:1, re-vegetated

Segment Number	Vert drop in Segment	Cum drop	Length Segment n	λn	100* Vert/Hor	LS per Segment	LS with λn-1	Final LS	
0	0	0	0	0	0				
1	0.50	0.50	23.1	23	2.17	0.110	0.000	0.11	Top of Topsoil
2	10.0	10.50	19.8	42.9	50.51	11.848	8.693	15.53	Storage
3	2.0	12.50	7.2	50.0	27.97	5.014	4.642	7.25	
4	12.0	24.50	23.8	73.8	50.42	15.507	12.765	21.27	
5	2.0	26.50	8.5	82.3	23.54	4.839	4.583	7.07	
6	16.0	42.50	24.0	106.4	66.61	27.470	24.170	38.78	
							Weighted Average	17.48	

LS for Section Line 2

Mixed slopes and surface conditions from upper side road to DD1 on site.

Note: Slope length is considered the length over which water flows uninterupted down slope. Vegetation and minor fluctuations in angle or or protruding rocks act to break slopes into numerous slope segments. In the absence of detailed surface survey work, and with brush every 6-10 feet, slope lengths of 35' or more for undisturbed existing ground is considered conservative.

Segment Number	Vert drop in Segment	Cum drop	Length Segment n	λ	100* Vert/Hor	LS per as whole	Broken into # of stretches	Final LS	Description
1	102.0	102	190.0	190.0	53.68	27.268	5	12.19	Undisturbed Ex ground

	Vert drop in Segment	Cum drop	Length Segment n	λn	100* Vert/Hor	LS per Segment	LS with λn-1	Final LS	
2	38.0	140.00	38.5	228.5	98.70	63.061	57.504	90.49	1:1 cut slope
3	0.8	140.80	161.8	390.3	0.49	0.207	0.158	0.28	Nearly flat pads
4	6.2	147.00	37.0	427.3	16.76	6.320	6.040	9.27	lined ditch on 2:1 slope
							Weighted Average	14.48	

LS for Section Line 3

Segment Number	Vert drop in Segment	Cum drop	Length Segment n	λ	100* Vert/Hor	LS per as whole	Broken into # of stretches	Final LS	Description
1	73.0	73	174.6	174.6	41.81	17.922	4	8.96	Undisturbed Ex ground

Segment Number	Vert drop in Segment	Cum drop	Length Segment n	λn	100* Vert/Hor	LS per Segment	LS with λn-1	Final LS	
2	15.0	88.00	15.7	190.3	95.54	55.742	53.393	81.86	1:1 cut slope
3	4.0	92.00	124.7	315.0	3.21	0.580	0.451	0.78	road
4	10.0	102.00	98.6	413.6	10.14	2.843	2.481	4.00	around top of topsoil pile
5	26.0	128.00	57.6	471.2	45.16	33.177	31.084	48.21	down alongside topsoil
							Weighted Average	12.98	

9. Potential Erosion

Section line 1 flows directly into the sediment pond

LS	K Value	R Adjusted	Vm	A (tons/year per acre)	Area acres	Soil density pcf	Cubic feet	Description
17.48	0.10	35.7	0.05	3.12	0.67	110	38.01	Mild slopes reveg., 12:1 to 2:1

Section line 1 Subtotal 0.67 acres 38.0 cubic feet Sediment

Sediment Pond

LS	K Value	R Adjusted	Vm	(tons/year per acre)	Area acres	Soil density pcf	Cubic feet	
0.78	0.10	35.7	0.95	2.64	0.38	110	18.21	Pond

Note Pond VM is weighted ave of .01 for water surface and 1.48 for surrounding road.

Sediment generated in the pond area Subtotal 0.38 acres 18.2 cubic feet Sediment

9. Potential Erosion continued

Section Line 2 Potential Erosion Sediment, flows to disturbed ditch DD1

LS	K Value	R Adjusted	Vm	A (tons/year per acre)	Area acres	Soil density pcf	Cubic feet	Description
12.19	0.10	35.7	0.35	15.23	2.42	110	670.31	Undisturbed Existing Ground above cut slopes
90.49	0.10	35.7	1.30	419.88	0.19	110	1415.01	Steep slopes - 1:1 Cut slopes above pads/roads
0.28	0.10	35.7	1.48	1.45	1.22	110	32.25	Flat areas - pads/roads - Compacted fill
9.27	0.10	35.7	0.05	1.65	0.43	110	12.94	Slope down from pads, mild 2:1 to lined ditch

Section line 2 Subtotals 4.26 acres 2130.5 cubic feet Sediment

Section Line 3 Potential Erosion Sediment, flows directly to sediment pond

LS	K Value	R Adjusted	Vm	A (tons/year per acre)	Area acres	Soil density pcf	Cubic feet	Description
8.96	0.10	35.7	0.35	11.19	1.20	110	244.25	Undisturbed Existing Ground above cut slopes
81.86	0.10	35.7	1.30	379.86	0.10	110	690.65	Steep slopes - 1:1 Cut slopes above pads/roads
0.78	0.10	35.7	1.48	4.11	0.17	110	12.69	Flat areas - pads/roads - Compacted fill
4.00	0.10	35.7	0.35	5.00	0.05	110	4.54	Undisturbed below road and above topsoil pile
48.21	0.10	35.7	0.35	60.23	0.19	110	208.07	Undisturbed above pond

Section line 3 Subtotals 1.71 acres 1160.2 cubic feet Sediment

Total Area 7.02 acres

Total Potential Sediment to Pond 3347 cubic feet

STEP-BY-STEP PROCEDURE FOR DETERMINING EROSION

The following step-by-step procedures will lead one through the proper use of appropriate tables, figures, maps, and graphs in this handbook for determining sheet erosion.

1. Determine as precisely as is practicable the latitude and longitude of the construction site in question.

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

2. Using the location information from 1, enter the appropriate iso-erodent map and determine the annual R value for the site. (Remember that these R values for Utah include snowmelt as well as rainfall.)

Example: 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 length of time the site will be exposed to erosive forces.

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

4. With the information from number 3, enter Figure 1 and read the percentage of annual R for each month or fraction thereof that the site will be exposed. These individual percentages are added together to give a percentage for the total time period. This total percentage is then multiplied by the annual R value from number 2 to obtain the proper value of R to use in the soil loss equation.

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

$$0.68 \times 13 = 8.84$$

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

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

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

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

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

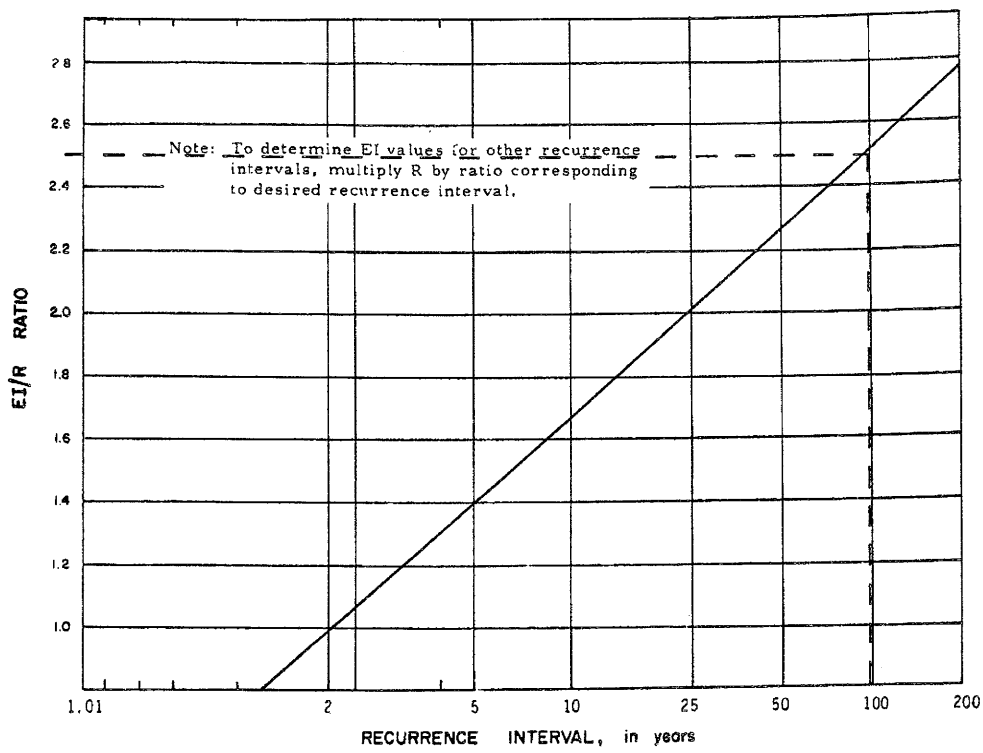


Figure 9. The relationship between the EI/R ratio and recurrence interval.

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

7. Determine the slope length in feet.

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

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

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

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

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

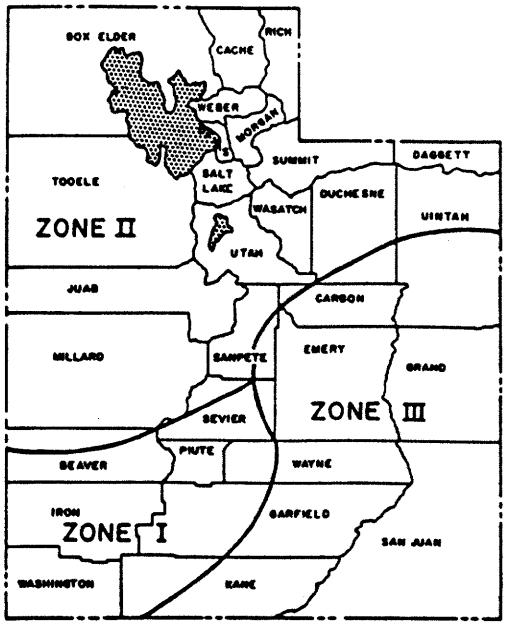
$= 229.34$ t/ac/yr

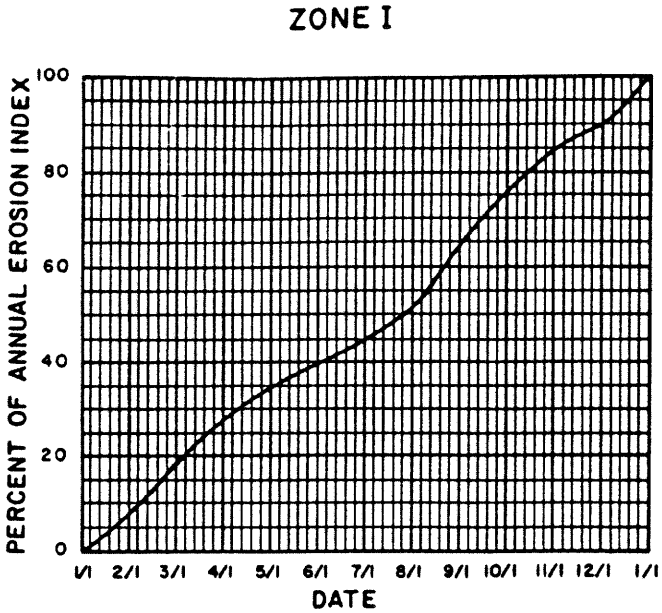
10. The amount of mulch required to reduce the potential erosion to the amount of 1 ton/acre can be determined from Figures 3 through 6. Other control measures are listed in Table 3 together with their approximate VM values. The VM value of any particular control measure, multiplied by the R·K·LS value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

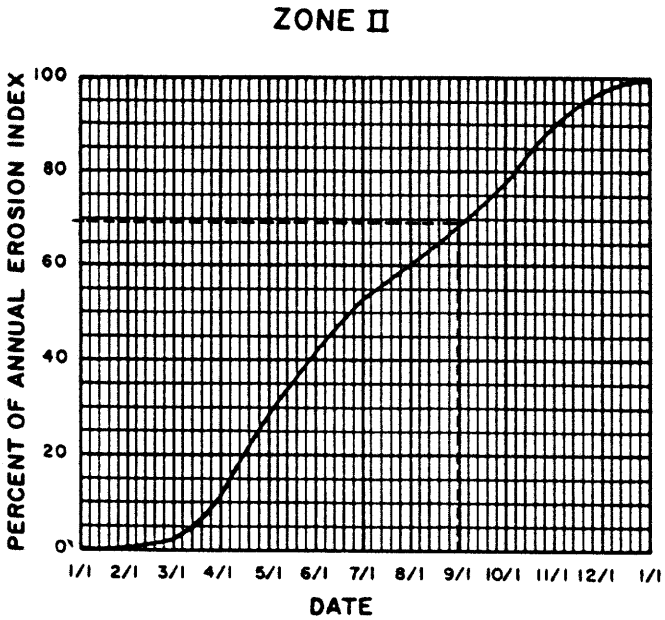
Example: Control measures: One may select from several alternatives, such as the following.

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

If R·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







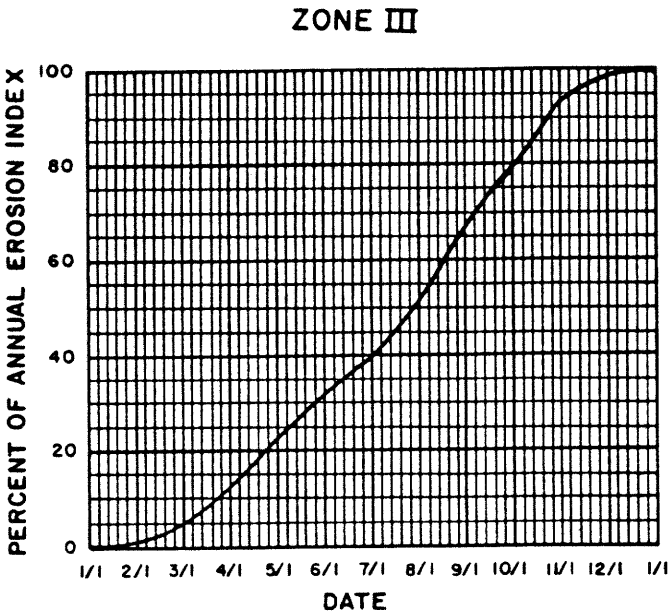


Figure 1. Erosion index distribution curves.

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

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

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

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

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

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

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

When a slope is shortened by means of intercept ditches, the LS values for the new slope segments created can be determined also by multiplying the LS for the individual slope by $1/\sqrt{\text{no. of segments}}$. For example, the original LS value for the 1000 ft slope in the example above is 40.01. Dividing the slope into 5 equal segments decreases the LS to $40.01/\sqrt{5} = 17.89$.

Cutting the slope length in half cuts the erosion amount on the total slope by approximately one-third or to 70 percent of the original amount.

The reader should remember that erosion potential, or the R·K·LS value, is a rate and must be multiplied by an area to determine total erosion amount.

Multiple Slopes

The soil loss equation is based on the assumption that the sediment load carried by the runoff is limited only by the amount of material detached and not by the capacity of the water to carry the detached material. Under this assumption the sediment load increases as the water moves downslope and the runoff from the upper slope adds to the rainfall on the lower slope and thus increases the erosion rate on the lower slope. To obtain an LS factor for a segment of a multiple slope which takes into account the runoff from the upper slope, the following formula can be used:

$$(LS)_n = \frac{(L\lambda_n \, S_{s_n}) \, \lambda_n - (L\lambda_{n-1} \, S_{s_n}) \, \lambda_{n-1}}{ln} \qquad \text{(C-2)}$$

in which

$(LS)_n$ = topographic factor for slope segment n

ln = length of slope segment n

s_n = slope gradient in percent of segment n

λ_n = the sum of the slope segment length from the top of the slope to the bottom of slope segment n

S_n = slope factor for slope segment n

L_n = length factor for slope segment n

To illustrate its use, consider the multiple slope shown in Figure C-1.

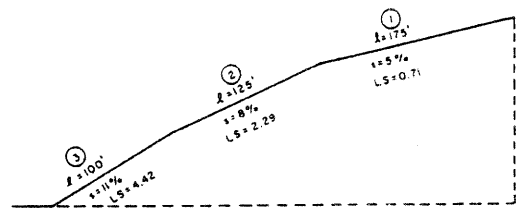


Figure C-1.

The parts can be tabulated thus:

	$\lambda_0 = 0$	
$\ell_1 = 175$	$\lambda_1 = 175$	$S_1 = 5\%$
$\ell_2 = 125$	$\lambda_2 = 300$	$S_2 = 8\%$
$\ell_3 = 100$	$\lambda_3 = 400$	$S_3 = 11\%$

Using Table C-1, the above values of ℓ, λ, and s, and Equation C-2, LS values for the three slope segments, as influenced by the slopes above them, can be determined

LS for λ_1 S_1 = 0.71
LS for λ_0 S_1 = 0
LS for λ_2 S_2 = 1.72
LS for λ_1 S_2 = 1.31
LS for λ_3 S_3 = 3.16
LS for λ_2 S_3 = 2.74

Segment 1 would have an LS value equal to:

$$LS_1 = \frac{(0.71)(175) - (0)(0)}{175} = 0.71$$

Segment 2 would have:

$$LS_2 = \frac{(1.72)(300) - (1.31)(175)}{125} = 2.29$$

and segment 3 would have:

$$LS_3 = \frac{(3.16)(400) - (2.74)(300)}{100} = 4.42$$

Potential erosion rates will now be calculated using the soil loss equation for a hypothetical site at Park City, Utah, where R = 13 and k = 0.30.

