C/015/009 Incoming

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

#5089

Sufco Mine
Kenneth E. May
General Manager
397 South 800 West
Salina, Utah 84654
(435) 286-4400
Fax (435) 286-4499

March 31, 2016

RECEIVED
APR 04 2016
DIV. OF OIL, GAS & MINING

Permit Supervisor, Utah Coal Regulatory Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
PO Box 145801
Salt Lake City, UT 84114-5801

Re: Clean Copies of Revisions to Change Names in M&RP from PacifiCorp (Trail Mountain Mine), Etc. to Fossil Rock Mine, Task ID#5089, Fossil Rock Resources, LLC, Canyon Fuel Company, LLC, Permit Number C/015/00~~2~~9

Dear Sirs:

Please find enclosed with this letter two copies of the amendment related to the changes needed within the Fossil Rock M&RP to change commitment from PacifiCorp to Fossil Rock Resources, LLC. Most text has minimal changes except in the chapter covers, headers and footers, other chapters required that some text be revised to better express changes which have occurred in the years since the Trail Mountain Mine has been in cessation.

If you have questions or need addition information please contact Vicky Miller at (435)286-4481.

CANYON FUEL COMPANY, SUFCO Mine

Vicky S Miller for

Kenneth E. May
General Manager

Encl.

cc: DOGM Correspondence File

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

Permittee: Canyon Fuel Company, LLC
Mine: Fossil Rock Resources, LLC **Permit Number:** C/015/0009
Title: Clean Copies of Amendment for Changing Name within the text of M&RP to Fossil Rock, Task ID#5089

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	Introduction with Chapter 1
☐ Add	☒ Replace	☐ Remove	Chapter 2, Legal - Text and Appendix 2
☐ Add	☒ Replace	☐ Remove	Chapter 3, Operations - Text, Figures, Tables and Appendix 1- Reclamation Bond
☐ Add	☒ Replace	☐ Remove	Chapter 4, Land Use - Text, Tables and Figures
☐ Add	☒ Replace	☐ Remove	Chapter 5, Cultural - Text
☐ Add	☒ Replace	☐ Remove	Chapter 6, Geology - Text, Figures and Tables
☐ Add	☒ Replace	☐ Remove	Chapter 7, Hydrology - Text, Tables and Figures
☐ Add	☒ Replace	☐ Remove	Chapter 8, Soils - Text and Tables
☐ Add	☒ Replace	☐ Remove	Chapter 9, Vegetation - Text and Tables
☐ Add	☒ Replace	☐ Remove	Chapter 10, Wildlife - Text, Figures and Tables
☐ Add	☒ Replace	☐ Remove	Chapter 11, Geotechnical - Text
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	Received by Oil, Gas & Mining
March 31, 2016	RECEIVED APR 04 2016 DIV. OF OIL, GAS & MINING

Form DOGM - C2 (Revised March 12, 2002)

APPLICATION FOR COAL PERMIT PROCESSING

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

Permittee: Canyon Fuel Company, LLC

Mine: Fossil Rock Resources, LLC **Permit Number:** C/015/0009

Title: Clean Copies of Amendment for Changing Name within the text of M&RP to Fossil Rock, Task ID#5089

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

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.

RICHARD PARKINS
Print Name

Richard Parkins, General Manager, March 30, 2016
Sign Name, Position, Date

Subscribed and sworn to before me this 30 day of MARCH, 2016

Kathleen Widner
Notary Public

My commission Expires: 8-3, 2018)
Attest: State of COLORADO) ss:
County of MESA

KATHLEEN WIDNER
Notary Public
State of Colorado
Notary ID 19944011144
My Commission Expires Aug 3, 2018

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining
		RECEIVED APR 04 2016 DIV. OF OIL, GAS & MINING

CHAPTER 1

INTRODUCTION AND SUMMARY OF PERMIT APPLICATION

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1.1 INTRODUCTION

Fossil Rock Mine is located in Cottonwood Canyon, l2 miles west of Orangeville, Utah (See Figure 1-1). A mining and reclamation permit, ACT/0l5/009, which incorporates the Office of Surface Mining (OSM) permit UT-00l7, was issued by the State of Utah, Division of Oil, Gas and Mining (DOGM) to Trail Mountain Coal Company on February l9, l985. The subsequent permit, ACT/0l5/009-1, was modified to include the Tract II area on April 30, l987. A permit transfer from Arch Minerals (Trail Mountain Coal Co.) to Beaver Creek Coal Company (Trail Mountain No. 9 Mine) was approved by DOGM on 11/23/87. A permit transfer from Beaver Creek Coal Company (Trail Mountain No. 9 Mine) to PacifiCorp (Mine) was approved on 11/13/92. A permit transfer from PacifiCorp (Trail Mountain Mine) to Fossil Rock Resources, LLC (Fossil Rock Mine) was approved on October 8, 2015.

PacifiCorp notified the Division of temporary cessation of coal mining operations at the Mine effective May 4, 2001. Coal mining at the Mine ceased as of march 15, 2001. I preparation of temporary cessation, all mining equipment including:" production (longwall and continuous miner), belt haulage and electrical were removed from the mine. Verification of equipment removal was conducted on April 6, 2001 with the Bureau of Land Management (Steve Falk) and Division of Oil, Gas and Mining (Pete Hess)participating in the review. A plan to construct permanent seals was submitted to and approved by Mine Safety Health Administration. Sealing of the mine portals was completed on May 1, 2001.

The following Permit Application will focus on the entire mine which from this time forth will be referred to as the Fossil Rock Mine.

The surface facilities are located in Sections 25, T.I7S, R 6 E., SLB&M, in Emery County, twelve miles west of Orangeville, Utah.

Historically, the Trail Mountain Mine has been developed to operate with longwalls and continuous miners in the Hiawatha Coal Seam. The Hiawatha seam is the only minable seam in the Mine area. The historic Trail Mountain Mine operated approximately 220 days per year, three shifts per day, eight hours per shift with two production shifts and one maintenance shift. Annual production from the Mine has been approximately 3,500,000 to 5,000,000 tons. Annual production was dictated by the demand requirements of the Hunter Power Plant.

1.2 SCOPE OF OPERATION

The Mine is an underground coal operation. The Trail Mountain operations have historically extended throughout Sections 25, 26, 27, 34, 35, and 36 in Township I7 South, Range 6 East; and Sections 1, 2, and 3 in Township 18 South, Range 6 East; and Section 6 in Township 18 South, Range 7 East, Salt Lake Base and Meridian, Emery County, Utah. The underground working covered an area of approximately 773.50 acres of Federal leases and fee coal lands. For the legal and financial information for the Fossil Rock Mine, refer to the General Chapter 1 binder. The waste rock site that serves the mine is located in Section 34, Township17 South, Range 7 East.

Underground mining occurs in the Hiawatha seam of the Blackhawk Formation. Surface facilities, including the offices, bathhouse, shop, storage facilities and tipple are located at the intersection of the coal seam and the canyon floor. Surface facilities occupy approximately 10.39 acres. The waste rock site disturbance adds an addition 15.82 acres.

1.3 SUMMARY OF ENVIRONMENTAL IMPACTS

Similar to many other coal operations along the east front of the Wasatch Plateau, the Mine is located in a steep walled canyon. Vegetation, soils, geology, hydrology, and wildlife of the mine plan area are typical of the general area.

As mining has been conducted in the area for over 50 years with rather minimal impact to the environmental resources, it is expected that continued operation of the Mine will also have minimal impact. Impacts are expected to be minimal due to implementation of mining practices which incorporate sound and practical engineering and environmental considerations in the mine planning process.