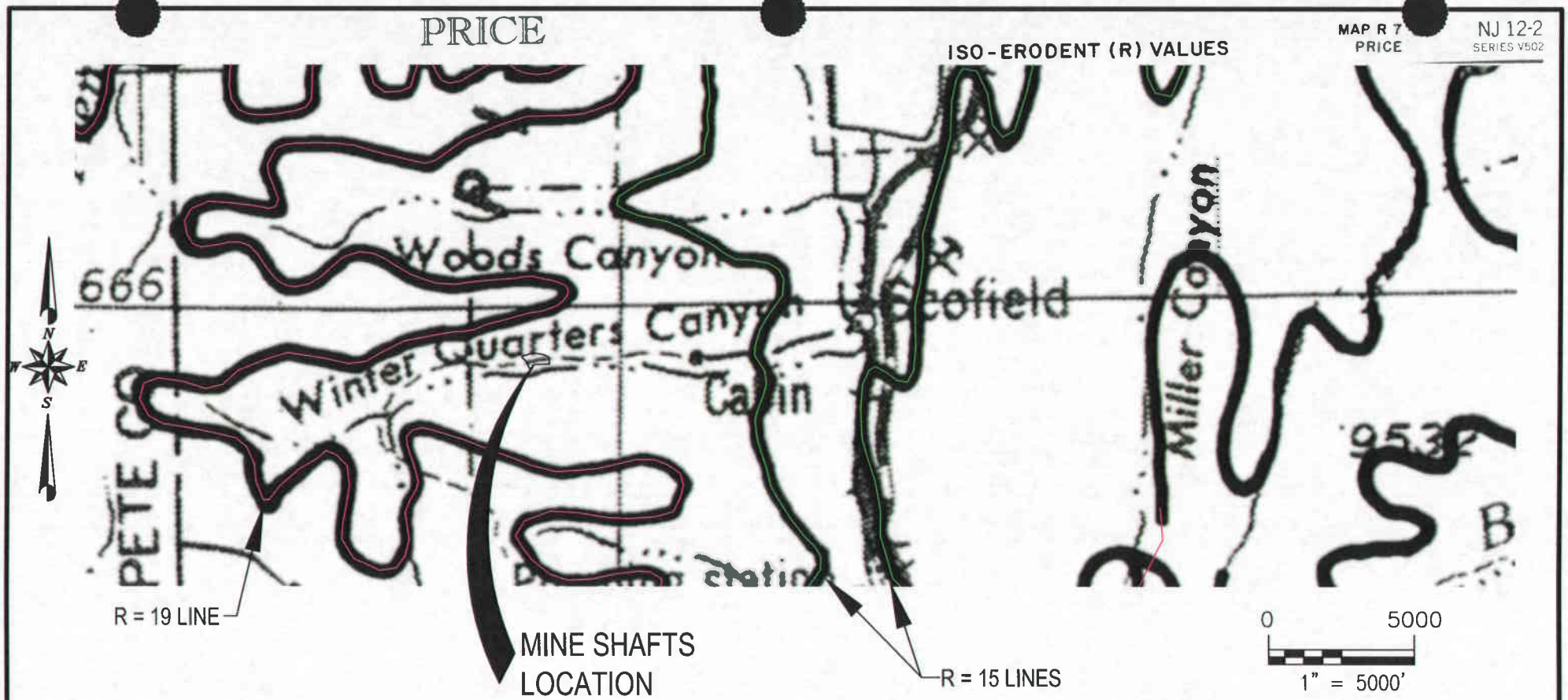
A = R·K·LS

segment 1, A = 13 (0.30)(0.71) = 2.77 T/A

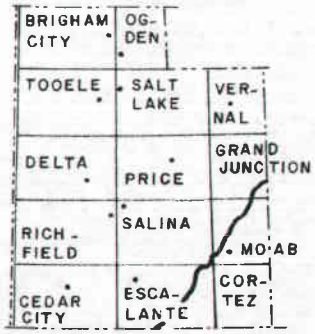
segment 2, A = 13 (0.30)(2.29) = 8.93 T/A

segment 3, A = 13 (0.30)(4.22) = 16.46 T/A

The VM values needed to reduce the potential on each slope segment to 1.0 T/A are calculated from:



LOCATION DIAGRAM



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

MEAN ANNUAL ISO-ERODENT (R) VALUES

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

UTAH WATER RESEARCH LABORATORY UTAH STATE UNIVERSITY LOGAN, UTAH 1983

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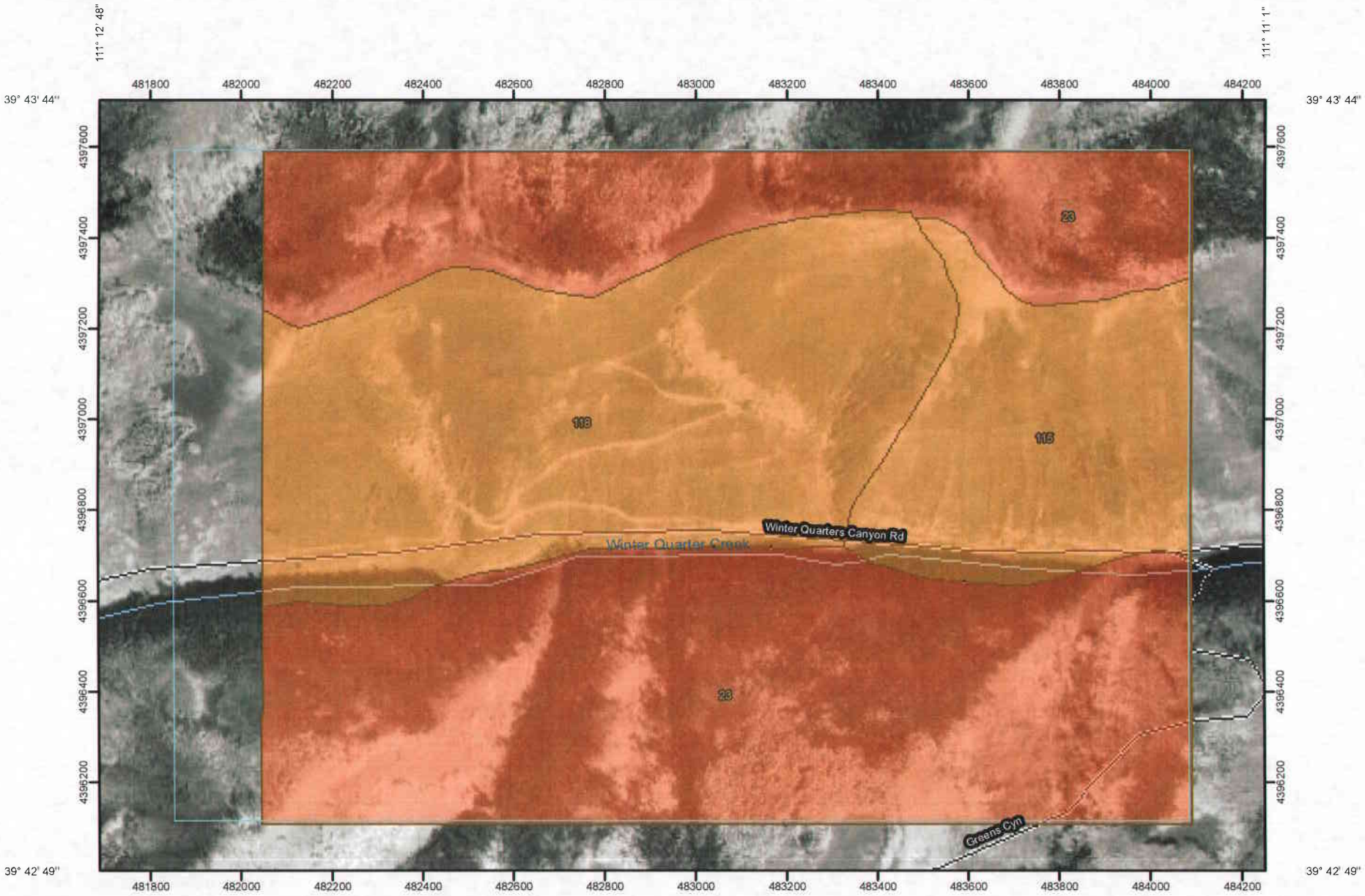
APPENDIX B. SITE LOCATION SHOWN ON ISO-ERODENT MAP 7

VALUE USED FOR CALCULATIONS IS 19. (ISRAELSON, 1984)



Map Scale: 1:12,200 if printed on A size (8.5" x 11") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1,000 2,000 3,000

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

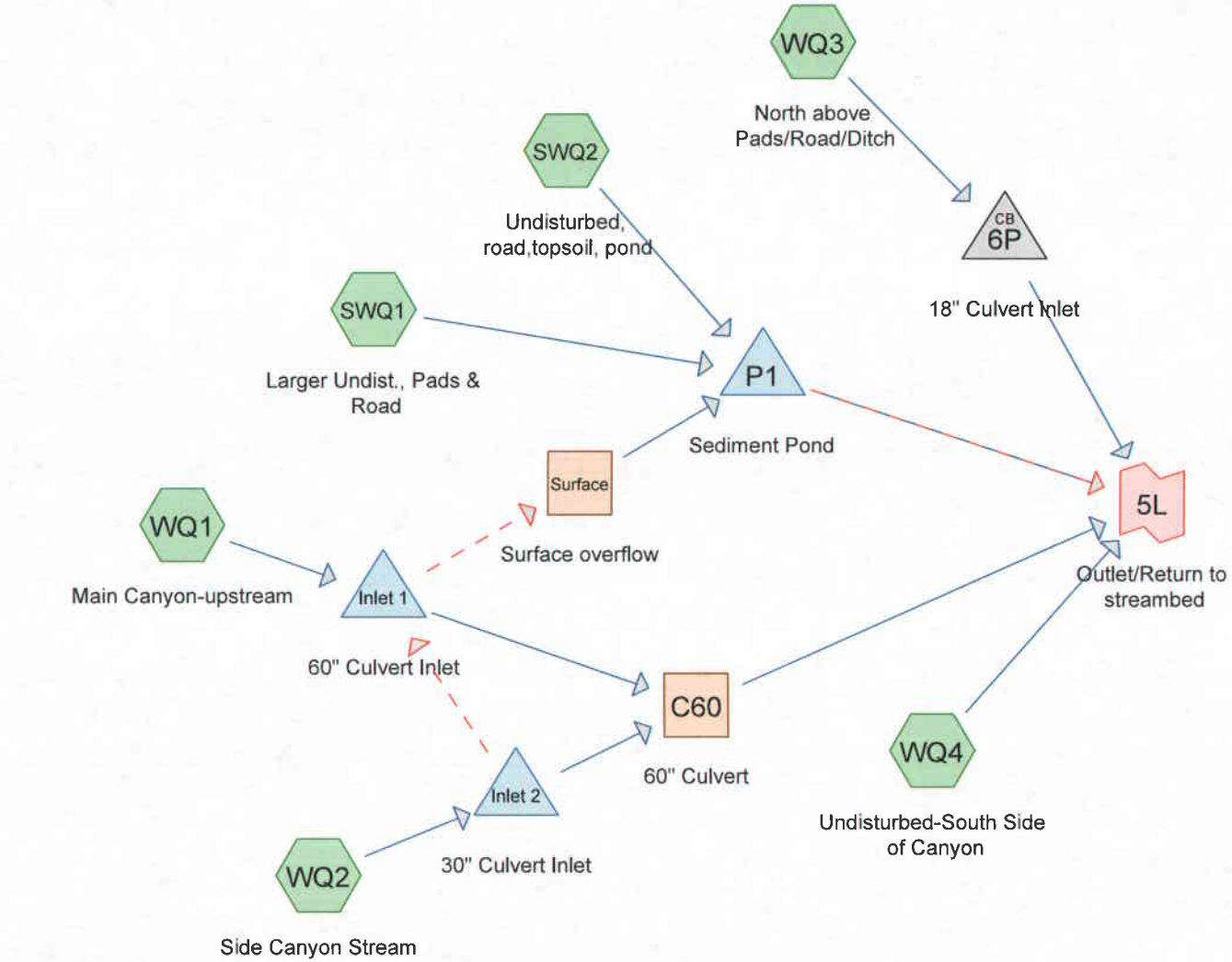
Component Percent Cutoff: *None Specified*

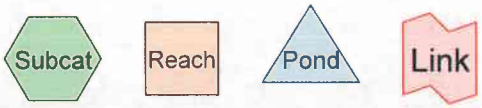
Tie-break Rule: Higher

Layer Options: Surface Layer

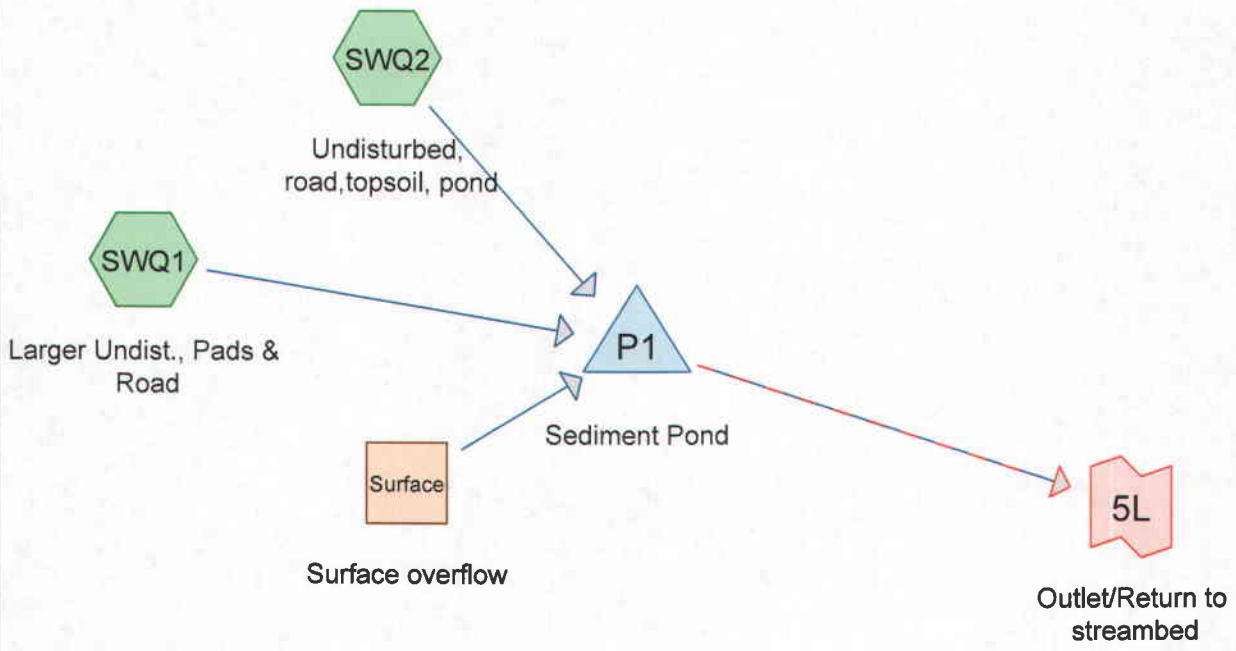
ATTACHMENT C

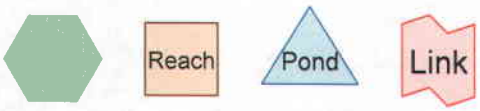
Sedimentation Pond Sizing Calculations





Drainage Diagram for Winter Quarters Pond
Prepared by Earthfax Engineering, Printed 8/22/2009
HydroCAD® 8.50 s/n 004020 © 2007 HydroCAD Software Solutions LLC





Drainage Diagram for Winter Quarters Pond full to Sediment level
Prepared by Earthfax Engineering, Printed 8/22/2009
HydroCAD® 8.50 s/n 004020 © 2007 HydroCAD Software Solutions LLC

Project Notes

Utah DOGM R645-301-
742.221. Sedimentation ponds, when used, will
742.221.33. Contain or treat the 10-year, 24-hour precipitation event ("design event") unless a lesser design event is approved by the Division based on terrain, climate, or other site-specific conditions and on a demonstration by the operator that the effluent limitations of R645-301-751 will be met;

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.860	48	Soil Type "Trag-Croydon Complex", Herbaceous range, Fair, HSG B (SWQ1,SWQ2)
0.581	71	Topsoil Pile - Soil Type "Trag-Croydon Complex", Herbaceous range, Poor, HSG B (SWQ1,SWQ2)
2.199	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B (SWQ1,SWQ2)
0.380	98	Pond Area (SWQ2)
7.020		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.000	HSG A	
6.640	HSG B	SWQ1, SWQ2
0.000	HSG C	
0.000	HSG D	
0.380	Other	SWQ2
7.020		**TOTAL AREA**

Time span=0.00-42.00 hrs, dt=0.02 hrs, 2101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Muskingum-Cunge method - Pond routing by Dyn-Stor-Ind method

Subcatchment SWQ1: Larger Undist., Pads & Road Runoff Area=4.638 ac 0.00% Impervious Runoff Depth=0.18"
Flow Length=810' Tc=10.6 min CN=65 Runoff=0.60 cfs 0.071 af

Subcatchment SWQ2: Undisturbed, road,topsoil, Runoff Area=2.382 ac 15.95% Impervious Runoff Depth=0.14"
Flow Length=613' Tc=9.6 min CN=63 Runoff=0.18 cfs 0.029 af

Reach Surface: Surface overflow Avg. Depth=0.00' Max Vel=0.00 fps
n=0.070 L=753.0' S=0.0525 '/' Capacity=549.97 cfs Outflow=0.00 cfs 0.000 af

Pond P1: Sediment Pond Peak Elev=8,074.36' Storage=627 cf Inflow=0.78 cfs 0.100 af
Discarded=0.17 cfs 0.100 af Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.17 cfs 0.100 af

Link 5L: Outlet/Return to streambed Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 7.020 ac Runoff Volume = 0.100 af Average Runoff Depth = 0.17"
94.59% Pervious = 6.640 ac 5.41% Impervious = 0.380 ac

Summary for Subcatchment SWQ1: Larger Undist., Pads & Road

Final segment of flow path (354 feet) is ditch DD1.