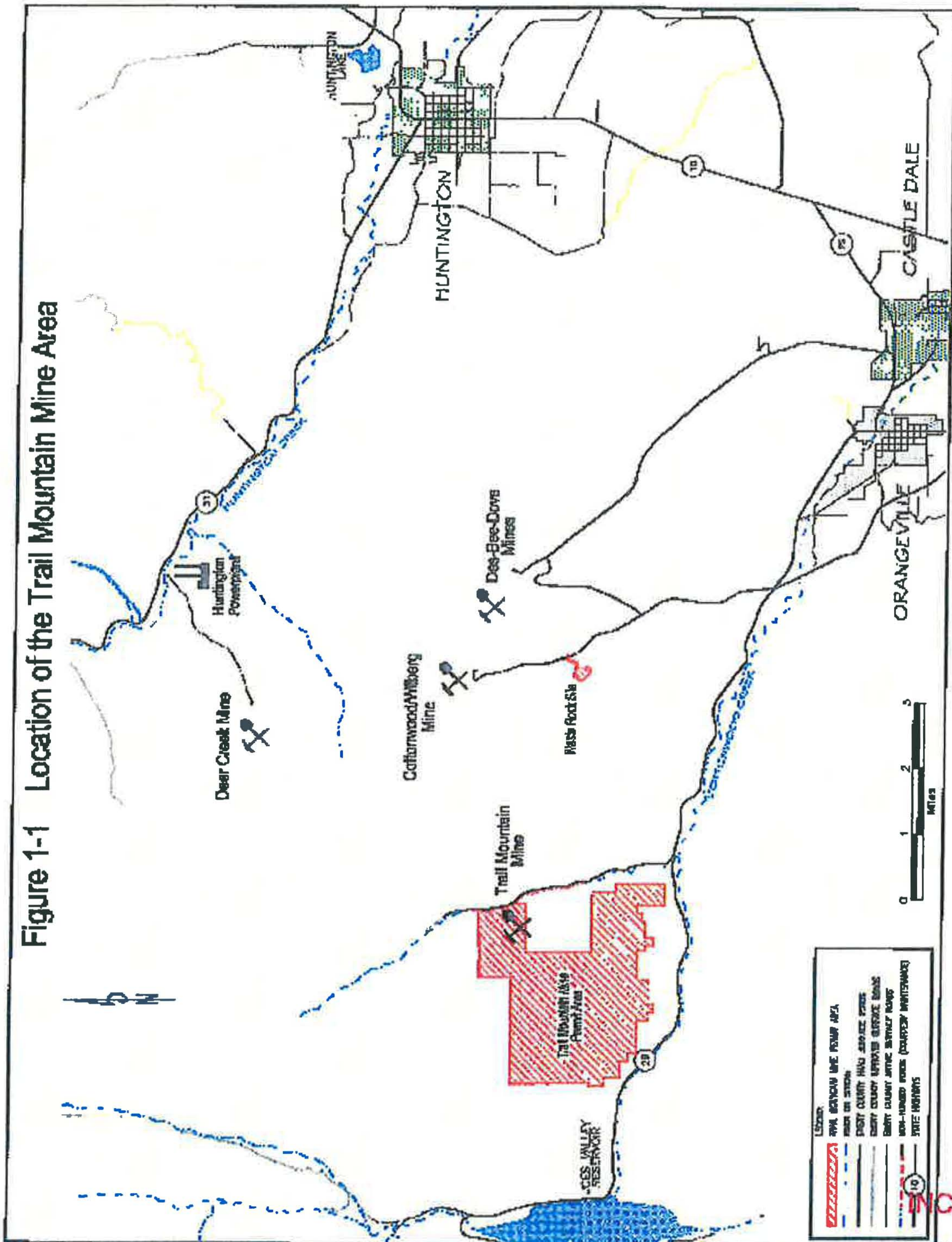

Figure 1-1 Location of the Trail Mountain Mine Area

CHAPTER 2
LEGAL AND FINANCIAL

FOSSIL ROCK MINE
LEGAL, FINANCIAL, COMPLIANCE AND RELATED INFORMATION

This application for a mining and/or reclamation permit is submitted to the State of Utah, Department of Natural Resources, Division of Oil, Gas and Mining, in accordance with the Utah Coal Mining and Reclamation Act, Title 40, Chapter 10, U.C.A., 1953 (as amended); the applicable rules and regulations adopted thereunder; the Surface Mining Control & Reclamation Act of 1977, and applicable regulations adopted thereunder (30 CFR 770, et seq.), the Cooperative Agreement between the State of Utah and the United States Secretary of Interior, and other applicable laws and regulations.

R645-301-100 GENERAL CONTENTS

Additional Legal and Financial Information pertaining to the Fossil Rock Mine is located in the Supplemental Volume entitled: GENERAL CHAPTER 1

Business Entity: Fossil Rock Resources, LLC is a Limited Liability Company organized under the laws of Delaware on August 29, 2014 and is owned 100% by Canyon Fuel Company, LLC. Canyon Fuel Company LLC a Limited Liability Company organized under the laws of Delaware in December 1996 which in turn is owned 100% by Bowie Resource Partners, LLC a Delaware Limited Liability Company. Refer to General Chapter 1 for addition organizational structure.

Applicant: Operations, Administration, Permit Revisions and Amendments
Fossil Rock Resources, LLC
225 North 5th Street, 9th Floor
Grand Junction, CO 81501
Telephone: (970)263-5130

Operator: Fossil Rock Resources, LLC (See information above)

Resident Agent: CSC Lawyers Incorporating Service Company
421 West Main
Frankfort, KY 40601
(800) 927-9800

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APR 05 2016
Div. of Oil, Gas & Mining

Contact Person: Eugene E. DiClaudio
Canyon Fuel Company, LLC
225 North 5th Street, 9th Floor
Grand Junction, CO 81501
Telephone: (970) 263-5130

Person Who Will Pay Abandoned Mine Reclamation Fees:

Eugene E. DiClaudio
Canyon Fuel Company, LLC
225 North 5th Street, 9th Floor
Grand Junction, CO 81501
Telephone: (970) 263-5130

Employer ID#: 47-1742876

APPENDIX 2

AFFIDAVIT OF PUBLICATION

STATE OF UTAH)

ss.

County of Carbon,)

I, Jenni Fasselin, on oath, say that I am the Publisher of the Sun Advocate, a twice-weekly newspaper of general circulation, published at Price, State of Utah a true copy of which is hereto attached, was published in the full issue of such newspaper for 1 (One) consecutive issues, and on the Utah legals.com website, the first publication was on the 8th day of September, 2015, and that the last publication of such notice was in the issue of such newspaper dated the 8th day of September 2015.

Jenni Fasselin

Jenni Fasselin – Publisher

Subscribed and sworn to before me this 8th day of September, 2015.

Linda Thayn

Notary Public My commission expires January 10, 2019 Residing at Price, Utah

Publication fee, $67.20

LINDA THAYN
NOTARY PUBLIC-STATE OF UTAH
COMMISSION# 680835
COMM. EXP. 01-10-2019

PUBLIC NOTICE CHANGE OF OWNERSHIP AND CONTROL

Canyon Fuel Company, LLC, has applied to the Division of Oil, Gas and Mining for the transfer of ownership and control of Trail Mountain Mine and Waste Rock Storage Facility from PacifiCorp, 1407 West No. Temple, Suite 310, Salt Lake City, Utah 84116 to Fossil Rock Resources, LLC, 225 North 5th Street, 9th Floor, Grand Junction, CO 81501

PacifiCorp owned and operated the following properties:

Trail Mountain Mine - C/015/0009, facilities located in Township 17 South, Range 6 East, Portions of the W1/2E1/2SW1/4NE1/4,E1/2W1/2SW 1/4NE1/4, W1/2E1/2NW1/4SE1/4 of Section 25, Emery County, UT

Trail Mountain Waste Rock Storage Facility - C/015/0009, facility located in Township 17 South, Range 7 East, SE1/4 of Section 34, in Emery County, UT

Written comments should be directed to the Utah Division of Oil, Gas and Mining, P.O. Box 145801, Salt Lake City, UT 84114-5801. Copies of the current mining and reclamation plans are available for public inspection at the office of the Utah Division of Oil, Gas and Mining, 1594 West North Temple, Suite 1210, Salt Lake City, Utah.

Published in the Sun Advocate September 8, 2015.

FOSSIL ROCK RESOURCES, LLC
OWNERSHIP AND CONTROL INFORMATION
September 2015

	Position	Beginning Date
OFFICERS:		
Manie Dreyer	CEO	8/29/14
James Wolff	CFO	8/29/14
Eugene DiClaudio	COO	8/29/14
Grant Quasha	CCO	8/29/14
Brian Settles	SR VP, SEC & GEN CSL	8/29/14

NO DIRECTORS

OWNERSHIP
CANYON FUEL COMPANY, LLC 100%

Business Entity : Fossil Rock Resources, LLC is a Limited Liability Company organized under the laws of Delaware on August 29, 2014 and is owned 100% by Canyon Fuel Company, LLC. Canyon Fuel Company LLC a Limited Liability Company organized under the laws of Delaware in December 1996 which in turn is owned 100% by Bowie Resource Partners, LLC a Delaware Limited Liability Company. Refer to General Chapter 1 for addition organizational structure.