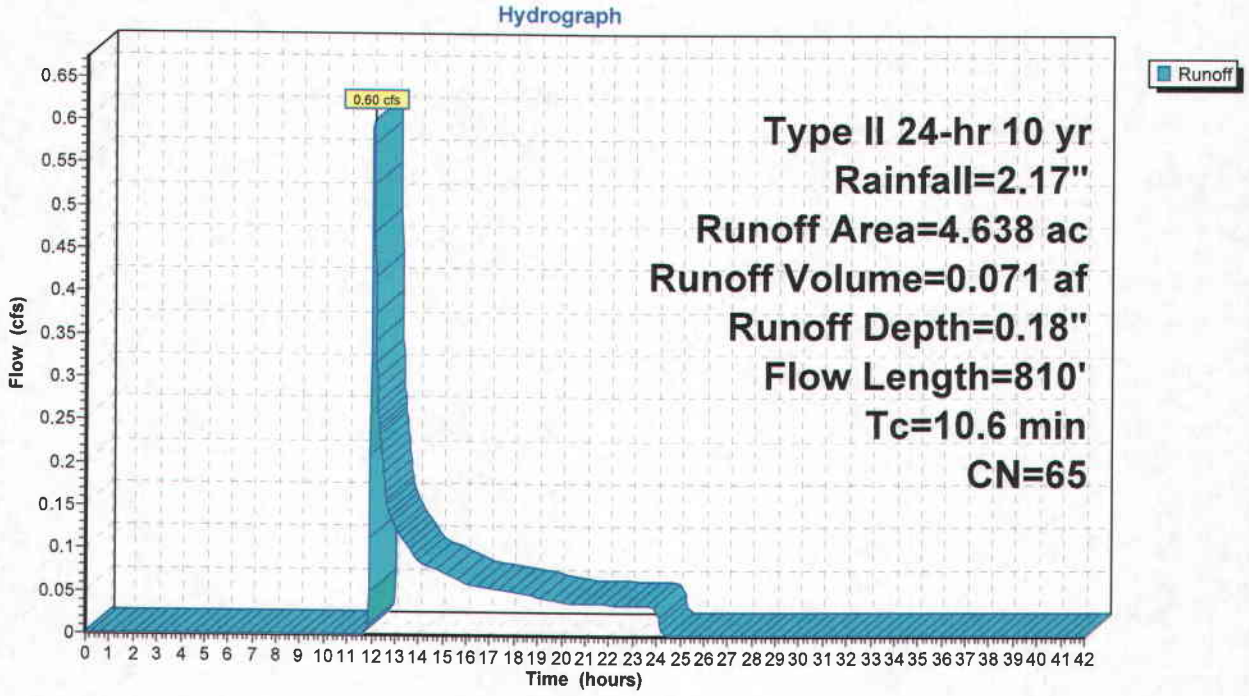
Runoff = 0.60 cfs @ 12.08 hrs, Volume= 0.071 af, Depth= 0.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 10 yr Rainfall=2.17"

	Area (ac)	CN	Description
*	1.929	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
*	2.420	48	Soil Type "Trag-Croydon Complex", Herbaceous range, Fair, HSG B
*	0.289	71	Topsoil Pile - Soil Type "Trag-Croydon Complex", Herbaceous range, Poor, HSG B
	4.638	65	Weighted Average
	4.638		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	9	0.2000	0.21		**Sheet Flow,** Range n= 0.130 P2= 1.56"
7.3	280	0.6000	0.64		**Sheet Flow,** Range n= 0.130 P2= 1.56"
1.9	130	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	37	0.2500	5.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.6	354	0.0989	10.62	10.62	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 1.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
10.6	810	Total			

Subcatchment SWQ1: Larger Undist., Pads & Road



Summary for Subcatchment SWQ2: Undisturbed, road,topsoil, pond

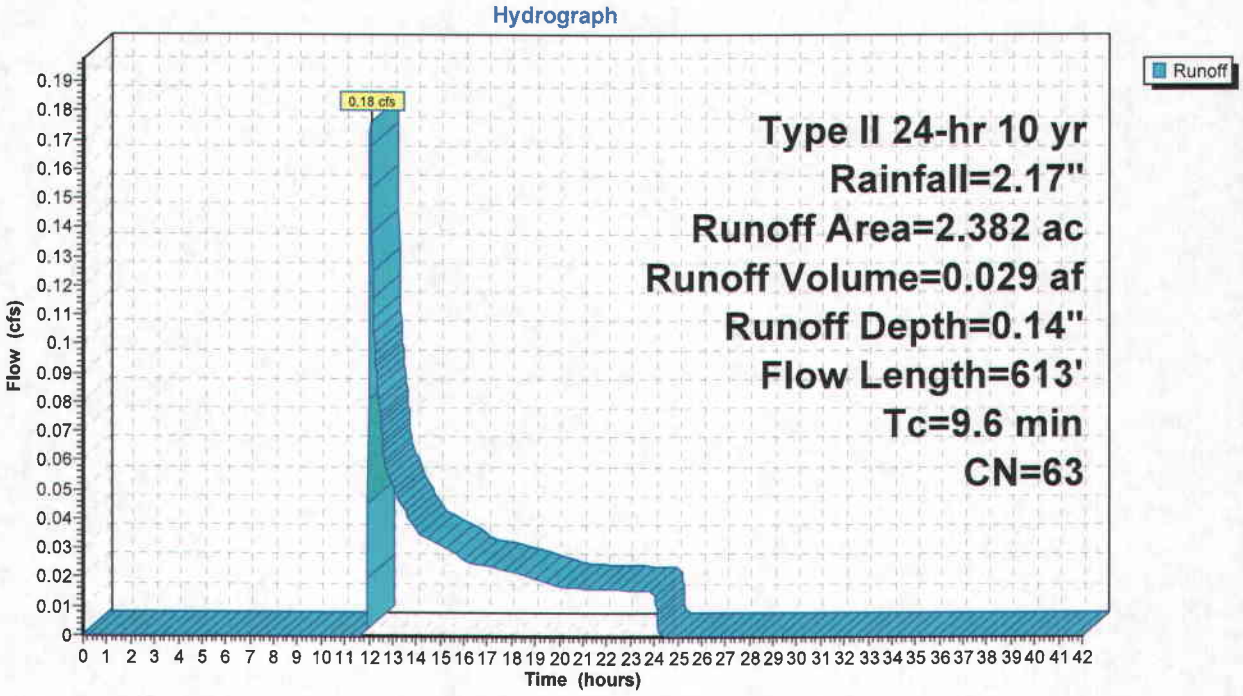
Runoff = 0.18 cfs @ 12.08 hrs, Volume= 0.029 af, Depth= 0.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 10 yr Rainfall=2.17"

	Area (ac)	CN	Description
*	0.270	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
*	1.440	48	Soil Type "Trag-Croydon Complex", Herbaceous range, Fair, HSG B
*	0.292	71	Topsoil Pile - Soil Type "Trag-Croydon Complex", Herbaceous range, Poor, HSG B
*	0.380	98	Pond Area
	2.382	63	Weighted Average
	2.002		Pervious Area
	0.380		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	10	0.2570	0.23		**Sheet Flow,** Range n= 0.130 P2= 1.56"
6.0	184	0.4212	0.51		**Sheet Flow,** Range n= 0.130 P2= 1.56"
0.0	16	1.0000	10.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.1	16	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.5	309	0.0422	2.05		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.3	78	0.4100	4.48		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.6	613	Total			

Subcatchment SWQ2: Undisturbed, road,topsoil, pond



Summary for Reach Surface: Surface overflow

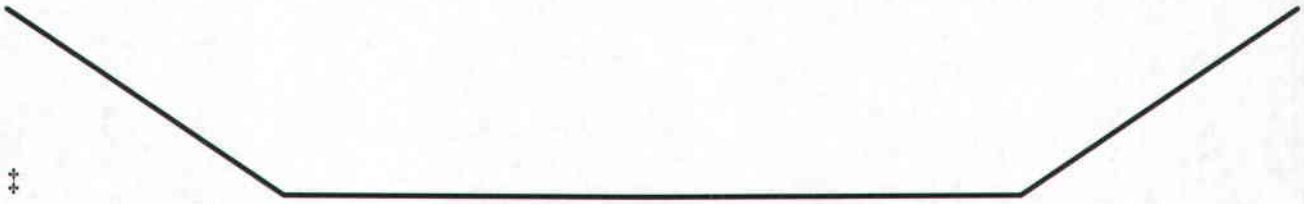
[43] Hint: Has no inflow (Outflow=Zero)

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

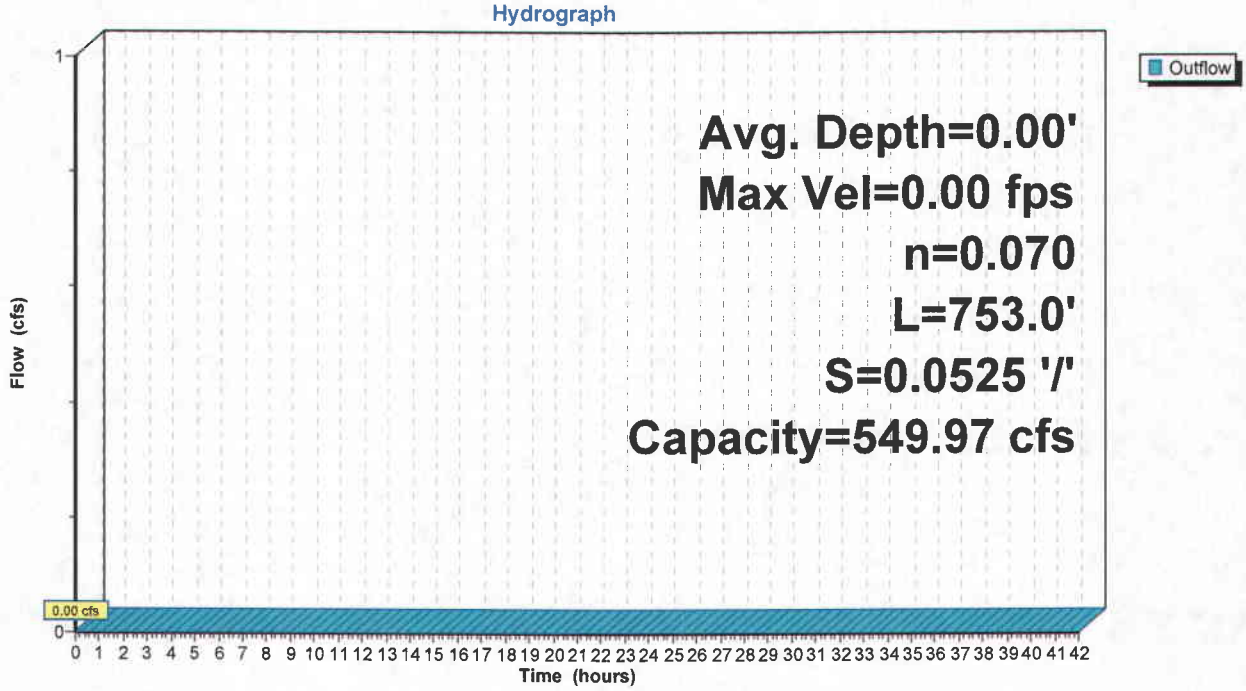
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs, Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 549.97 cfs

16.00' x 3.00' deep channel, n= 0.070 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 28.00'
Length= 753.0' Slope= 0.0525 '/'
Inlet Invert= 8,117.50', Outlet Invert= 8,078.00'



Reach Surface: Surface overflow



Summary for Pond P1: Sediment Pond

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area =	7.020 ac,	5.41% Impervious,	Inflow Depth =	0.17"	for 10 yr event
Inflow =	0.78 cfs @	12.08 hrs,	Volume=	0.100 af	
Outflow =	0.17 cfs @	13.20 hrs,	Volume=	0.100 af,	Atten= 79%, Lag= 67.2 min
Discarded =	0.17 cfs @	13.20 hrs,	Volume=	0.100 af	
Primary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Peak Elev= 8,074.36'@ 13.20 hrs Surf.Area= 5,484 sf Storage= 627 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=25.6 min (985.4 - 959.8)

Volume	Invert	Avail.Storage	Storage Description
#1	8,074.25'	24,243 cf	**Custom Stage Data (Irregular)** Listed below(Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,074.25	5,422	362.0	0	0	5,422
8,075.00	5,833	369.0	4,220	4,220	5,913
8,076.00	6,383	377.9	6,106	10,326	6,560
8,077.00	6,957	387.4	6,668	16,994	7,254
8,078.00	7,545	396.8	7,249	24,243	7,960

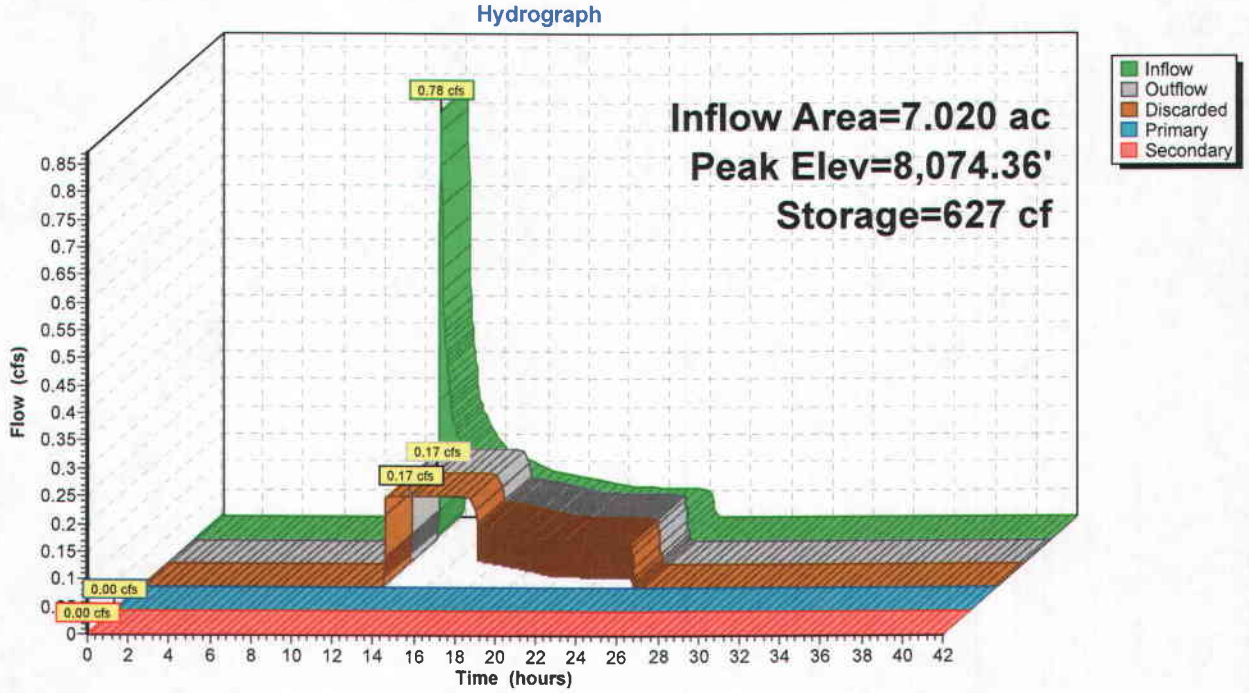
Device	Routing	Invert	Outlet Devices
#1	Secondary	8,077.00'	**14.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Device 3	8,075.00'	**18.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
#3	Primary	8,068.25'	**18.0" x 64.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 8,065.00' S= 0.0508 '/' Cc= 0.900 n= 0.025 Corrugated metal
#4	Discarded	8,074.25'	**1.300 in/hr Exfiltration over Surface area**

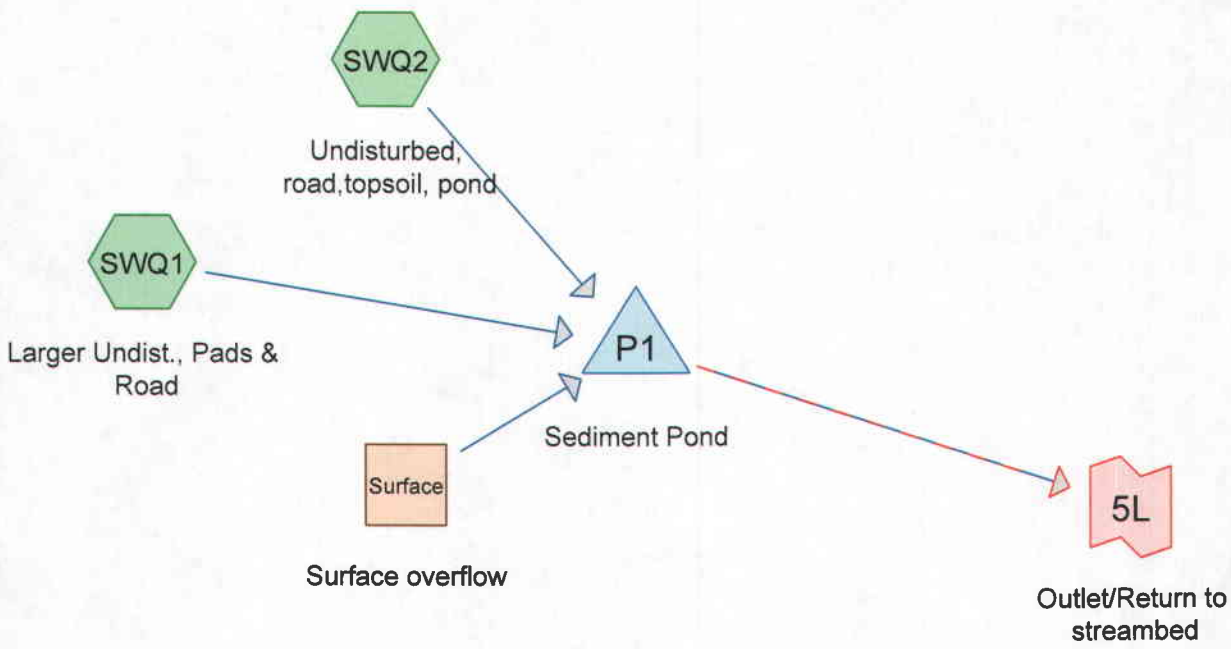
Discarded OutFlow Max=0.17 cfs @ 13.20 hrs HW=8,074.36' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.17 cfs)