Applicant: Operations, Administration, Permit Revisions and Amendments
Fossil Rock Resources, LLC
225 North 5th Street, 9th Floor
Grand Junction, CO 81501
Telephone: (970)263-5130

Operator: Fossil Rock Resources, LLC (See information above)
EIN#: 47-1742876

Resident Agent: CSC Lawyers Incorporating Service Company
421 West Main
Frankfort, KY 40601
(800) 927-9800

Contact Person: Eugene E. DiClaudio
Canyon Fuel Company, LLC
225 North 5th Street, 9th Floor
Grand Junction, CO 81501
Telephone: (970) 263-5130

Person Who Will Pay Abandoned Mine Reclamation Fees:

Eugene E. DiClaudio
Canyon Fuel Company, LLC
225 North 5th Street, 9th Floor
Grand Junction, CO 81501
Telephone: (970) 263-5130

Errata Sheet Pertaining to Proposed Transfer of Permit From PacifiCorp to Fossil Rock Resources, LLC

This sheet is to be placed at the beginning of Chapters 1 thru 12 of the Trail Mountain Permit C/015/0009, the associated binders containing appendices, tables, figures, drawings, maps and to remain until such time that the permit is transferred and amended to reflect the information for the new permittee, Fossil Rock Resources, LLC (Fossil Rock Mine). This sheet is to be placed in the Waste Rock Site binder at the beginning of sections containing text, appendices and maps.

The facilities have changed hands multiple times, which means there are various references in the text, reports, studies, right-of-ways, leases and laboratory analyses which refer to the company owning or operating the mine facilities during a specific period of time. To provide clarification the following table lists the various names used through the life of the permit (to the best of our knowledge) and what entity under the new ownership those references will refer to.

Names Existing	Following Permit Transfer	
PacifiCorp	Fossil Rock Resources, LLC	
Beaver Creek Coal Company		
Interwest Mining		
Energy West Mining Company		
Arco Mining		
Arch Minerals		
Ark Land		
Trail Mountain Coal Company		
Utah Power & Light Company		
Utah Power & Light Mining Division		
Trail Mountain Mine	Fossil Rock Mine	
Trail Mountain Mine No. 9		
Cottonwood/Wilberg Waste Rock		
Natomas Mine		
Utah Power & Light Mining Division		
Cottonwood Mine		
Grimes Wash Facility		

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When use of the above referenced names appear in the permit documents to describe events which would be considered historic they will remain the same. When the names are used to imply a commitment or ownership the names will be changed or amended where possible as designated in this table.

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OCT 08 2015
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OPERATION AND RECLAMATION PLAN

3.1 SCOPE

Chapter 3 sets out the plans intended to be undertaken during the permit term and life of the operation. The chapter is divided into five sections: surface facilities, operation plan, environmental protection, reclamation plan, and bibliography.

The Division was notified of temporary cessation of coal mining operations at the Trail Mountain Mine effective May 4, 2001. Coal mining at the Trail Mountain Mine ceased as of March 15, 2001. In preparation of temporary cessation, all mining equipment including; production (longwall and continuous miner), belt haulage and electrical were removed from the mine. Verification of equipment removal was conducted on April 6, 2001 with Bureau of Land Management (Steve Falk) and Division of Oil, Gas and Mining (Pete Hess) participating in the review. A plan to construct permanent seals was submitted to and approved by Mine Safety Health Administration. Sealing of the mine portals was completed on May 1, 2001.

3.2 SURFACE FACILITIES

The Trail Mountain Mine (renamed Fossil Rock Mine in 2015) is an existing operation that was started in the 1940's. All surface facilities are in place under an approved mining and reclamation plan C/015/0009.

3.2.1 Site Selection and Preparation

The mine site was selected for its location. Access to the coal seam is facilitated by the intersection at the mine site of the coal outcrop and the canyon floor.

Site preparation consisted of clearing the site, construction of pads and facilities, and development of portals.

3.2.2 Portals

Five portals provide access to the Mine. One portal located on the corner of the outcrop of Cottonwood Canyon and a small side-drainage canyon is a fan portal. The second portal, 150 feet south of the fan portal, is the main intake and travel portal. The third portal is the belt portal. It is located just to the south of the main portal. The fourth portal is south of the belt portal and is used as a ventilation portal.

A fifth portal has been driven to the outside approximately 1000' south of the fourth portal. This is a ventilation portal, and surfaces just south of the old sealed entry at this location. Complete description of this project is found in Appendix 3-7. (See Plate 3-1 for locations). An old sealed entry is found 500 feet south of the fourth portal (ventilation portal). It is not used in this operation. The Mine went into temporary cessation on May 4, 2001. All portals associated with the Mine were sealed as specified in 30CFRPart 75.335 (except one (1) opening which was inaccessible, this opening was completely backfilled with non-combustible fill from the surface).

3.2.3 Surface Building and Structures

The buildings and structures associated with the Mine are shown in Plate 3-1. They consist of an office, bathhouse, shop, power substation, and fan control house, coal handling system, explosive magazines, sediment control facilities, and fuel storage tank farm area. The following table describes the tanks within the tank farm area:

Tank Contents*	Diesel	Unleaded Gasoline	Emulsion Oil	Calcium Chloride
Capacity	15,000 gal.	4,100 gal.	6,300 gal.	500 gal.

* Spill containment and cleanup is outline in the SPCC Plan.

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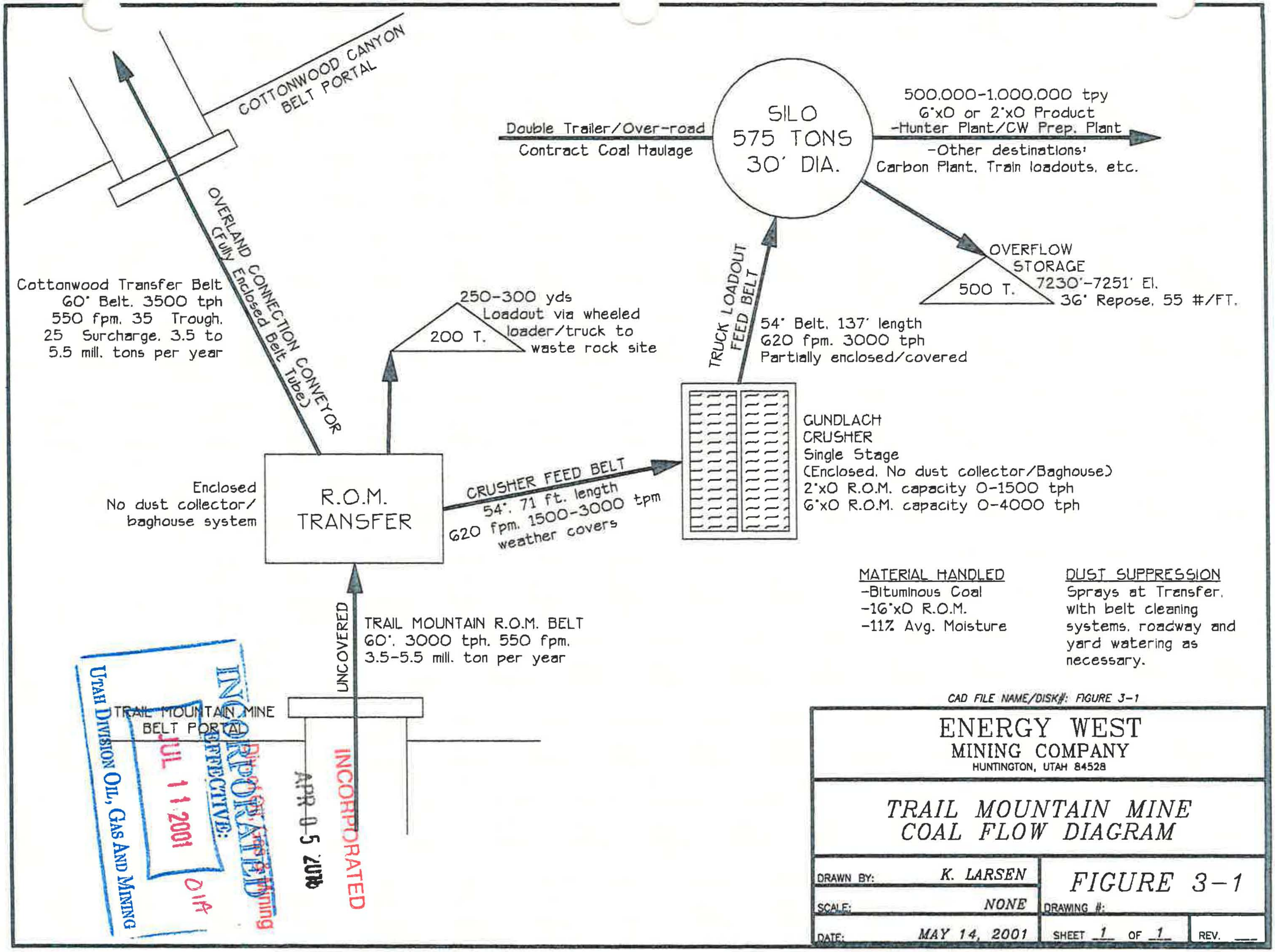
The office, shop, sub-station, fan control house, fuel storage tank farm area, and sediment controls were all in place prior to 1987. A new bathhouse, coal handling facility, explosive magazines, ventilation portal, and culinary water system were added in late 1990. The main canyon culvert was also extended approximately 300' at that time. After PacifiCorp purchased the Trail Mountain Mine in 1992, surface modifications have taken place such as, concrete portal liners, new travel portal, new twin fan, new fuel storage area, high pressure water building and tank, relocation of water treatment plant, storage shed, storage dock, modified ROM transfer and a 60" overland tube conveyor. See Appendix 3-4 for the Operation Plan for the structures. Also see Appendices 3-7, 3-8, 3-9, 3-10 and 7-13 for details on the new facilities.

3.2.4 Coal Handling, Processing, Preparation, and Storage

Historical - Coal in the Mine has been mined by longwalls and continuous miners. The 48 inch section belts transferred coal to the 60 inch main belt. The 60 inch main belt conveyed the coal to the surface where a magnet at the ROM transfer removed metal from the coal stream. The coal could then be shipped on a 60 inch belt to the Cottonwood Mine via the tube conveyor or could be shipped to the 575 ton silo and coal storage area via the crusher and the 54 inch belt. When the coal was shipped to the Cottonwood Mine it was sized from 16" x 0" run of mine to 6" x 0". When the coal was shipped to the Mine Facilities it passed through a crusher. The crusher at the Mine has the capability of sizing the coal from 16" x 0" through 2" x 0". The crushed coal was then conveyed to a 575-ton bin where it was loaded by a short belt into on-road trucks for shipment. In the event the crusher failed or the bin was full, coal was diverted by a flop gate into a chute and placed in an open storage pile. Figure 3-1 shows a generalized schematic of the coal handling system. Appendix 3-8 describes further details on the coal handling system.

Coal mining at the Mine ceased as of March 15, 2001. In preparation of temporary cessation all mining equipment including; production (longwall and continuous miner), belt haulage and



CAD FILE NAME/DISK#: FIGURE 3-1

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TRAIL MOUNTAIN MINE
COAL FLOW DIAGRAM

DRAWN BY: *K. LARSEN*	*FIGURE 3-1*	
SCALE: *NONE*	DRAWING #:	
DATE: *MAY 14, 2001*	SHEET 1 OF 1	REV. ___

electrical were removed from the mine. Verification of equipment removal was conducted on April 6, 2001 with Bureau of Land Management (Steve Falk) and Division of Oil, Gas and Mining (Pete Hess) participating in the review. A plan to construct permanent seals was submitted to and approved by Mine Safety Health Administration. Sealing of the mine portals was completed on May 1, 2001.

3.2.5 Power System Transmission Lines, Substation, Mine Feeders

The present utility power is supplied at 25,000 volts, 60 HZ. This incoming line supplies the mine substation located south of the office building. The existing 25,000 volts primary, 12,470 volts secondary, substation rate at 7500 KVA is connected to this transmission line in a delta primary, wye secondary configuration for underground distribution. Underground power was distributed by three (3) 4/0 mine feeder cables at 12,470 volts. At each working section, belt drive location, compressor station, high pressure pump station, etc., a transformer reduces the 12,470 volts to 950/480 machine voltage.

A 400 KVA 4160 volt primary, 480 volt secondary transformer supplies power to miscellaneous surface areas (tipple, shop, etc.). The mine office receives power from a pole mounted 480/220/120 transformer.

PacifiCorp upgraded the power system on August 5, 1995 which consisted of the following: 1) incoming utility power upgraded by Utah Power to 69,000 volts, 60 HZ, phase 3, 2) installation of two (2) identical substation transformers (one of which is a standby/backup unit) rated at 10 MVA. These transformers are located southwest of the office building. The primary voltage is 69,000 volts delta connected and the secondary will be 12,470 volts wye connected. The existing 7500 KVA transformer will remain in place for a secondary backup power system. All power from the substation on will remain the same as mentioned above.

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3.2.6 Water Supply System

Historically, the culinary water supply for the Mine was drawn from underground mine water. Mine water was collected in an underground sump and skimmed of oil. Approximately 10,000 gallons per day of this water was prepared in the treatment plant for use as potable water. Some mine water was used for wash down. Water was treated on the surface at a maximum rate of 10 gpm and then stored in two 22,000 gallon capacity fresh water storage tanks. The treatment plant and process are approved by the State of Utah, Department of Environmental Quality, Division of Drinking Water. A schematic of the water system is shown in Figure 3-2. This system is connected to the mine water system at the belt portal location. If the need should develop for filling water trucks, or supplying alternate water to the mine or surface system, this water would be drawn from the 2-22,000 gallon surface storage tanks referred to in Figure 3-2.

Refer to Figure 3-3 for typical underground water system schematic. As stated previously, PacifiCorp notified the Division of temporary cessation of coal mining operations at the Trail Mountain Mine effective May 4, 2001. Coal mining at the Mine ceased as of March 15, 2001. In preparation of temporary cessation, all of mine de-watering system was removed from the mine, except for a six (6) inch steel supply line (9066') and a twelve (12) inch PVC de-watering line (9066), refer to Plate 3-8 for details. Verification of equipment removal was conducted on April 6, 2001 with Bureau of Land Management (Steve Falk) and Division of Oil, Gas and Mining (Pete Hess) participating in the review.

3.2.7 Sewage System

The septic system for the Facility was approved by the Division of Water Quality on March 17, 1995. The system is somewhat unique in that the grey-water portion of the sewage is separated and eventually enters the Cottonwood Mine sewage system and leach field for final disposal.

The sewage enters one of three septic tanks, depending on location, removing the majority of solids from the sewage. The grey-water then flows, via an 8 inch line, to the collection/pumping station, located south of the rock dust silo. The collection/pumping station contains a 10,000 gallon holding tank and two pumps. In the case of emergencies, the system can dispose of the sewage grey-water at the collection/pumping station by haulage truck to the Cottonwood Mine sewage system or to another facility licensed to accept septic tank waste. For short term emergencies, the storage capacity of the collection tank can handle more than the 24 hour sewage waste generation of the mine.