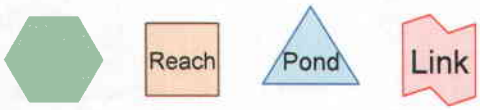
Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=8,074.25' TW=0.00' (Dynamic Tailwater)
└─**3=Culvert** (Passes 0.00 cfs of 15.39 cfs potential flow)
  └─**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=8,074.25' TW=0.00' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond P1: Sediment Pond







Drainage Diagram for Winter Quarters Pond full to primary spillway
Prepared by Earthfax Engineering, Printed 8/22/2009
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Project Notes

Utah DOGM R645-301-
742.221. Sedimentation ponds, when used, will
742.221.33. Contain or treat the 10-year, 24-hour precipitation event ("design event") unless a lesser design event is approved by the Division based on terrain, climate, or other site-specific conditions and on a demonstration by the operator that the effluent limitations of R645-301-751 will be met;

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.860	48	Soil Type "Trag-Croydon Complex", Herbaceous range, Fair, HSG B (SWQ1,SWQ2)
0.581	71	Topsoil Pile - Soil Type "Trag-Croydon Complex", Herbaceous range, Poor, HSG B (SWQ1,SWQ2)
2.199	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B (SWQ1,SWQ2)
0.380	98	Pond Area (SWQ2)
7.020		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.000	HSG A	
6.640	HSG B	SWQ1, SWQ2
0.000	HSG C	
0.000	HSG D	
0.380	Other	SWQ2
7.020		**TOTAL AREA**

Time span=0.00-42.00 hrs, dt=0.02 hrs, 2101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Muskingum-Cunge method - Pond routing by Dyn-Stor-Ind method

Subcatchment SWQ1: Larger Undist., Pads & Road Runoff Area=4.638 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=810' Tc=10.6 min CN=65 Runoff=0.18 cfs 0.038 af

Subcatchment SWQ2: Undisturbed, road,topsoil, Runoff Area=2.382 ac 15.95% Impervious Runoff Depth=0.07"
Flow Length=613' Tc=9.6 min CN=63 Runoff=0.07 cfs 0.014 af

Reach Surface: Surface overflow Avg. Depth=0.00' Max Vel=0.00 fps
n=0.070 L=753.0' S=0.0525 '/' Capacity=549.97 cfs Outflow=0.00 cfs 0.000 af

Pond P1: Sediment Pond Peak Elev=8,075.02' Storage=139 cf Inflow=0.25 cfs 0.051 af
Discarded=0.18 cfs 0.046 af Primary=0.06 cfs 0.005 af Secondary=0.00 cfs 0.000 af Outflow=0.23 cfs 0.051 af

Link 5L: Outlet/Return to streambed Manual Hydrograph Inflow=0.06 cfs 0.005 af
Primary=0.06 cfs 0.005 af

Total Runoff Area = 7.020 ac Runoff Volume = 0.051 af Average Runoff Depth = 0.09"
94.59% Pervious = 6.640 ac 5.41% Impervious = 0.380 ac

Summary for Subcatchment SWQ1: Larger Undist., Pads & Road

Final segment of flow path (354 feet) is ditch DD1.

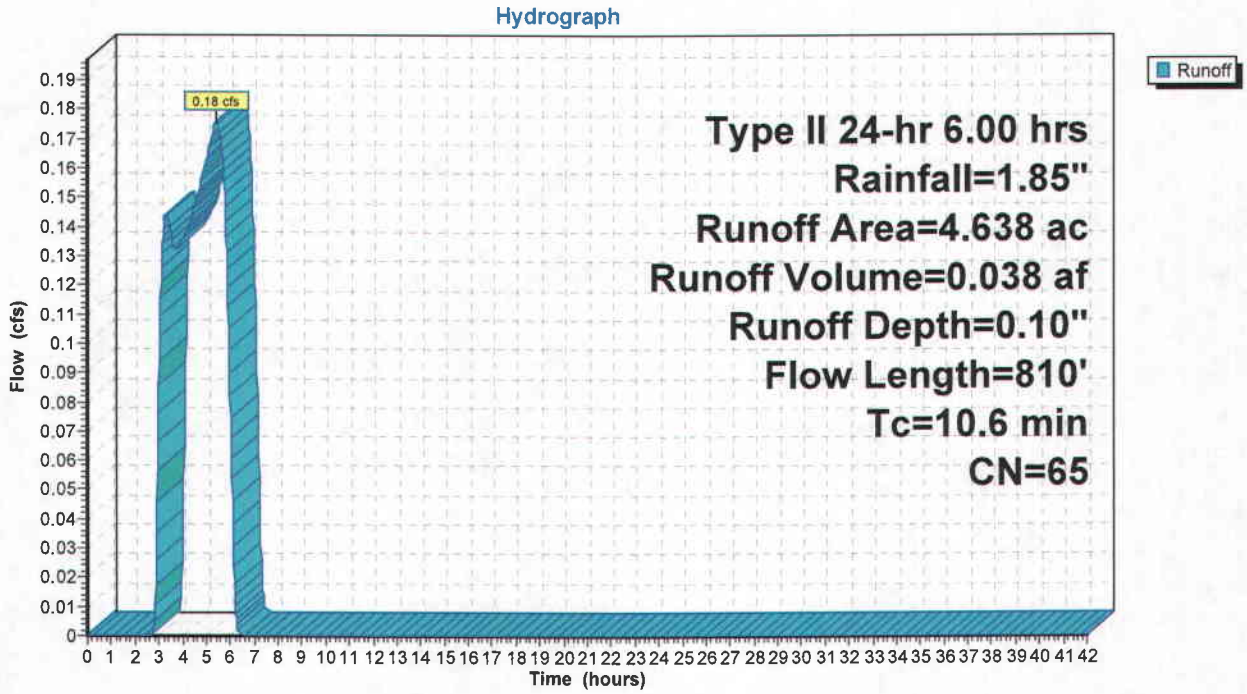
Runoff = 0.18 cfs @ 5.42 hrs, Volume= 0.038 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=1.85"

	Area (ac)	CN	Description
*	1.929	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
*	2.420	48	Soil Type "Trag-Croydon Complex", Herbaceous range, Fair, HSG B
*	0.289	71	Topsoil Pile - Soil Type "Trag-Croydon Complex", Herbaceous range, Poor, HSG B
	4.638	65	Weighted Average
	4.638		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	9	0.2000	0.21		**Sheet Flow,** Range n= 0.130 P2= 1.56"
7.3	280	0.6000	0.64		**Sheet Flow,** Range n= 0.130 P2= 1.56"
1.9	130	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	37	0.2500	5.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.6	354	0.0989	10.62	10.62	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 1.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
10.6	810	Total			

Subcatchment SWQ1: Larger Undist., Pads & Road



Summary for Subcatchment SWQ2: Undisturbed, road,topsoil, pond

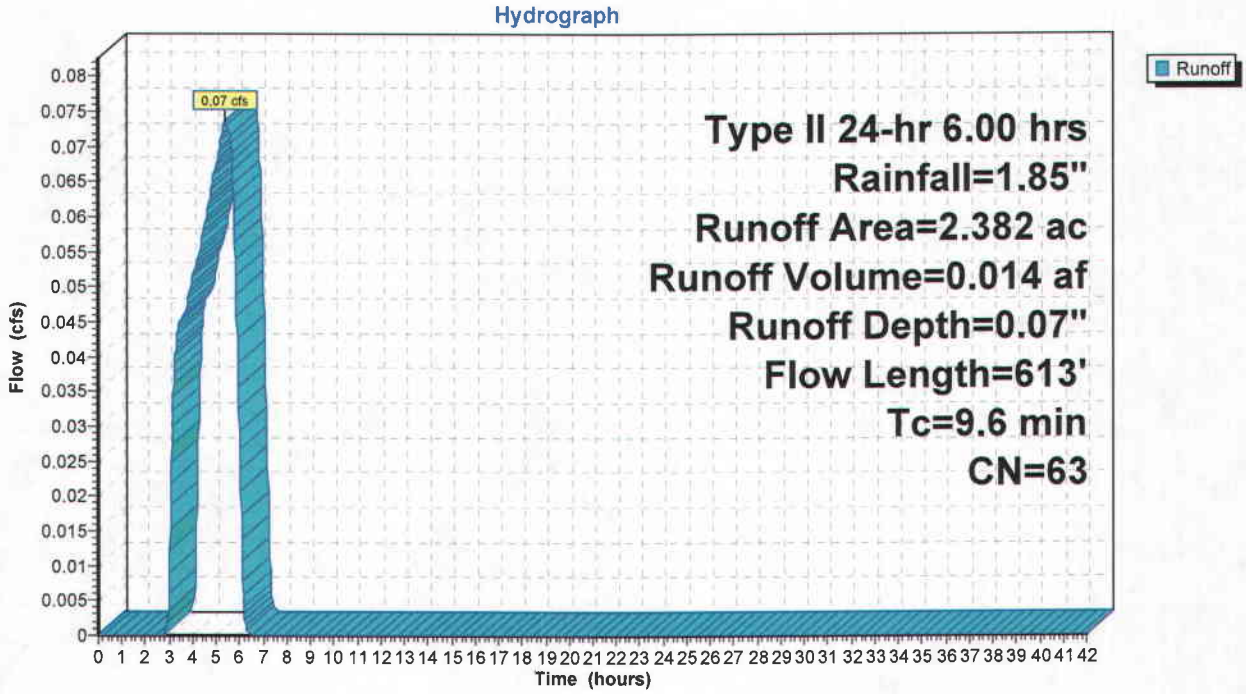
Runoff = 0.07 cfs @ 5.42 hrs, Volume= 0.014 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=1.85"

	Area (ac)	CN	Description
*	0.270	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
*	1.440	48	Soil Type "Trag-Croydon Complex", Herbaceous range, Fair, HSG B
*	0.292	71	Topsoil Pile - Soil Type "Trag-Croydon Complex", Herbaceous range, Poor, HSG B
*	0.380	98	Pond Area
	2.382	63	Weighted Average
	2.002		Pervious Area
	0.380		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	10	0.2570	0.23		**Sheet Flow,** Range n= 0.130 P2= 1.56"
6.0	184	0.4212	0.51		**Sheet Flow,** Range n= 0.130 P2= 1.56"
0.0	16	1.0000	10.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.1	16	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.5	309	0.0422	2.05		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.3	78	0.4100	4.48		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.6	613	Total			

Subcatchment SWQ2: Undisturbed, road,topsoil, pond



Summary for Reach Surface: Surface overflow

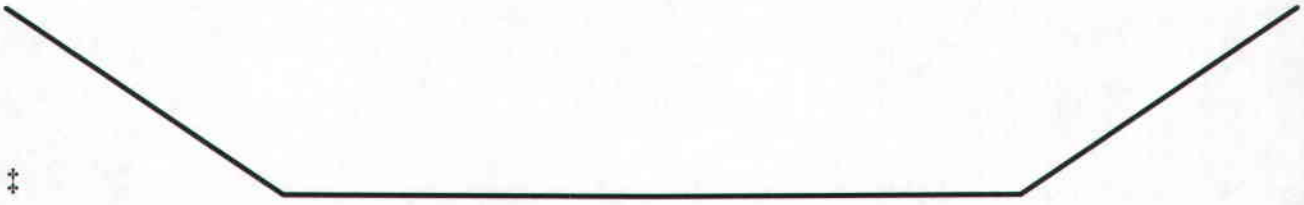
[43] Hint: Has no inflow (Outflow=Zero)

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

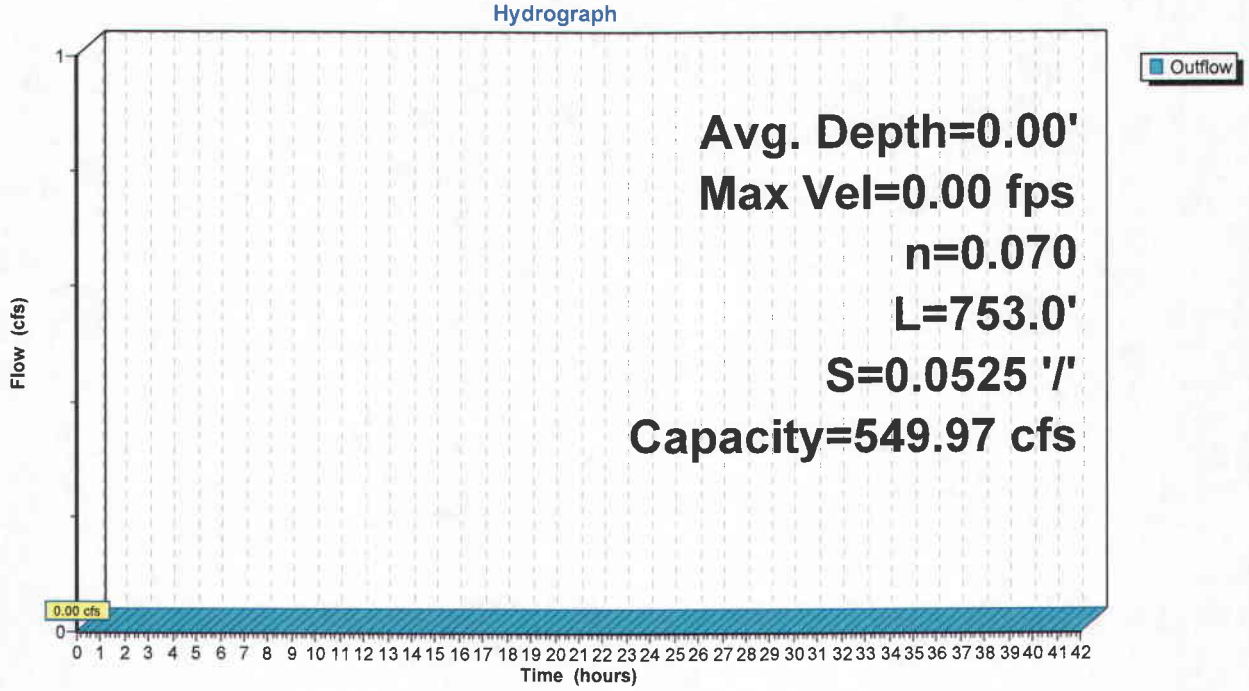
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs, Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 549.97 cfs

16.00' x 3.00' deep channel, n= 0.070 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 28.00'
Length= 753.0' Slope= 0.0525 '/'
Inlet Invert= 8,117.50', Outlet Invert= 8,078.00'



Reach Surface: Surface overflow



Summary for Pond P1: Sediment Pond

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area =	7.020 ac,	5.41% Impervious,	Inflow Depth =	0.09"
Inflow =	0.25 cfs @	5.42 hrs, Volume=	0.051 af	
Outflow =	0.23 cfs @	5.71 hrs, Volume=	0.051 af, Atten= 7%, Lag= 17.0 min	
Discarded =	0.18 cfs @	5.71 hrs, Volume=	0.046 af	
Primary =	0.06 cfs @	5.71 hrs, Volume=	0.005 af	
Secondary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Peak Elev= 8,075.02'@ 5.71 hrs Surf.Area= 5,846 sf Storage= 139 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=4.9 min (281.4 - 276.4)

Volume	Invert	Avail.Storage	Storage Description
#1	8,075.00'	20,023 cf	**Custom Stage Data (Irregular)** Listed below(Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,075.00	5,833	369.0	0	0	5,833
8,076.00	6,383	377.9	6,106	6,106	6,481
8,077.00	6,957	387.4	6,668	12,774	7,174
8,078.00	7,545	396.8	7,249	20,023	7,880

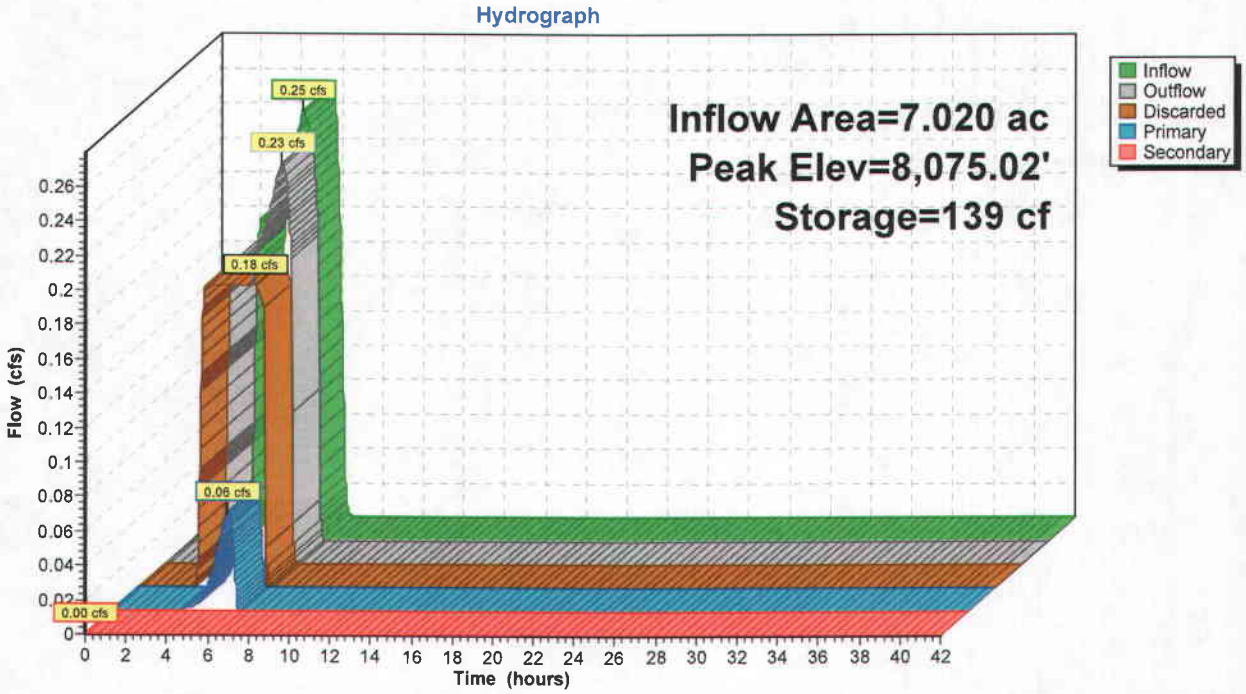
Device	Routing	Invert	Outlet Devices
#1	Secondary	8,077.00'	**14.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Device 3	8,075.00'	**18.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
#3	Primary	8,068.25'	**18.0" x 64.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 8,065.00' S= 0.0508 '/' Cc= 0.900 n= 0.025 Corrugated metal
#4	Discarded	8,075.00'	**1.300 in/hr Exfiltration over Surface area**

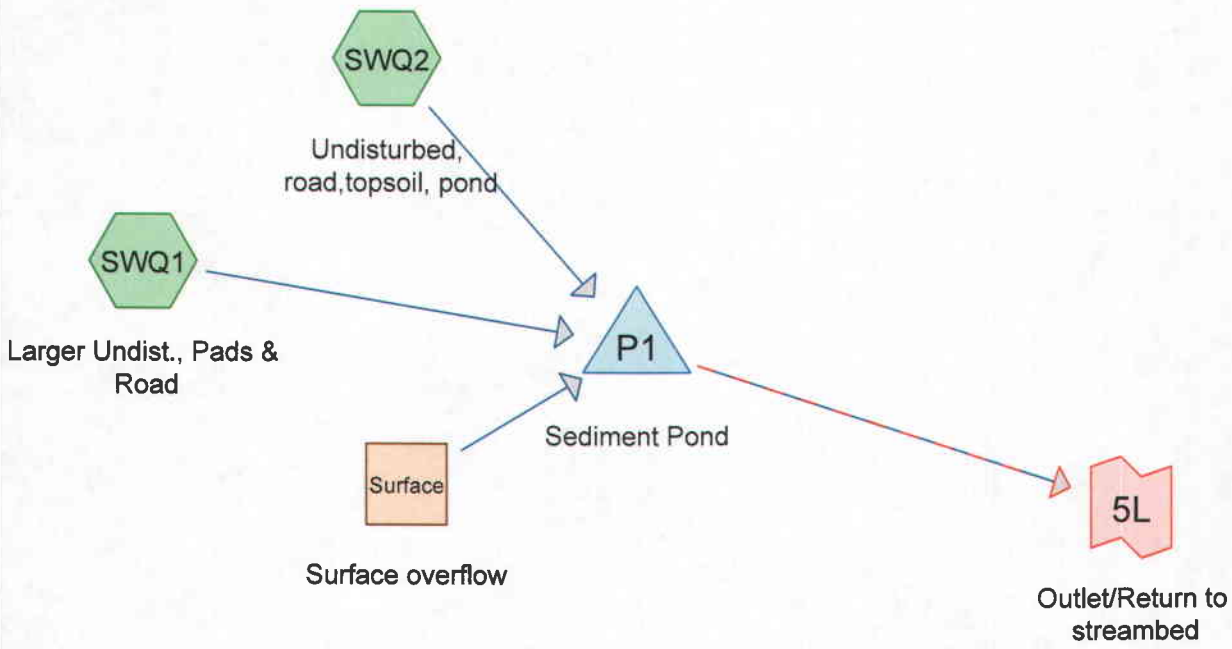
Discarded OutFlow Max=0.18 cfs @ 5.71 hrs HW=8,075.02' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.18 cfs)

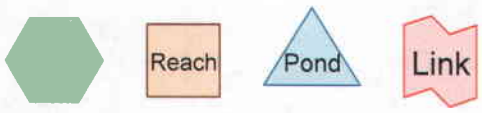
Primary OutFlow Max=0.06 cfs @ 5.71 hrs HW=8,075.02' TW=0.00' (Dynamic Tailwater)
└─**3=Culvert** (Passes 0.06 cfs of 16.49 cfs potential flow)
└─**2=Orifice/Grate** (Weir Controls 0.06 cfs @ 0.51 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=8,075.00' TW=0.00' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond P1: Sediment Pond







Drainage Diagram for Winter Quarters Pond full to emergency spillway
Prepared by Earthfax Engineering, Printed 8/22/2009
HydroCAD® 8.50 s/n 004020 © 2007 HydroCAD Software Solutions LLC

Project Notes

Utah DOGM R645-301-
742.221. Sedimentation ponds, when used, will
742.221.33. Contain or treat the 10-year, 24-hour precipitation event ("design event") unless a lesser design event is approved by the Division based on terrain, climate, or other site-specific conditions and on a demonstration by the operator that the effluent limitations of R645-301-751 will be met;

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.860	48	Soil Type "Trag-Croydon Complex", Herbaceous range, Fair, HSG B (SWQ1,SWQ2)
0.581	71	Topsoil Pile - Soil Type "Trag-Croydon Complex", Herbaceous range, Poor, HSG B (SWQ1,SWQ2)
2.199	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B (SWQ1,SWQ2)
0.380	98	Pond Area (SWQ2)
7.020		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.000	HSG A	
6.640	HSG B	SWQ1, SWQ2
0.000	HSG C	
0.000	HSG D	
0.380	Other	SWQ2
7.020		**TOTAL AREA**

Time span=0.00-42.00 hrs, dt=0.02 hrs, 2101 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Muskingum-Cunge method - Pond routing by Dyn-Stor-Ind method

Subcatchment SWQ1: Larger Undist., Pads & Road Runoff Area=4.638 ac 0.00% Impervious Runoff Depth=0.10"
Flow Length=810' Tc=10.6 min CN=65 Runoff=0.18 cfs 0.038 af

Subcatchment SWQ2: Undisturbed, road,topsoil, Runoff Area=2.382 ac 15.95% Impervious Runoff Depth=0.07"
Flow Length=613' Tc=9.6 min CN=63 Runoff=0.07 cfs 0.014 af

Reach Surface: Surface overflow Avg. Depth=0.00' Max Vel=0.00 fps
n=0.070 L=753.0' S=0.0525 '/' Capacity=549.97 cfs Outflow=0.00 cfs 0.000 af

Pond P1: Sediment Pond Peak Elev=8,077.01' Storage=58 cf Inflow=0.25 cfs 0.051 af
Discarded=0.21 cfs 0.050 af Secondary=0.02 cfs 0.001 af Outflow=0.23 cfs 0.051 af

Link 5L: Outlet/Return to streambed Inflow=0.02 cfs 0.001 af
Primary=0.02 cfs 0.001 af

Total Runoff Area = 7.020 ac Runoff Volume = 0.051 af Average Runoff Depth = 0.09"
94.59% Pervious = 6.640 ac 5.41% Impervious = 0.380 ac

Summary for Subcatchment SWQ1: Larger Undist., Pads & Road

Final segment of flow path (354 feet) is ditch DD1.

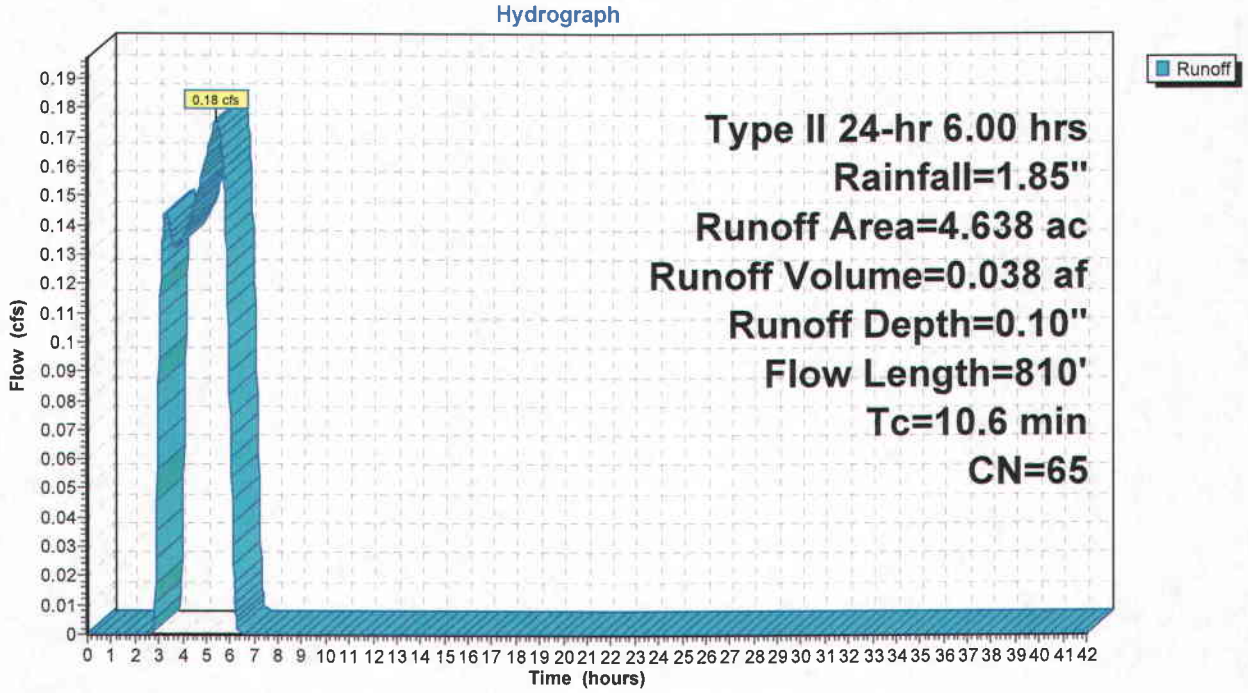
Runoff = 0.18 cfs @ 5.42 hrs, Volume= 0.038 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=1.85"

	Area (ac)	CN	Description
*	1.929	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
*	2.420	48	Soil Type "Trag-Croydon Complex", Herbaceous range, Fair, HSG B
*	0.289	71	Topsoil Pile - Soil Type "Trag-Croydon Complex", Herbaceous range, Poor, HSG B
	4.638	65	Weighted Average
	4.638		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	9	0.2000	0.21		**Sheet Flow,** Range n= 0.130 P2= 1.56"
7.3	280	0.6000	0.64		**Sheet Flow,** Range n= 0.130 P2= 1.56"
1.9	130	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	37	0.2500	5.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.6	354	0.0989	10.62	10.62	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 1.0 '/' Top.W=2.00' n= 0.022 Earth, clean & straight
10.6	810	Total			

Subcatchment SWQ1: Larger Undist., Pads & Road



Summary for Subcatchment SWQ2: Undisturbed, road,topsoil, pond

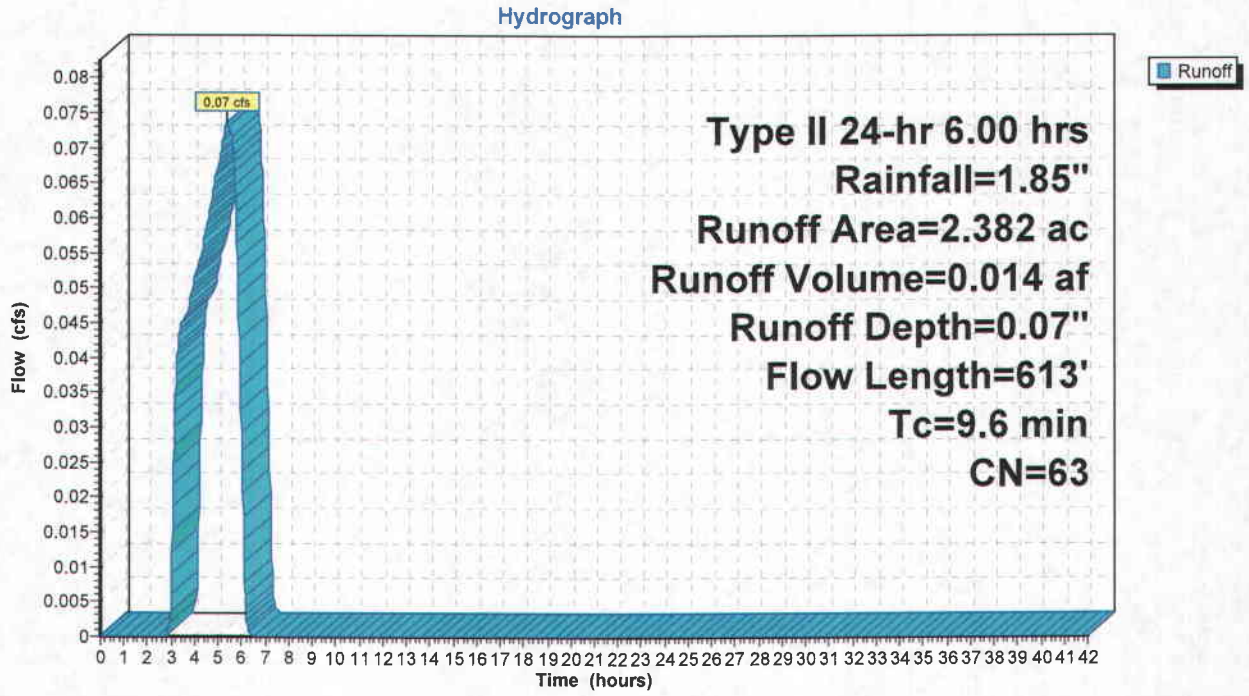
Runoff = 0.07 cfs @ 5.42 hrs, Volume= 0.014 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=1.85"

	Area (ac)	CN	Description
*	0.270	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
*	1.440	48	Soil Type "Trag-Croydon Complex", Herbaceous range, Fair, HSG B
*	0.292	71	Topsoil Pile - Soil Type "Trag-Croydon Complex", Herbaceous range, Poor, HSG B
*	0.380	98	Pond Area
	2.382	63	Weighted Average
	2.002		Pervious Area
	0.380		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	10	0.2570	0.23		**Sheet Flow,** Range n= 0.130 P2= 1.56"
6.0	184	0.4212	0.51		**Sheet Flow,** Range n= 0.130 P2= 1.56"
0.0	16	1.0000	10.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.1	16	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.5	309	0.0422	2.05		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.3	78	0.4100	4.48		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.6	613	Total			

Subcatchment SWQ2: Undisturbed, road,topsoil, pond



Summary for Reach Surface: Surface overflow

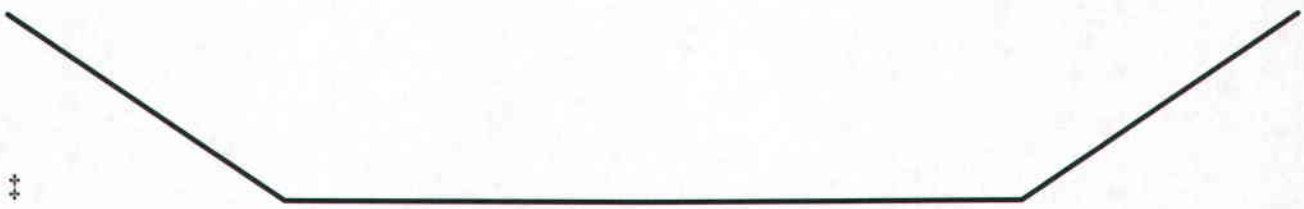
[43] Hint: Has no inflow (Outflow=Zero)