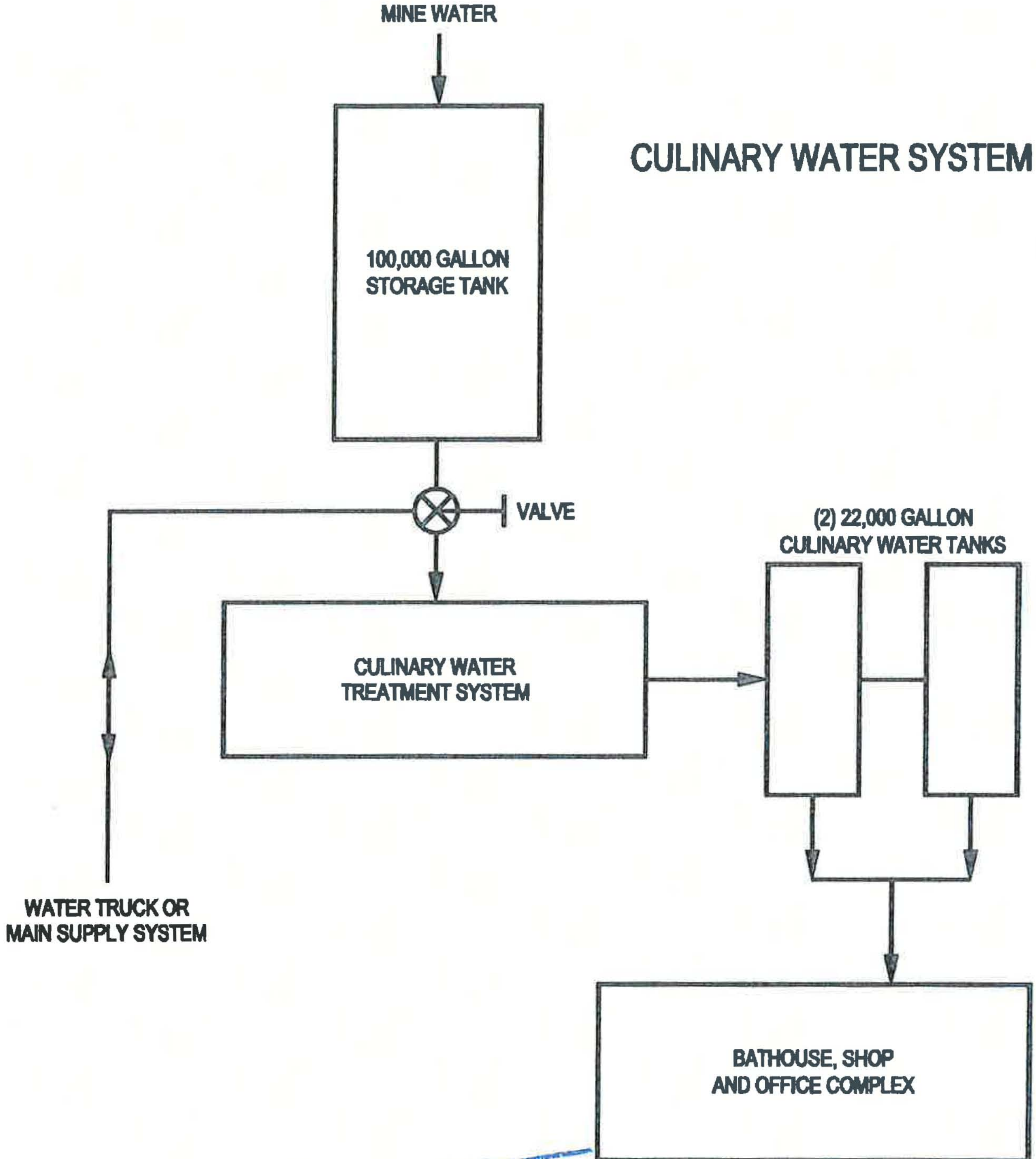
3.2.8 Water Diversion Structures

Three water diversion structures are maintained at the Mine. A concrete curb and gutter running north-south through the facilities area diverts water from the disturbed area into the sediment pond. A 66-inch culvert that has been placed in Cottonwood Creek has allowed the facilities pad area to be extended, and also allow Cottonwood Creek to flow beneath the mining operation. The length of this culvert is approximately 1,900 feet, extending from below the sedimentation pond to the property boundary north of the bathhouse (see Chapter 7). A 48-inch culvert located at the mouth of the side canyon, just west of the fan portal, diverts water from the canyon directly into the 66-inch culvert of Cottonwood Creek without crossing the mine property (see Chapter 7).

3.2.9 Sedimentation Control Structures and Water Treatment Facilities

A sedimentation pond is located on the southern end of the permit area. All surface water that has crossed the mine property is diverted to this structure. Mine water can also be periodically pumped directly into the sediment pond. The pond contains a 48 inch emergency overflow culvert and a decant pipe, located on the east side of the pond (see Chapter 7).

CULINARY WATER SYSTEM



CAD FILE NAME/DISK#: USERS\KJL\TRAIL\FIGURE 3-2.DWG

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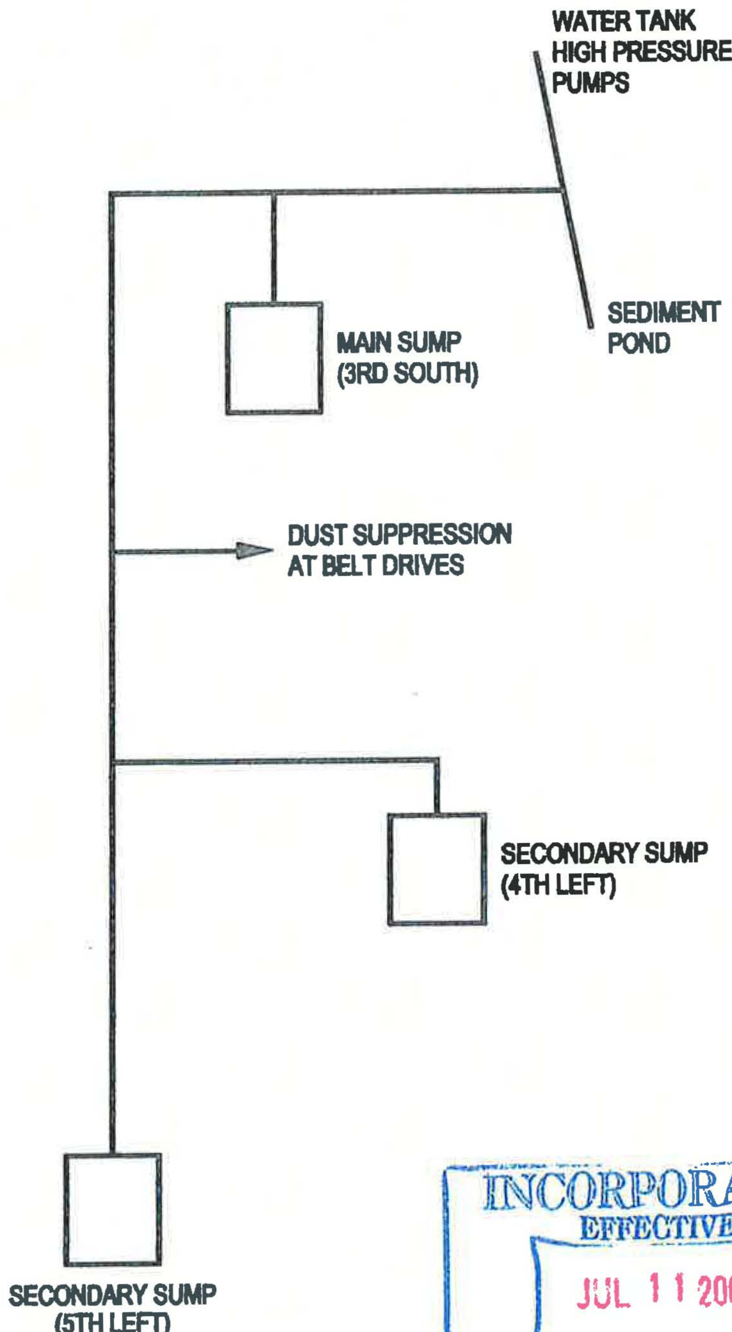
TRAIL MOUNTAIN MINE
CULINARY WATER SYSTEM

DRAWN BY:	K. LARSEN	FIGURE 3-2	
SCALE:	NONE	DRAWING #:	
DATE:	MAY 4, 2001	SHEET 1 OF 1	REV.

TYPICAL UNDERGROUND WATER SYSTEM



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CAD FILE NAME/DISK#: USERS\KJL\TRAIL\FIGURE 3-3.DWG

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TRAIL MOUNTAIN MINE
TYP. UNDERGROUND WATER SYSTEM

DRAWN BY: K. LARSEN	FIGURE 3-3		
SCALE: NONE	DRAWING #:		
DATE: MAY 4, 2001	SHEET 1 OF 1	REV. ___	

3.2.10 Transportation, Roads, Parking Areas

Access to the mine is provided by county road, Forest Service road, and private right-of-way along Cottonwood Creek. The road is paved and used by mine personnel private vehicles, coal trucks for haulage, and by the public for access to the upper canyon.

The facilities area of the Mine is accessed from a county road (see Plate 3-1 and Appendix 3-5). The facilities area consists of: coal storage areas, parking lot, supply yard, equipment and material storage areas. No primary road exists on the mine site. Controlled pad and parking lot drainage flow across the facility and enters the curb and gutter system which reports to the sediment pond.

The roads on the site are ancillary roads. These include the upper terrace access road, portal access road and the tipple access road. Ancillary roads are used on an occasional, as needed basis only, and therefore are classed as ancillary roads according to R645-301-527.100.

The roads are constructed and maintained to minimize disturbance and adverse impacts on fish, wildlife and related environmental values. Roads will be maintained to meet applicable design standards throughout their use, by blading, watering and resurfacing as necessary. Roads are also located, designed, constructed, reconstructed, used, maintained, and will be reclaimed so as to prevent or control damage to public or private property; using non-acid or non-toxic forming substances in surfacing; and will have a static safety factor of 1.3 for all embankments.

The mining operation is conducted within 100 feet of a public (county owned) road. The requirements of R645-103-234 and protection of the public interests are met in the following ways:

(1) This is a pre-law operation, and has always been located adjacent to the public road which provides access to the public and private lands in and beyond Cottonwood Canyon;

(2) The road has been upgraded and paved through cooperation of the Mine, Emery County Road Department, and the US Forest Service;

(3) Necessary approvals for the road have been obtained from the authorities with jurisdiction over the public road through the cooperative effort of upgrading and paving of the road to the mine site. Necessary encroachment permits have been obtained from Emery County for accesses to and from the public road.

(4) Required public notices concerning the operation have been posted in local newspapers for Permit Approvals, Permit Renewals and Permit Transfers.

3.2.11 Total Area for Surface Disturbance During the Permit Term

The total area of present surface disturbance at the Mine plan area, including all compliance activities (sediment pond, upper and lower culvert installation, borrow area, portal areas, and surface pad extension), is 10.39 acres (see Plate 3-1 in Volume 3). Other disturbed areas include the waste rock site area which covers 15.82 acres of disturbance (refer to Plate 4-1 in Volume 4

3.2.12 Detailed Construction Schedule

Construction of basic facilities was completed prior to the 1977 Act. Sediment controls, including the sediment pond, curb/gutter and bypass culverts were completed in late 1987. Minor system enhancements were completed from 1987 through the fall of 1990. Construction details and schedules for these projects are found in Appendices 7-13, 3-7, 3-8, 3-9 and 3-10 respectively.