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

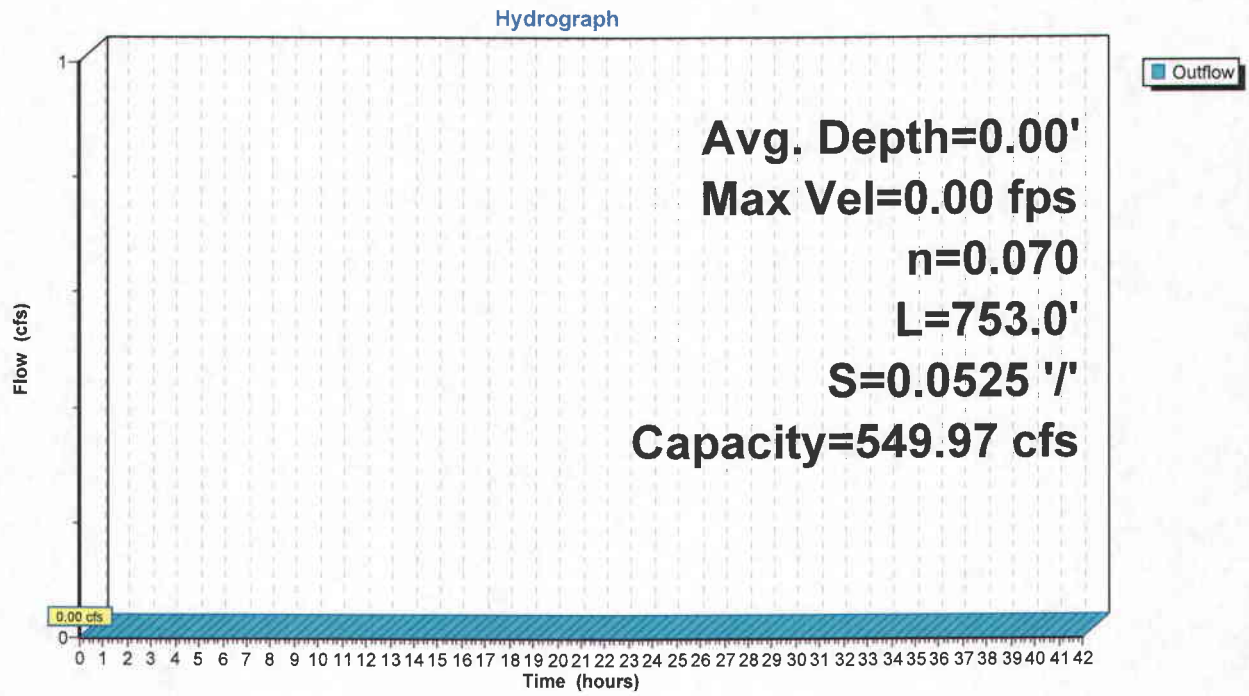
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs, Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 549.97 cfs

16.00' x 3.00' deep channel, n= 0.070 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 28.00'
Length= 753.0' Slope= 0.0525 '/'
Inlet Invert= 8,117.50', Outlet Invert= 8,078.00'



Reach Surface: Surface overflow



Summary for Pond P1: Sediment Pond

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area =	7.020 ac,	5.41% Impervious,	Inflow Depth =	0.09"
Inflow =	0.25 cfs @	5.42 hrs, Volume=	0.051 af	
Outflow =	0.23 cfs @	5.70 hrs, Volume=	0.051 af, Atten= 6%, Lag= 16.4 min	
Discarded =	0.21 cfs @	5.70 hrs, Volume=	0.050 af	
Secondary =	0.02 cfs @	5.70 hrs, Volume=	0.001 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-42.00 hrs, dt= 0.02 hrs
Peak Elev= 8,077.01'@ 5.70 hrs Surf.Area= 6,962 sf Storage= 58 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=1.2 min (277.6 - 276.4)

Volume	Invert	Avail.Storage	Storage Description
#1	8,077.00'	7,249 cf	**Custom Stage Data (Irregular)** Listed below(Recalc)

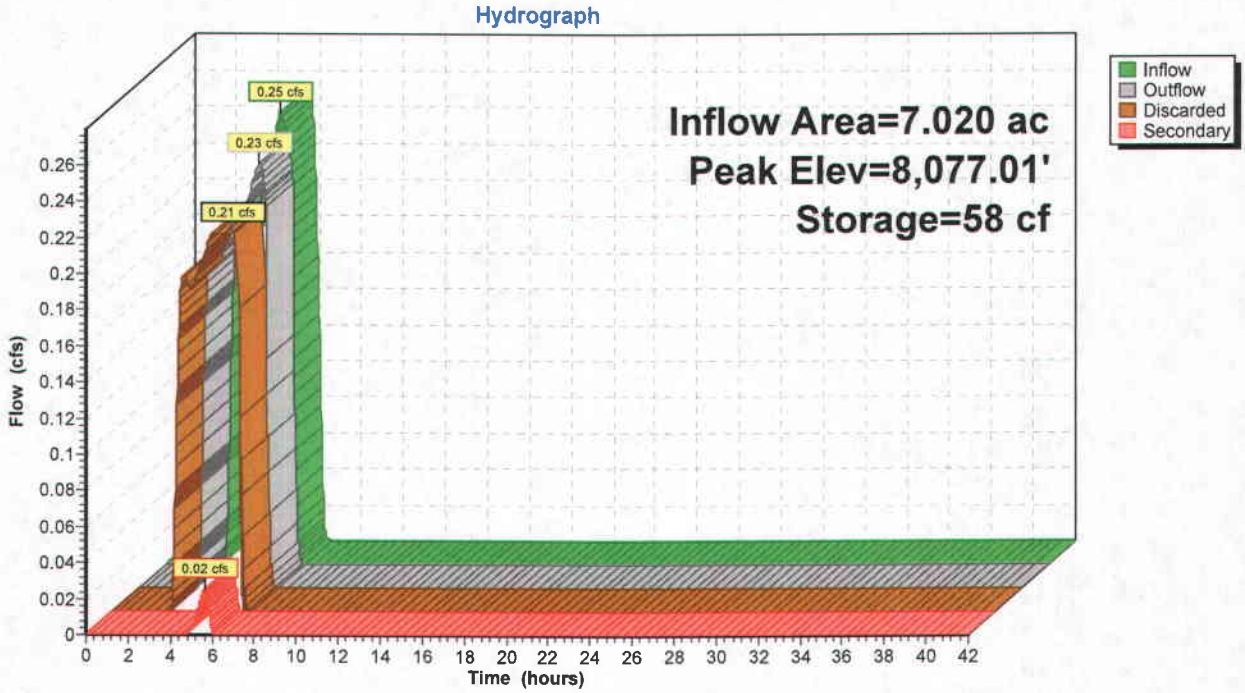
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,077.00	6,957	387.4	0	0	6,957
8,078.00	7,545	396.8	7,249	7,249	7,663

Device	Routing	Invert	Outlet Devices
#1	Secondary	8,077.00'	**14.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	8,077.00'	**1.300 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.21 cfs @ 5.70 hrs HW=8,077.01' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.21 cfs)

Secondary OutFlow Max=0.02 cfs @ 5.70 hrs HW=8,077.01' TW=0.00' (Dynamic Tailwater)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.02 cfs @ 0.21 fps)

Pond P1: Sediment Pond



ATTACHMENT D

Slope Stability Calculations

ATTACHMENT D

Slope Stability Calculations

Slope stability analyses were conducted using the software program *Slide* 5.0. The soil properties used for the two soil types are summarized below in Table D1.

Table D1: Summary of soil engineering properties used for input into *Slide*

Soil Type	Unit Weight[a]	Hydraulic Conductivity[b]	Friction Angle of Soil[c]	Cohesion[d]
	(pcf)	(cm/s)	(degrees)	(psf)
Clay-Loam	115	10^{-7}	25	150
Sandy Loam	115	10^{-3}	27	190

a - Typical unit weight for compacted sands and silts (Anderson et al, 1980).
b - Conservative estimates of hydraulic conductivity based on soil type (Terzaghi & Peck, 1968).
c - Expected minimum value of friction angle based on soil type (Terzaghi & Peck, 1968).
d - Fully softened strength of soil based on soil type. Taken as 60% of the peak drained strength (Duncan & Wright, 2005).

The minimum factors of safety (FS) are summarized below in Table D2 for each scenario analyzed (inside and outside slopes for each soil type). The output from *Slide* for each scenario follows in Figures D1 through D4. For analysis of the outside slopes, water was modeled at the level of the riser pipe as shown in Figures D2 and D4. The pink line represents the location of the water surface throughout the embankment as determined by finite element seepage analysis and the shading shows the pressure head within the embankment as a result of this water surface.

Table D2: Minimum factors of safety against failure

Soil Type	FS Inside Slope	FS Outside Slope
Clay-Loam	2.04	**1.74**
Sandy-Loam	2.38	2.04

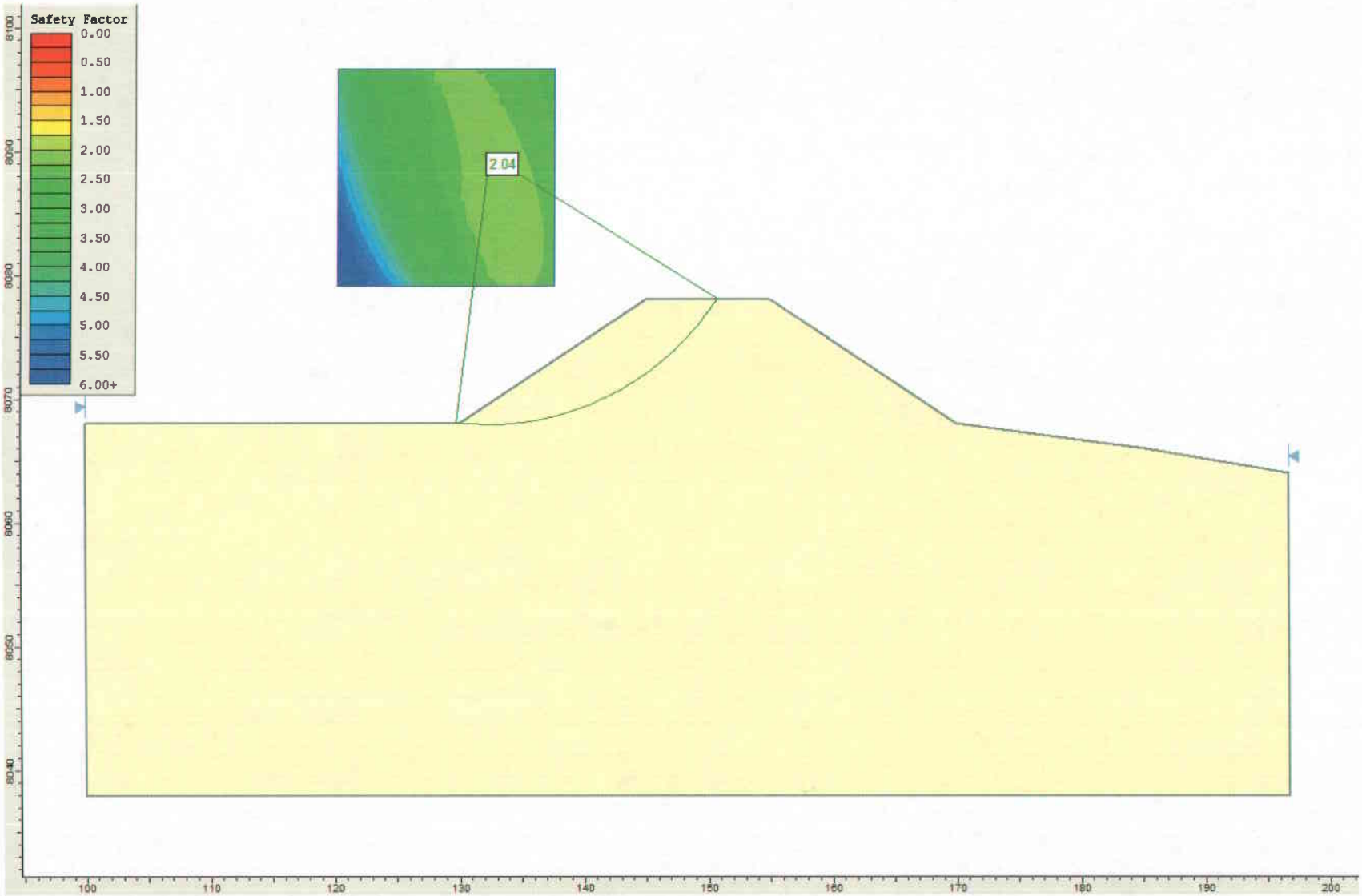


Figure D1: Critical failure surface for inside slope with clay loam FS = 2.04

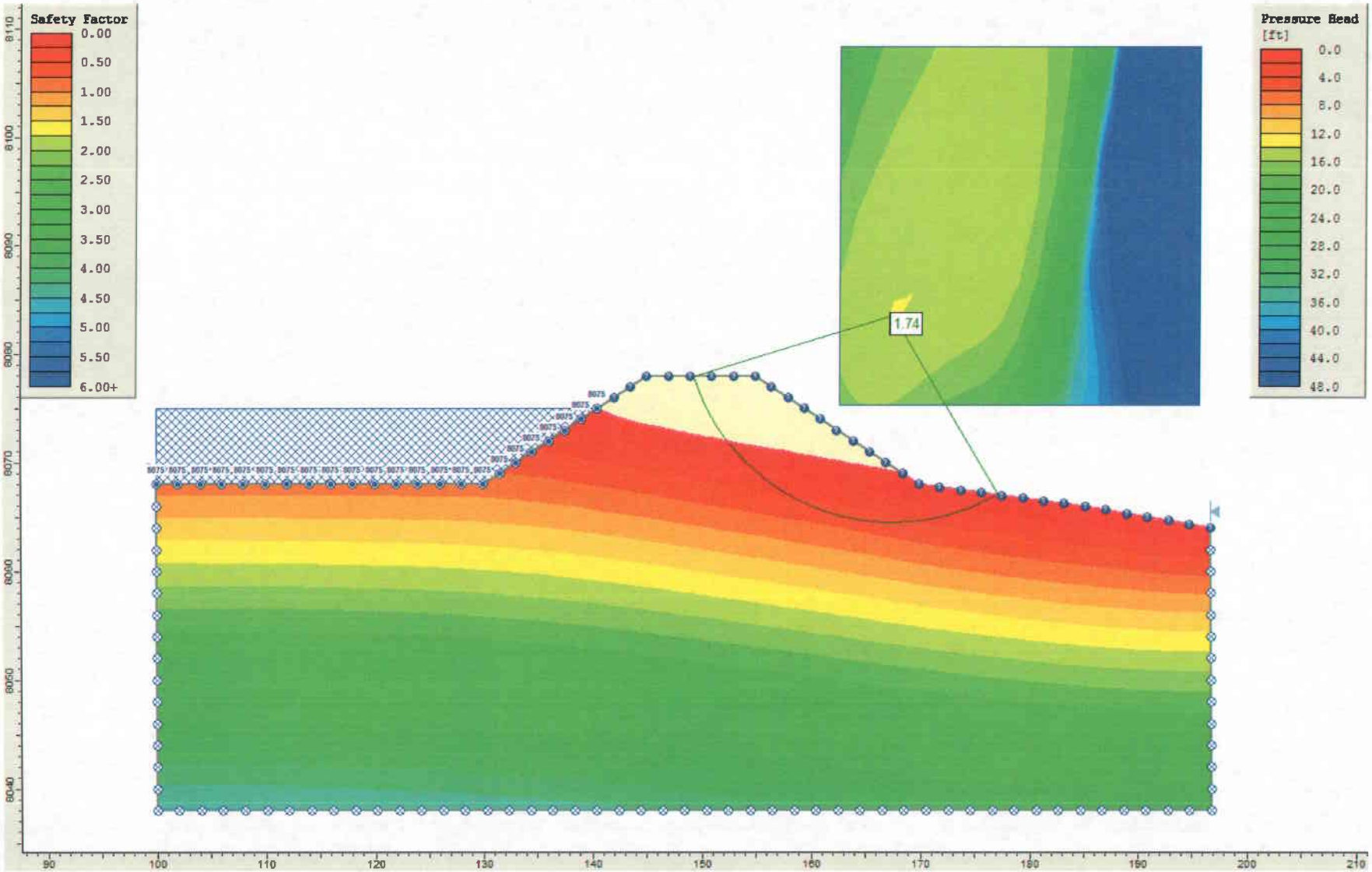


Figure D2: Critical failure surface for outside slope with clay loam FS = 1.74

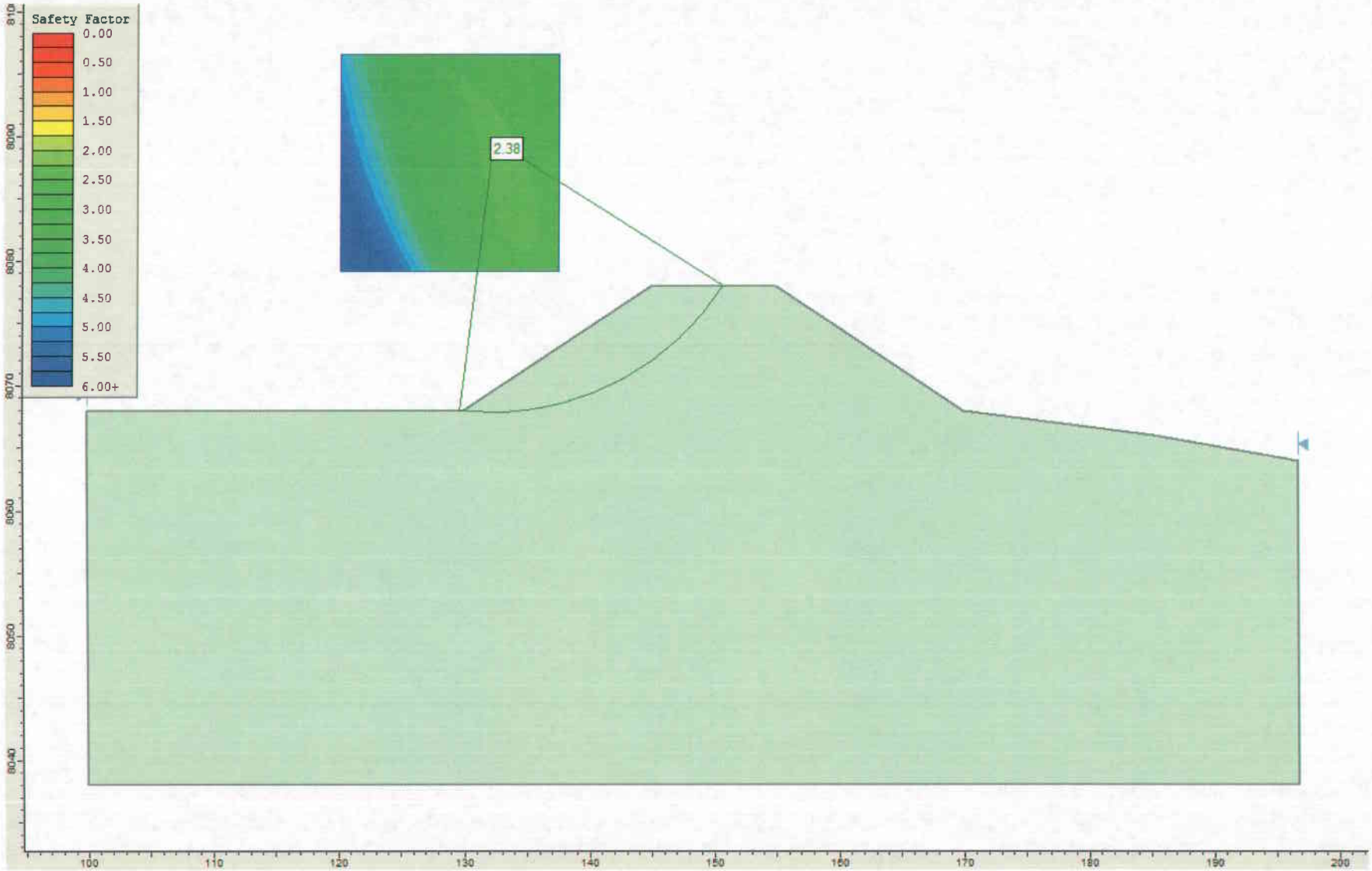


Figure D3: Critical failure surface for inside slope with sandy loam FS = 2.38

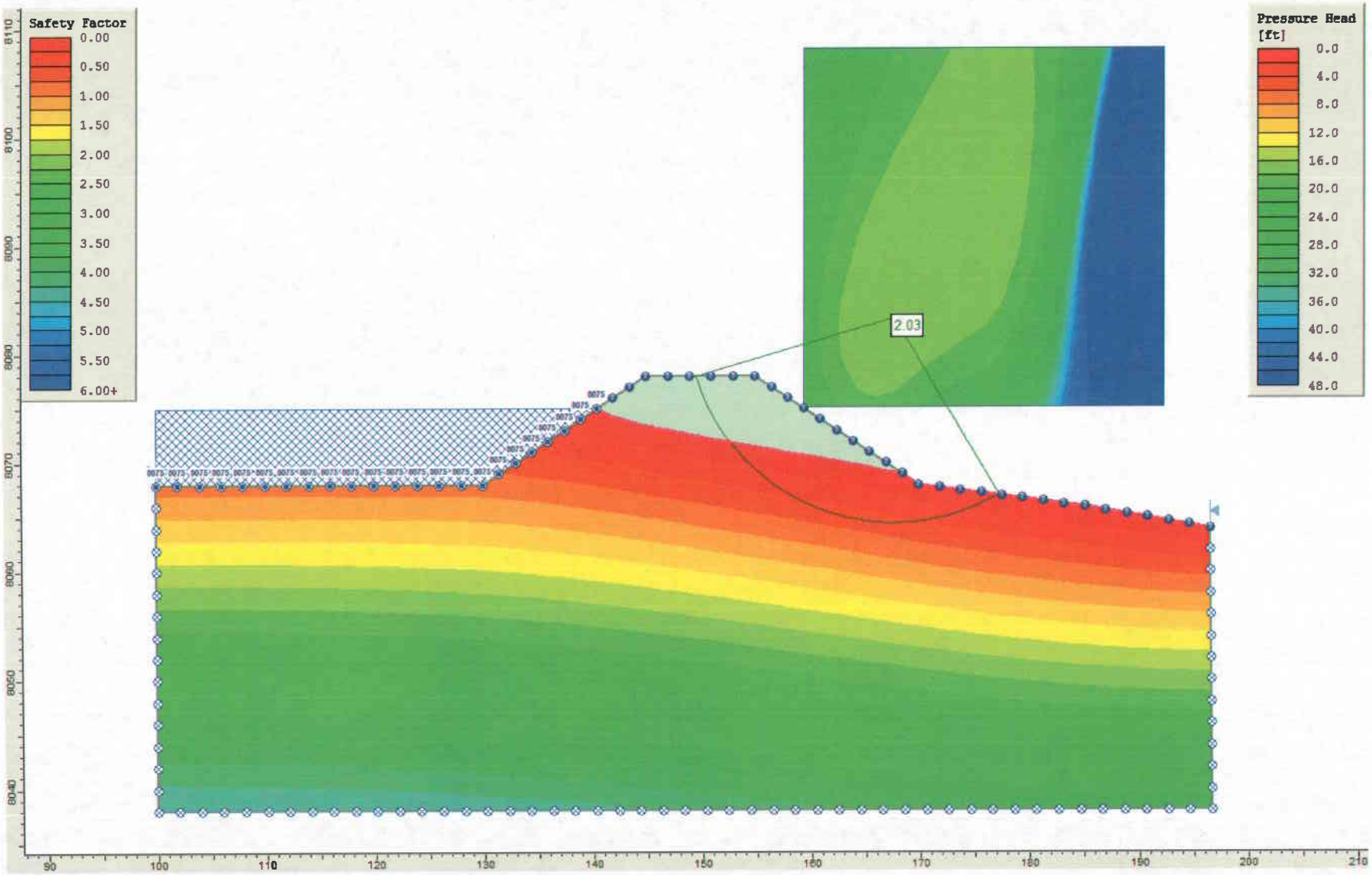
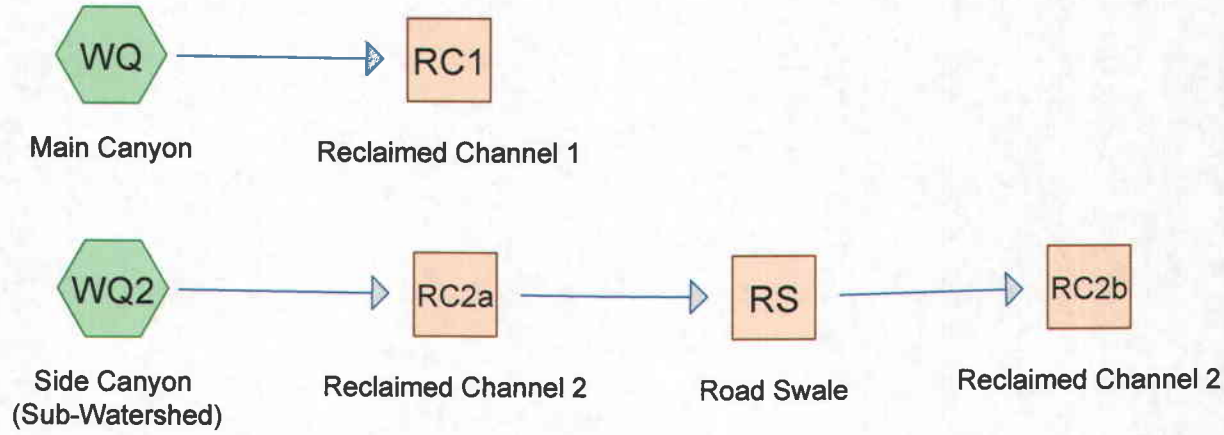
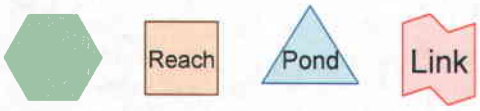


Figure D4: Critical failure surface for outside slope with sandy loam FS = 2.03

ATTACHMENT E

Reclamation Hydrology Calculations





Drainage Diagram for Reclaimed Hydrology
Prepared by EarthFax Engineering, Inc., Printed 10/9/2009
HydroCAD® 8.50 s/n 003900 © 2007 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
758.000	48	Soil Type "Trag-Croydon Complex", Pinyon/juniper range, Fair, HSG B (WQ)
7.000	48	Soil Type "Unita-Toze families complex", Pinyon/juniper range, Fair, HSG B (WQ)
275.000	51	Soil Type "Trag stony loam", Pinyon/juniper range, Poor, HSG B (WQ)
281.000	61	Soil Type "Curecanti-Pathead Complex", Oak/aspen range, Poor, HSG C (WQ2)
2,302.000	61	Soil Type "Curecanti-Pathead Complex", Pinyon/juniper range, Poor, HSG C (WQ)
3,623.000		**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Muskingum-Cunge method - Pond routing by Dyn-Stor-Ind method

SubcatchmentWQ: Main Canyon Runoff Area=3,342.000 ac 0.00% Impervious Runoff Depth>0.27"
Flow Length=17,727' Tc=317.1 min CN=57 Runoff=94.47 cfs 76.235 af

SubcatchmentWQ2: Side Canyon Runoff Area=281.000 ac 0.00% Impervious Runoff Depth=0.40"
Flow Length=6,047' Tc=63.6 min CN=61 Runoff=35.71 cfs 9.364 af

Reach RC1: Reclaimed Channel 1 Avg. Depth=1.46' Max Vel=7.52 fps Inflow=94.47 cfs 76.235 af
n=0.070 L=950.0' S=0.0421 '/' Capacity=162.20 cfs Outflow=94.47 cfs 76.233 af

Reach RC2a: Reclaimed Channel 2 Avg. Depth=0.41' Max Vel=14.59 fps Inflow=35.71 cfs 9.364 af
n=0.050 L=74.0' S=0.1351 '/' Capacity=143.74 cfs Outflow=35.72 cfs 9.364 af

Reach RC2b: Reclaimed Channel 2 Avg. Depth=0.35' Max Vel=17.37 fps Inflow=35.72 cfs 9.364 af
n=0.050 L=115.0' S=0.1913 '/' Capacity=171.02 cfs Outflow=35.73 cfs 9.364 af

Reach RS: Road Swale Avg. Depth=0.44' Max Vel=8.74 fps Inflow=35.72 cfs 9.364 af
n=0.040 L=30.0' S=0.0667 '/' Capacity=102.08 cfs Outflow=35.72 cfs 9.364 af

Total Runoff Area = 3,623.000 ac Runoff Volume = 85.599 af Average Runoff Depth = 0.28"
100.00% Pervious = 3,623.000 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment WQ: Main Canyon

The soil for most of this basin has not been surveyed. The NRCS has surveyed the lower eastern portion nearest Scofield, and the proportions of soils there were used for the entire basin.

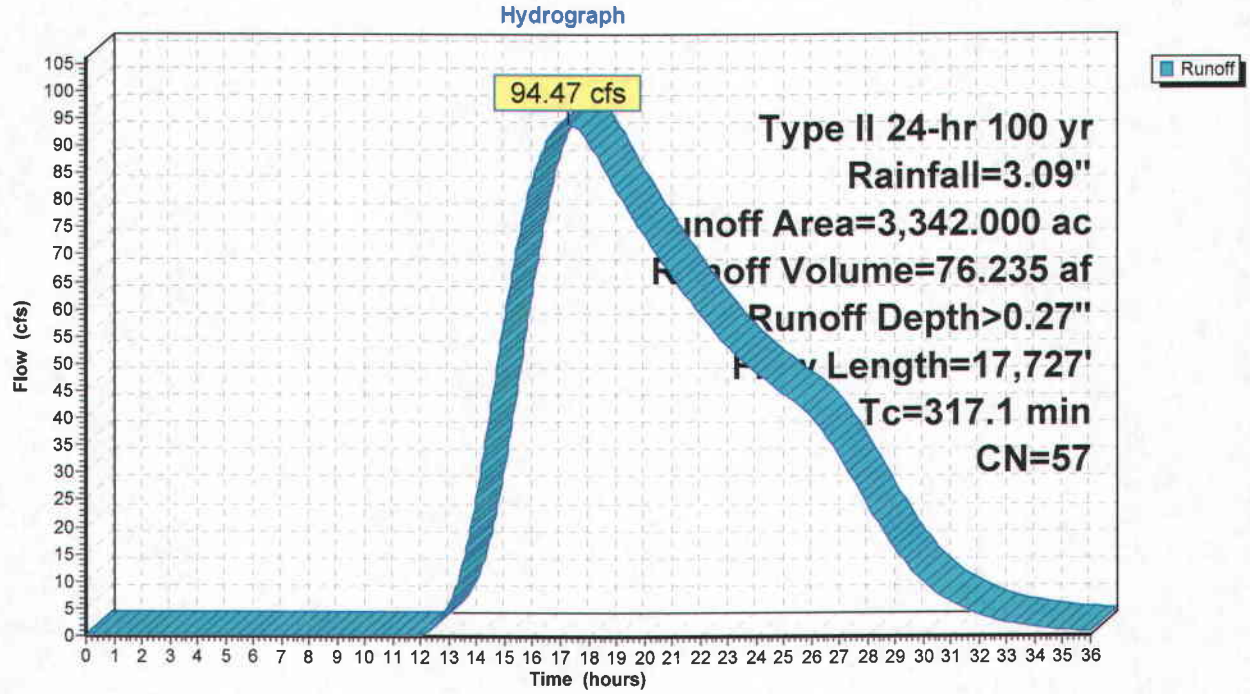
Runoff = 94.47 cfs @ 17.26 hrs, Volume= 76.235 af, Depth> 0.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 yr Rainfall=3.09"

	Area (ac)	CN	Description
*	2,302.000	61	Soil Type "Curecanti-Pathead Complex", Pinyon/juniper range, Poor, HSG C
*	275.000	51	Soil Type "Trag stony loam", Pinyon/juniper range, Poor, HSG B
*	758.000	48	Soil Type "Trag-Croydon Complex", Pinyon/juniper range, Fair, HSG B
*	7.000	48	Soil Type "Unita-Toze families complex", Pinyon/juniper range, Fair, HSG B
	3,342.000	57	Weighted Average
	3,342.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.4	300	0.0167	0.15		**Sheet Flow,** Range n= 0.130 P2= 1.56"
6.2	600	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.9	1,095	0.3835	3.10		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.6	1,256	0.0637	1.26		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
22.7	1,547	0.0517	1.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
130.5	7,165	0.0335	0.92		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
98.6	4,122	0.0194	0.70		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.2	1,642	0.0305	6.49	162.20	**Channel Flow,** Area= 25.0 sf Perim= 25.0' r= 1.00' n= 0.040 Winding stream, pools & shoals
317.1	17,727	Total			

Subcatchment WQ: Main Canyon



Summary for Subcatchment WQ2: Side Canyon (Sub-Watershed)

The soil for part of this basin has not been surveyed. The NRCS has surveyed the most eastern portion, nearest Scofield,

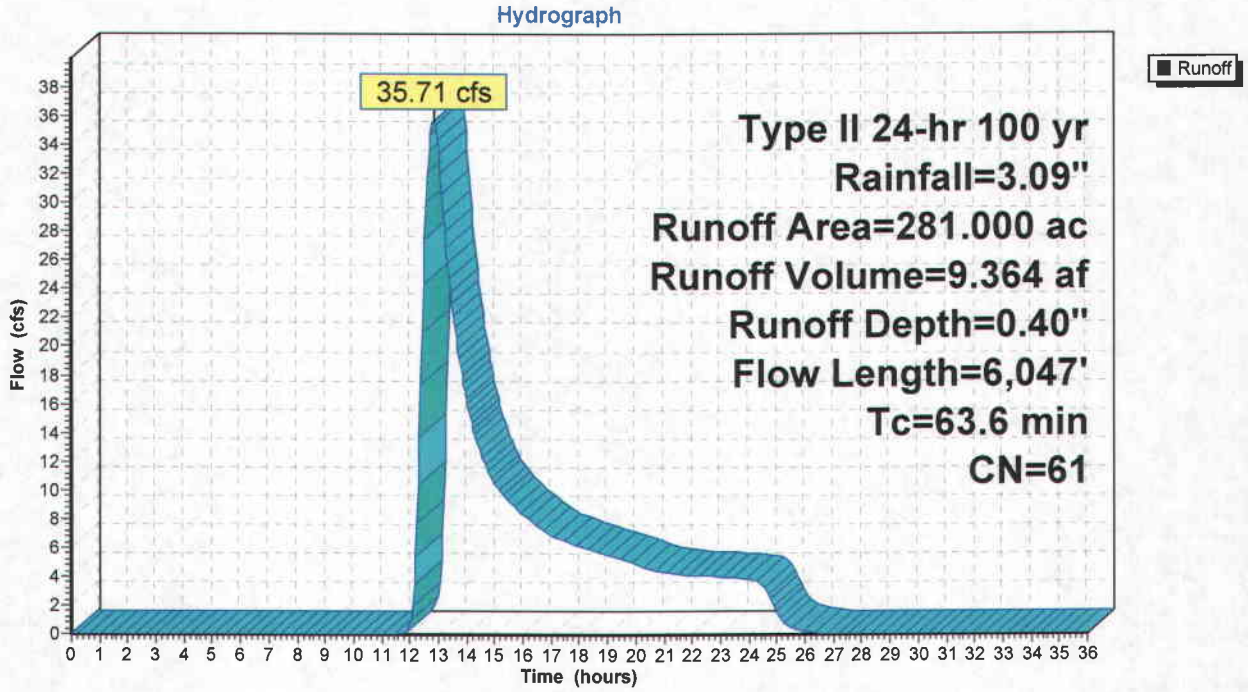
Runoff = 35.71 cfs @ 12.85 hrs, Volume= 9.364 af, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 yr Rainfall=3.09"

	Area (ac)	CN	Description
*	281.000	61	Soil Type "Curecanti-Pathead Complex", Oak/aspen range, Poor, HSG C
	281.000		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.9	300	0.0500	0.24		**Sheet Flow,** Range n= 0.130 P2= 1.56"
11.8	2,079	0.3463	2.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.4	1,465	0.2184	2.34		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.5	2,203	0.1280	1.79		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
63.6	6,047	Total			

Subcatchment WQ2: Side Canyon (Sub-Watershed)