3.3 OPERATION PLAN

During the operational phase of Trail Mountain, the mine employed a maximum of approximately 300 people to conduct its underground mining activities. Underground mining consisted of longwall retreat mining and continuous miner development. Production ranged from 3,500,000 to 5,000,000 tons per year. Coal was conveyed to the surface at approximately 16" x 0" run of mine product. It was then conveyed through an overland tube conveyor (demolished in September 2014) to the Cottonwood Mine Portal on the opposite canyon side. It then traveled underground until it reached the Cottonwood Mine Facility, where it was crushed to a 6" x 0" run of mine product before shipment via triple trailers to the Hunter Power Plant. Coal could also be crushed to 6" x 0" run of mine product at the existing Mine facilities and shipped via double trailers.

3.3.1 Mining Plans

The layout of the mine are shown on Plate 3-2. Historically, first and second mining occurred in the areas within the southern end of Trail Mountain. Those areas have been mined out and the leases have been relinquished backed to the federal agencies who manage the surface and subsurface resources.

3.3.1.1 Orientation and Multiple Seam Considerations

As shown on Plate 3-2, the original mains were driven north to south, with panels being driven off the mains in an east to west orientation. This mine layout was developed prior to the Act. Longwall section development was in an east to west orientation. Surface exploration drilling, along with geologic mapping, have been utilized to document the coal resources of the Trail Mountain area. (United States Department of the Interior. Memorandum Resource Recovery Report

March 25, 1982, states that the Hiawatha is the only coal seam of current economic interest known to occur in the vicinity of the Trail Mountain tract). Coal resources above the Hiawatha seam to date show the seams to be thin, discontinuous and of poor quality[1]. PacifiCorp had no plans to mine the upper coal seam (see Appendix 3-2).

3.3.1.2 Portals, Shafts, and Slopes

Portals have been previously addressed in the Surface Facilities section. Shafts and slopes do not apply to this property because of the geology of the coal seam.

3.3.1.3 Mining Methods – Continuous Miner and Longwall

No room and pillar mining is anticipated during the permit term. Longwall retreat mining with continuous miner development of mains, longwall panels and gate road development will be employed during the life of the mine.

Continuous Mining Unit

The principal purpose of continuous mining units at the Mine was mine development; i.e., section development of mainline entries, longwall sections - gate road development and longwall section - setup/bleeder entry development.

Figure 3-4 illustrates the basic configuration of a typical five entry main, consisting of 20 ft. wide entries and crosscuts driven on 80 ft. x 100 ft. pillar centers. The pillars created measure a nominal 60 ft. wide x 80 ft. long; a size which has been developed for sufficient support of the main entries and overlying strata.

Figure 3-4 also illustrates the basic configuration of a typical two-entry longwall panel development, consisting of 20 ft. wide entries and crosscuts driven on 50 ft. x 100 ft. pillar centers. Bleeder and setup development consists of 20 ft. wide entries and crosscuts on nominal 50 ft. x 100 ft. pillar centers. With the retreating longwall mining system, all panel development work is accomplished by continuous mining units prior to longwall equipment installation.

Longwall Mining System

The predominant mining method at the Trail Mountain Mine was longwall retreat mining. This method, as practiced by PacifiCorp, presents the safest and most efficient underground resource recovery mining method available. PacifiCorp notified the Division of temporary cessation of coal mining operations at the Trail Mountain Mine effective May 4, 2001and mining ceased as of March 15, 2001.

As referenced above, the two-entry gate road system is developed with 20 ft. wide entries and crosscuts on nominal 50 ft. x 100 ft. pillar centers. This type of "yield pillar" configuration is designed so that the gate road support pillars will gradually yield as longwall retreat proceeds from panel to panel. The purpose of this design is to prevent the buildup of unrelieved stresses within the pillar; stresses which, in the past have resulted in pillar failure and the accompanying danger to personnel and property.

Figure 3-5 illustrates the basic configuration of a retreating longwall system. After gate road entries are driven to the extent of the longwall panel length, on both sides of the longwall face, setup and bleeder entries are driven to connect the gate roads. A solid coal barrier is left between the setup and bleeder entries, sized based on geologic parameters, to insure long term bleeder stability.

Long wall face width, depending on geologic parameters of the coal deposit, varies from 500 ft. to 1000 ft. wide. Standard face width is 750 ft., from center-line of headgate entry to center-line setup entry, the longwall begins retreat mining; from the setup entry, "outby" toward the mainline entries. A protection barrier is left between the mined out longwall panel (extraction face) and the mainline entries; sized to insure long term mainline entry stability. Panels are designed within the mining area, bounded by natural and imposed limits with varying degrees of confidence as to location and extent. Lease boundaries are definitely located and invariable in the short term. Faults may vary somewhat from currently assumed locations. Geologic limitations; such as seam splits, channel scours, spars, stratigraphic thinning, etc. may affect the mining limits by varying hundreds of feet as information becomes available and as mining recovery economics and practicality are further refined. Underground burned areas, from a practical point of view, are indeterminate prior to mining. Regulatory mining restrictions, such as escarpment protection barriers and perennial stream buffer zones further confine the mining extent.

Within the limitation of the above boundaries, longwall panel length and width are maximized to the extent possible due to the economic cost and production loss associated with longwall moves. The minimum panel length, currently considered economical, is 1500 ft. of recoverable reserves. The minimum panel width, currently considered economical, is 500 ft. of recoverable reserve.

3.3.1.4 Projected Mine Development – Mains, Submains, Panels, Etc.

The plan of mine development projected for the Mine is shown in Plate 3-2.

After the mine acquisition, development of the fifth left mains and third west mains continued. The panels east of fifth left main were driven west to east and the panels west off the fifth left mains were driven east to west. Panel sequence for extraction was from second east to fifth east and tenth right to first right. The coal lease of these underground areas (with exception of 3rd West) were partially relinquished effective January 9, 2009.

3.3.1.5 Retreat Mining

Panel extraction commenced once the fifth left mains were developed below the second east panel and the second east tailgate, headgate and bleeders were completed. All coal leases containing panels off the 5th Left mains below 1st Right have been relinquished effective January 9, 2009.

3.3.1.6 Roof Control, Ventilation, Water Systems, Dust Suppression, Dewatering, Electrical, Etc.

Plans for roof control, ventilation, water system, dust suppression, etc., have been submitted to MSHA and are on file at the MSHA district office; Mine Safety and health Administration, P.O. Box 25367, Denver Colorado 80225.

3.3.2 Barrier Pillars

PacifiCorp left barrier pillars around oil and gas wells, surface structures and streams, property boundaries, and outcrops. These barriers will protect the recovery of the resource and the environment. A complete discussion of barrier pillars is presented in Chapter 12, Geotechnical.