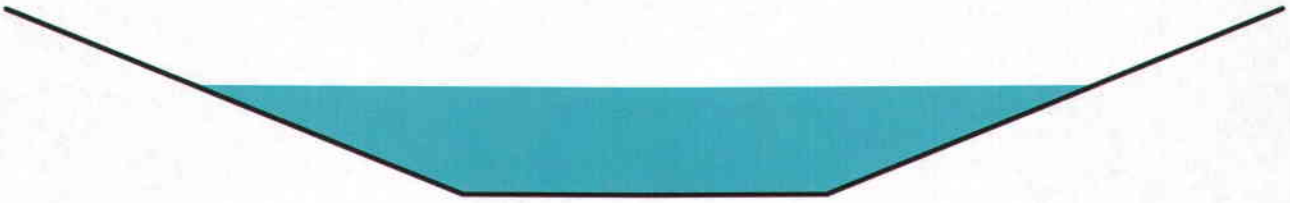
Summary for Reach RC1: Reclaimed Channel 1

Inflow Area = 3,342.000 ac, 0.00% Impervious, Inflow Depth > 0.27" for 100 yr event
Inflow = 94.47 cfs @ 17.26 hrs, Volume= 76.235 af
Outflow = 94.47 cfs @ 17.30 hrs, Volume= 76.233 af, Atten= 0%, Lag= 2.4 min

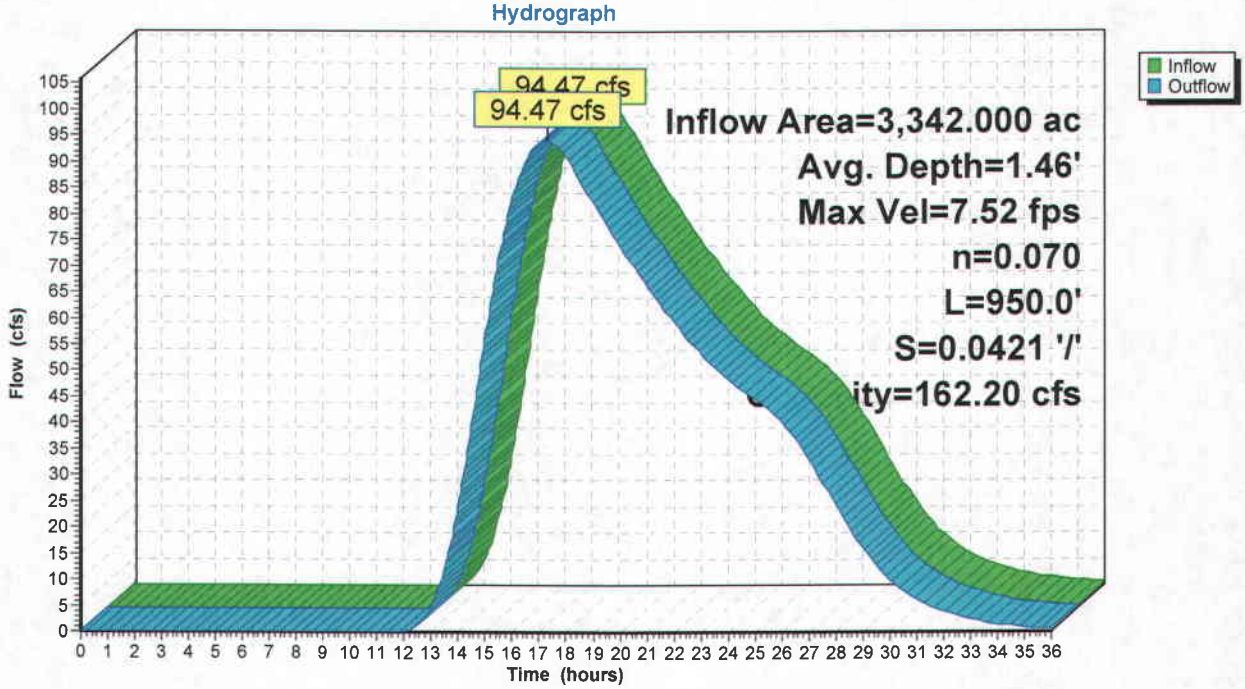
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Reference Flow= 121.65 cfs Estimated Depth= 2.18' Velocity= 5.35 fps
m= 1.393, c= 7.45 fps, dt= 3.0 min, dx= 950.0' / 1 = 950.0', K= 2.1 min, X= 0.480
Max. Velocity= 7.52 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 7.42 fps, Avg. Travel Time= 2.1 min

Peak Storage= 12,050 cf @ 17.28 hrs, Average Depth at Peak Storage= 1.46'
Bank-Full Depth= 2.50', Capacity at Bank-Full= 162.20 cfs

5.00' x 2.50' deep channel, n= 0.070 Mountain streams w/large boulders
Side Slope Z-value= 2.5 '/' Top Width= 17.50'
Length= 950.0' Slope= 0.0421 '/'
Inlet Invert= 8,105.00', Outlet Invert= 8,065.00'



Reach RC1: Reclaimed Channel 1



Summary for Reach RC2a: Reclaimed Channel 2

[90] Warning: Qout>Qin may require Finer Routing or smaller dt

Inflow Area = 281.000 ac, 0.00% Impervious, Inflow Depth = 0.40" for 100 yr event
Inflow = 35.71 cfs @ 12.85 hrs, Volume= 9.364 af
Outflow = 35.72 cfs @ 12.85 hrs, Volume= 9.364 af, Atten= 0%, Lag= 0.1 min

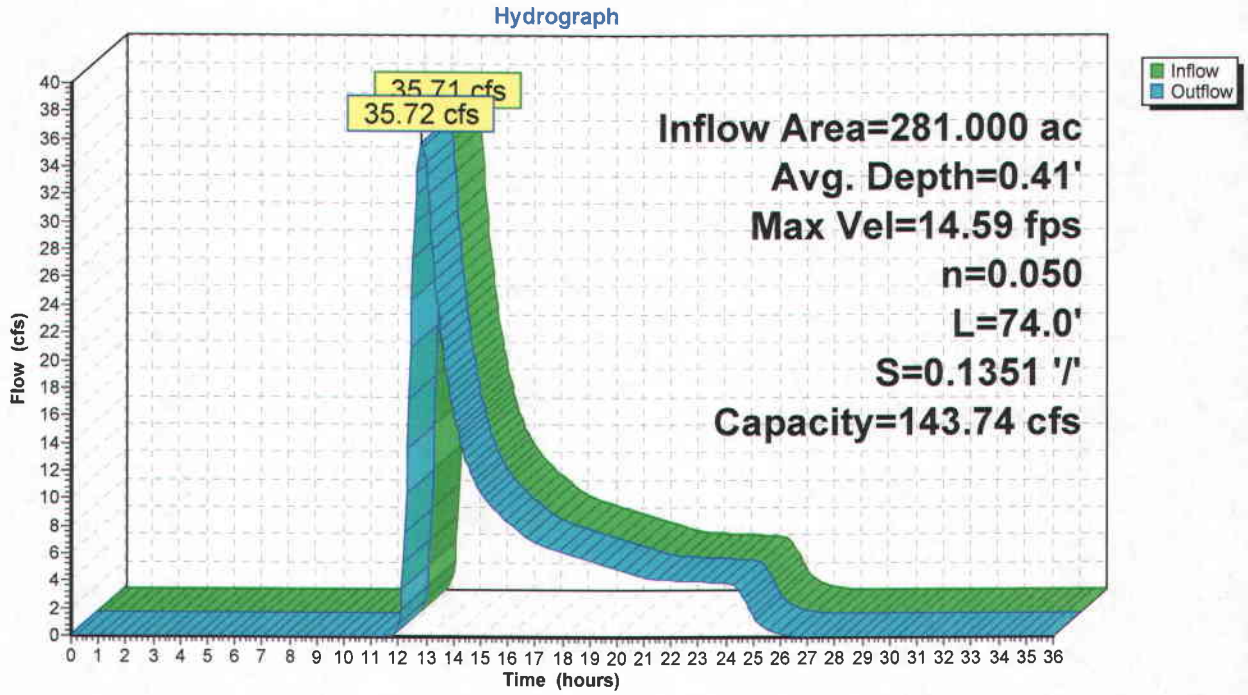
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Reference Flow= 107.80 cfs Estimated Depth= 1.29' Velocity= 10.11 fps
m= 1.434, c= 14.50 fps, dt= 3.0 min, dx= 74.0' / 1 = 74.0', K= 0.1 min, X= 0.455
Max. Velocity= 14.59 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 14.50 fps, Avg. Travel Time= 0.1 min

Peak Storage= 182 cf @ 12.85 hrs, Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 143.74 cfs

5.00' x 1.50' deep channel, n= 0.050 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.5 '/' Top Width= 12.50'
Length= 74.0' Slope= 0.1351 '/'
Inlet Invert= 8,134.00', Outlet Invert= 8,124.00'

‡

Reach RC2a: Reclaimed Channel 2



Summary for Reach RC2b: Reclaimed Channel 2

[90] Warning: Qout>Qin may require Finer Routing or smaller dt
[61] Hint: Exceeded Reach RS outlet invert by 0.35' @ 12.85 hrs

Inflow Area = 281.000 ac, 0.00% Impervious, Inflow Depth = 0.40" for 100 yr event
Inflow = 35.72 cfs @ 12.85 hrs, Volume= 9.364 af
Outflow = 35.73 cfs @ 12.85 hrs, Volume= 9.364 af, Atten= 0%, Lag= 0.1 min

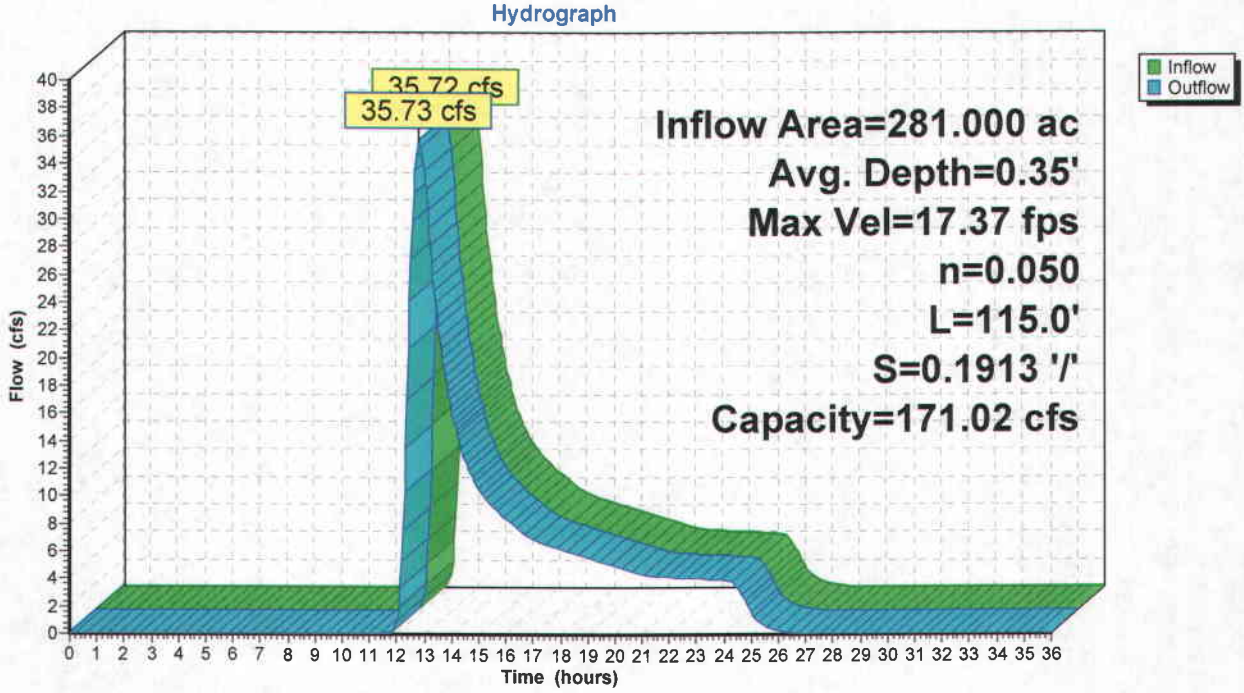
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Reference Flow= 128.27 cfs Estimated Depth= 1.29' Velocity= 12.03 fps
m= 1.434, c= 17.25 fps, dt= 3.0 min, dx= 115.0' / 1 = 115.0', K= 0.1 min, X= 0.479
Max. Velocity= 17.37 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 17.26 fps, Avg. Travel Time= 0.1 min

Peak Storage= 238 cf @ 12.85 hrs, Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 171.02 cfs

5.00' x 1.50' deep channel, n= 0.050 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.5 '/' Top Width= 12.50'
Length= 115.0' Slope= 0.1913 '/'
Inlet Invert= 8,122.00', Outlet Invert= 8,100.00'

‡

Reach RC2b: Reclaimed Channel 2



Summary for Reach RS: Road Swale

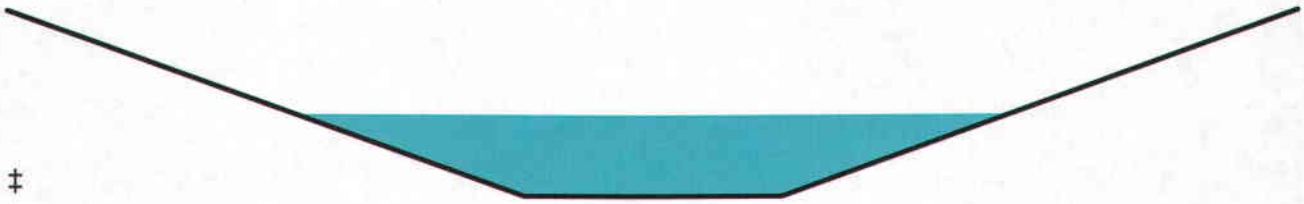
[90] Warning: Qout>Qin may require Finer Routing or smaller dt
[62] Warning: Exceeded Reach RC2a OUTLET depth by 0.05' @ 13.95 hrs

Inflow Area = 281.000 ac, 0.00% Impervious, Inflow Depth = 0.40" for 100 yr event
Inflow = 35.72 cfs @ 12.85 hrs, Volume= 9.364 af
Outflow = 35.72 cfs @ 12.85 hrs, Volume= 9.364 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Reference Flow= 76.56 cfs Estimated Depth= 0.88' Velocity= 6.32 fps
m= 1.371, c= 8.66 fps, dt= 3.0 min, dx= 30.0' / 1 = 30.0', K= 0.1 min, X= 0.340
Max. Velocity= 8.74 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 8.67 fps, Avg. Travel Time= 0.1 min

Peak Storage= 124 cf @ 12.85 hrs, Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 102.08 cfs

5.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 10.0 '/' Top Width= 25.00'
Length= 30.0' Slope= 0.0667 '/'
Inlet Invert= 8,124.00', Outlet Invert= 8,122.00'



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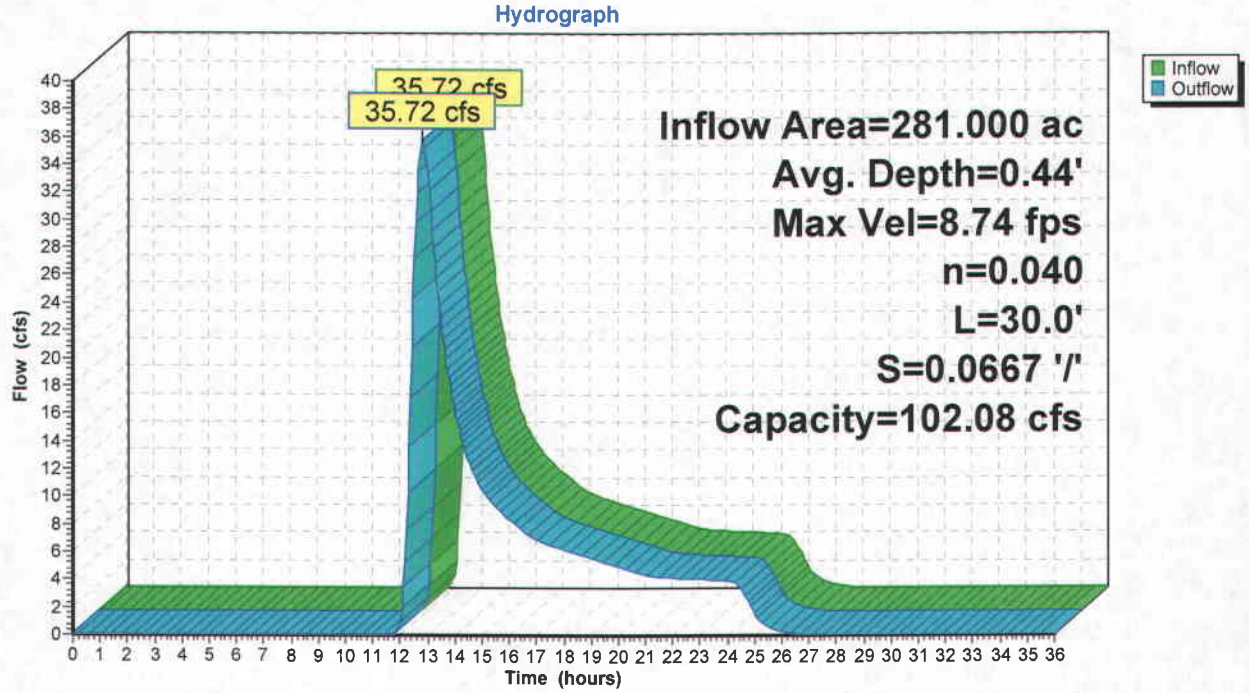
Reach RS: Road Swale