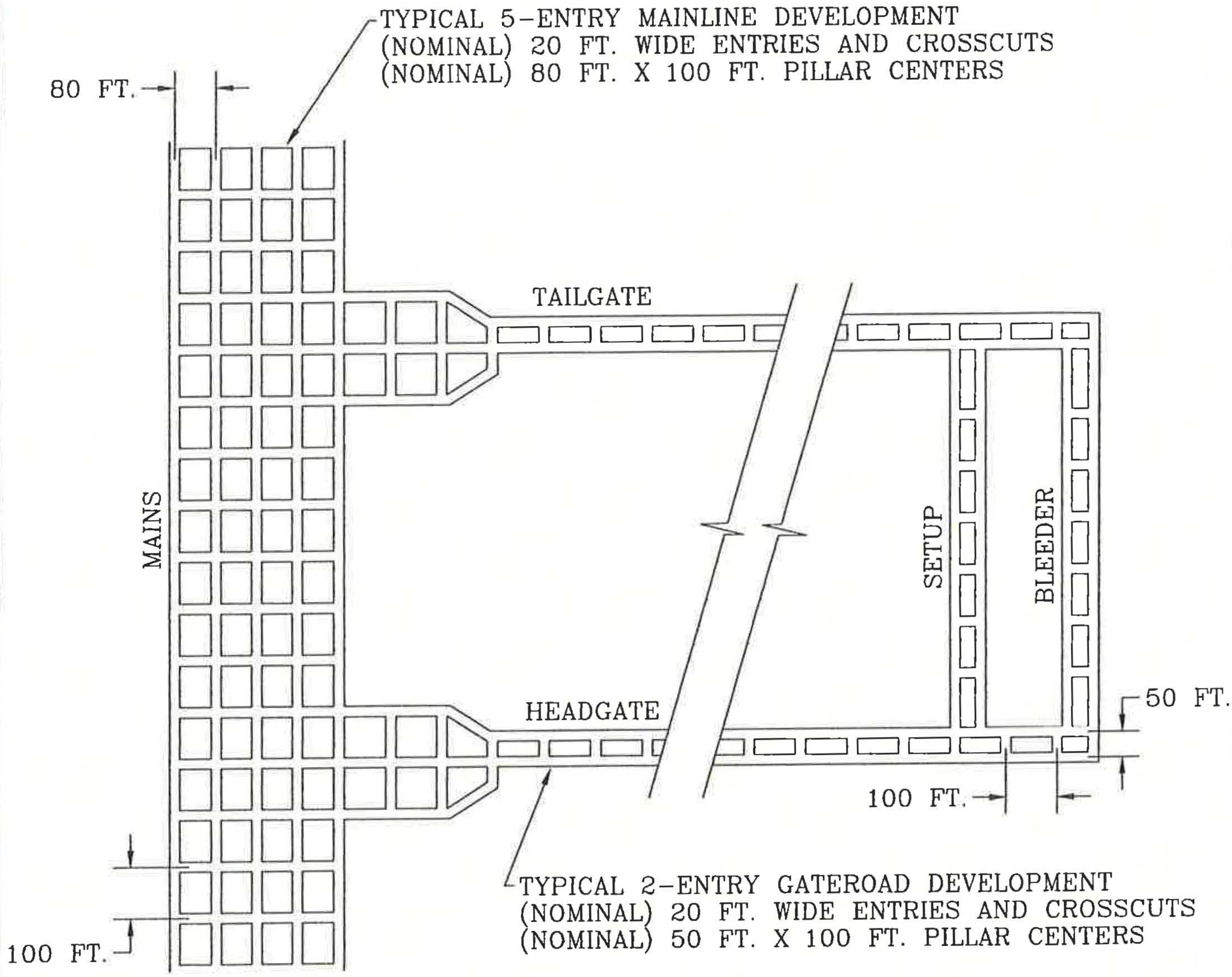

FIGURE 3-4
TYPICAL MAIN ENTRY AND PANEL DEVELOPMENT
AT THE TRAIL MOUNTAIN MINE

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TRAIL MOUNTAIN MINE
TYPICAL MAIN ENTRY AND PANEL DEVELOPMENT

DRAWN BY:	*K. LARSEN*	*FIGURE 3-4*	
SCALE:	*NONE*	DRAWING #:	
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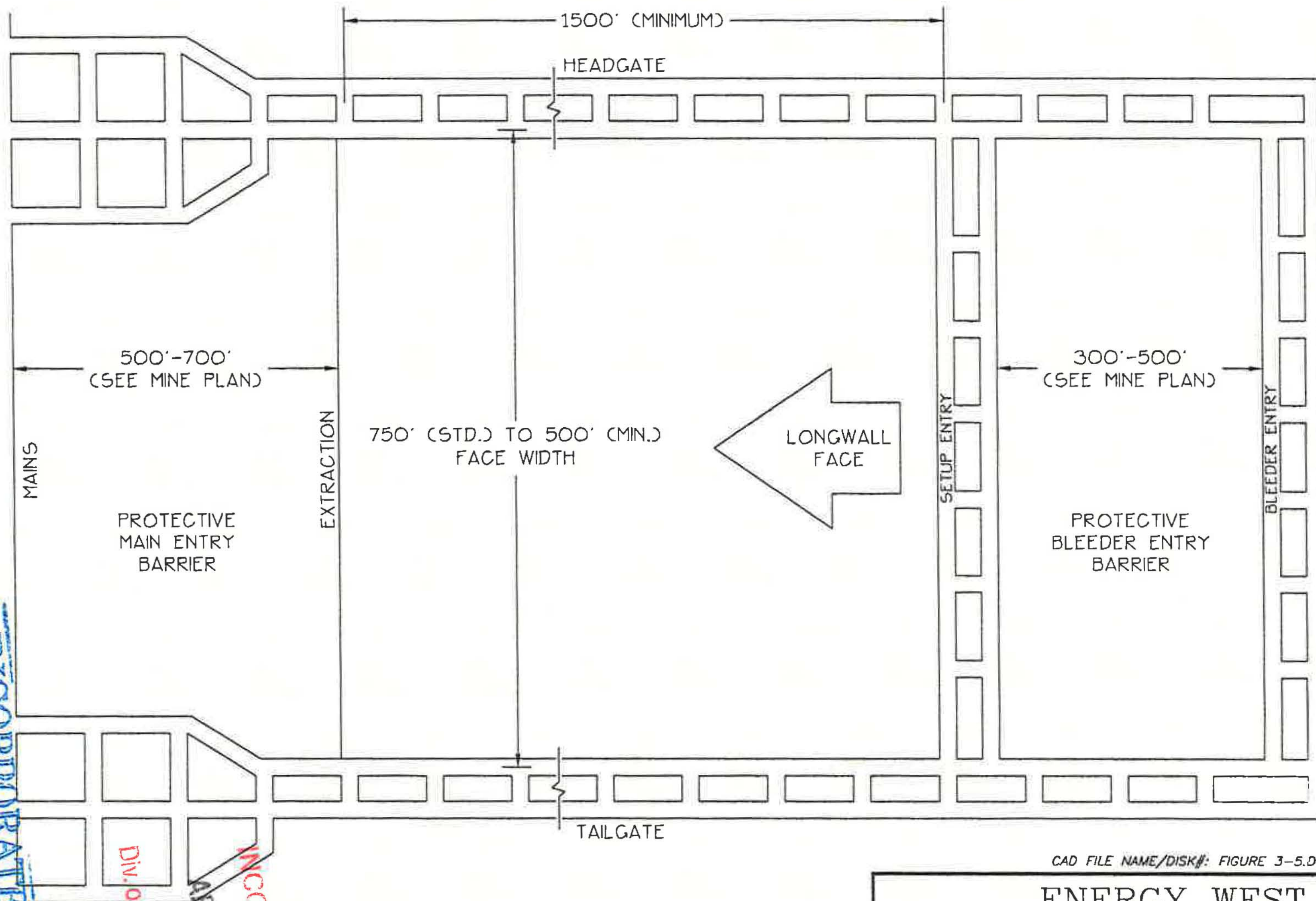

FIGURE 3-5

TYPICAL LONGWALL PANEL RETREAT AS USED AT THE TRAIL MOUNTAIN MINE

CAD FILE NAME/DISK#: FIGURE 3-5.DWG

ENERGY WEST
MINING COMPANY
HUNTINGTON, UTAH 84528

TRAIL MOUNTAIN MINE
TYPICAL LONGWALL PANEL RETREAT

DRAWN BY: K. LARSEN	FIGURE 3-5
SCALE: NONE	DRAWING #:
DATE: MAY 14 2001	SHEET 1 OF 1 REV.

3.3.2.1 Protection of Oil and Gas Wells

Presently no oil or gas wells exist in the areas of underground mining activities. However, should any well be drilled, a barrier of 300 feet in diameter will be left unless a variance from MSHA is obtained to leave a smaller barrier.

3.3.2.2 Protection of Surface Structures and Streams

No surface structures or perennial stream beds will be undermined during the life of the mine.

3.3.2.3 Boundaries

Lease, permit, and adjacent area boundaries are designated in accordance with both State and Federal mining regulations.

3.3.2.4 Outcrop Protection

Outcrop protection is provided by leaving a minimum barrier of 200' between mine workings and the coal outcrop. One exception to the above is the eastern most entry of the 3-entry system driven north and northeast to the ventilation portal. The eastern entry is located within the 200' barrier for a distance of approximately 240' and at no time comes closer than 160' from the outcrop. The 3-entries were necessary to meet MSHA regulations and provide adequate ventilation. The location of this variance is in the side canyon approximately 1700' south of the forth portal, and is shown on Figure A-3-7-2, Appendix 3-7. Outcrop protection is further addressed in the geotechnical chapter of this permit.

3.3.3 Conservation of Coal Resources

3.3.3.1 Projected Maximum Recovery

There is no recoverable coal from the historical (relinquished) Trail Mountain mine plan area. Table 3-1 shows the breakdown of coal recovery (refer to Plate 3-2: Mining Plan and Plate 3-3: Areas of Coal Recovery).

3.3.3.2 Justification of Non-Recovery

It is estimated that resource recovery rate of 80% or better can be obtained within the proposed longwall panels. Overall minable reserve recovery for the Trail Mountain Mine was estimated at 60%. The maximum amount of economically recoverable coal will be extracted with the exception of protective coal, which must be left in place to ensure the integrity of the mine. This protective coal falls into two categories. The two categories are barrier coal and strata control coal. (See Appendix 11-1).

3.3.3.3 Access to Future Reserves

There are two (2) areas currently designated as future reserve access points at the Mine: 1) 3rd West Mains and 2) North Mains.

Access to future western reserves will be by western extension of the existing 3rd West Mains, running east/west, at the northern boundary of Federal Lease U-64375. Access to future northern reserves will be by northern extension of the existing North Mains, running north/south, at the western boundary of Federal Lease U-49332. Solid coal barrier pillars are to be left on either side of these main entries to ensure their long term stability for access.

Mining plans and projections may change between permit submittal and actual mining. However, the permittee will commit to conducting operations in accordance with accepted industry practices, so as to achieve maximum economic recovery as specified by 43 CFR 3482.1 (c) (7). The permittee also commits to professional cooperation with the Bureau of Land Management (BLM) in achieving MER on all Federal Coal leases.

TABLE 3-1
RECOVERABLE RESERVES

LEASE AREA	IN-PLACE TONS	RECOVERABLE TONS	ACTUAL PRODUCED TONS By EWMC (as of 6/1/2001)	TOTAL PRODUCED TONS BY ALL
*Federal Lease UTU-49332	4,361,837	1,239,936	22,917	1,509,199
Federal Lease U-082996	276,954	56,718	0	219,755
**Federal Lease U-64375	45,404,832	433,363	21,508,007	21,938,730
TOTAL TONS	50,043,623	1,730,017	21,530,924	23,667,684
TOTAL REMAINING TONS		1,730,017		

*Partial relinquishment of 261.47 acres effective January 9, 2009.
**Partial relinquishment of 2504.01 acres effective January 9, 2009.

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3.3.4 Equipment Section

3.3.4.1 Surface Equipment

As stated previously, PacifiCorp notified the Division of temporary cessation of coal mining operations at the Trail Mountain Mine effective May 4, 2001. Coal mining at the Trail Mountain Mine ceased as of March 15, 2001. In preparation of temporary cessation, all surface equipment was transferred to remaining operations.

3.3.4.2 Underground Equipment

The permit area will be mined with longwall and continuous mining equipment. Typical continuous mining equipment is;

Continuous Miners	Shuttle Cars
Section Scoops	Roof Bolters
Feeder Breakers	Rock Dusters
Face Fans	Power Centers
Welders	Shop Car

Typical longwall mining equipment is;

Longwall Shearer	Power Center
Face Conveyor	Electrical Controls
Longwall Supports	Emulsion pumps
Stageloader	Shield Movers
Crusher	Pod Rock Duster
Scoop/Forklift	Shop Car

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Typical general mine equipment is;

Diesel Scoops	Conveyors
Diesel Trucks	Belt Storage
Diesel Pickups	Road Grader
Mantrips	Dozer
Trailers	Power Centers
Compressors	Section Switches
Welders	Submersible Pumps
Belt Drives	Rock Dusters

3.3.5 Mine Safety, Fire Protection, and Security

During mining operations, a safety department was maintained at the mine site. All new miners were trained in basic first aid before working underground. Once each year all miners were given an eight hour retraining class. All working sections maintained the necessary first aid items including stretchers, bandages, splints, tourniquets, etc. Fire protection-All machines underground are equipped with a fire suppression system. On portable non-water machines a dry-type chemical system is used. On machines equipped with water, a deluge system or a dry type chemical system is maintained. All belt drives and take-ups were equipped with these systems. An adequate supply of rock dust and a dry-type fire extinguisher were located at belt drives transformers, oil storage areas, and other dangerous areas in and around the mine.

Surface Fire Fighting Plan

In compliance with Title 30 Code of Federal Regulations Part 77.215(j) and R645-301-528.323.1 the following plan to extinguish surface fires and coal waste fires will be adhered to in the advent of a fire.

I. PREVENTION

A. All warning and non-smoking signs will be observed by employees and visitors to the mine.

B. Accumulations of oil, grease, diesel fuel, coal fines and other combustibles will not be allowed to accumulate as a possible source of fire.

C. Coal stock piles and coal waste piles will be closely monitored to detect symptoms of a possible fire.

D. All employees will be trained as to their responsibilities in the advent of a fire.

II. EXTINGUISHING SURFACE FIRES

A. In the advent of a fire on the surface area of the coal mine all employees both in the mine and on the surface will be notified immediately, all persons will be accounted for and evacuated to a safe place.

B. The local fire departments, mine rescue teams and other trained and qualified persons experienced in fighting fires will be notified immediately, equipped with the appropriate equipment, and the proper action will be taken to extinguish the fire.

C. Measures will be taken to prevent unauthorized persons interfering or being endangered by the fire and the methods to extinguish the fire.

D. All necessary controls available to prevent adverse impact on water quality and other environmental concerns will be incorporated immediately.

III. REPORTING PROCEDURES

A. All necessary reports and accident claims will be completed and filed with the appropriate state and/or federal agency.

3.3.5.1 Signs

Required signs are maintained at the Mine. Property boundary signs are posted along the access to the mine property and at the northern and southern property boundaries. Buffer zone signs are maintained on the west side of Cottonwood Creek (see Figure 3-6).

All signs will be maintained throughout the operational life of the facility, or at least as long as they are required and relevant. Permit ID signs and required perimeter markers will be maintained until bond release.

3.3.5.2 Fences and Gates

Approximately 2,000 feet of chain link fence, containing three access gates, is maintained at the Mine site. This chain link fence also serves to alienate the east boundaries of the surface disturbance of the mine plan area. Identification and perimeter signs are installed on the fence. Also, a substation is enclosed by a seven foot chain link fence with a three strand barb-wire cap and two gates.

3.3.5.3 Facilities – Coal Stockpiles, Refuse Piles, Coal Seams

Coal conveyed from the mine is transferred via a tube conveyor (demolished September 2014) to the Cottonwood Mine or to a 575-ton storage bin at the Mine. In the event of a system failure or if the bin is full, coal is diverted and stockpiled north of the bin. The size of this pile will vary greatly depending on conditions; however, extreme dimensions are approximately 300' by 150'. This pile is recovered by front-end loaders which place the coal back into the handling system going to the loadout bin. All runoff from the stockpile, as well as other coal handling facilities, is directed to the sediment pond. All conveyors are covered, and water sprays are used as necessary to reduce fugitive dust emissions. There are no refuse piles at this mine site. Any coal refuse or waste generated will be hauled to the approved Cottonwood/Wilberg Waste Rock disposal area.

3.3.5.4 Explosive – Storage and Handling

Storage - Explosives and caps are stored in separate MSHA approved explosive magazines. The magazines are of approved steel construction. The doors are so constructed to prevent easy access and tampering with the locking mechanisms. All magazines are properly electrically grounded. The magazines are located as required to provide added security. Locations of the magazines are shown on Plate 3-1.

Handling - All materials are transported in an approved boxes separated into two compartments with a divider. These boxes are then carried on trailers and diesel powered tractors.

Use - Explosives are primarily used underground. Underground explosives are used to blast rock to make room for overcasts, belt drives, and at other areas where extra height is required. Other uses underground include grading of roadways and to facilitate cleaning up of unintentional roof falls, etc.

When surface blasting is done it will be in accordance with the applicable R645-301-524 rules. Surface blasting will be done by a certified blaster under the Utah

TRAIL MOUNTAIN MINE
OWNER: PACIFICORP

201 SOUTH MAIN SUITE 2100
SALT LAKE CITY, UTAH 84140-0021
PHONE: 801-220-4612

UTAH PERMIT NO. C/015/009
U.P.D.E.S. PERMIT NO. UT-0023728

OPERATOR: ENERGY WEST MINING CO.

P.O. BOX 310
HUNTINGTON, UTAH 84528
PHONE: 435-687-9821

MSHA ID. NO. 42-01211

BUFFER ZONE
DO NOT DISTURB

PERIMETER
DO NOT DISTURB

INCORPORATED
EFFECTIVE:
JUL 11 2001
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INCORPORATED
APR 05 2011
Div. of Oil, Gas & Mining

CAD FILE NAME/DISK#: USERS\KJL\TRAIL\FIGURE\ID.DWG

ENERGY WEST
MINING COMPANY
HUNTINGTON, UTAH 84528

TRAIL MOUNTAIN MINE
IDENTIFICATION SIGNS

DRAWN BY: K. LARSEN	FIGURE 3-6		
SCALE: NONE	DRAWING #:		
DATE: MAY 4, 2001	SHEET 1 OF 1	REV.	

Blaster Certification Program. This certification will be carried by the blaster or kept on file during the blasting operations. At least one other person will be present during the blast. Proper training will be given to crews associated with the blast or explosive handling. The blast design will be prepared by a certified blaster and will be submitted to the Division at a time before the blast.

No blasts will utilize more than five (5) pounds of blasting agent or explosives detonated in any eight-millisecond period; therefore a pre-blast survey is not required.

When using explosives on the surface, all blasting will be done between sunrise and sunset. No residents are located within a half mile radius of the permit area. Blasting signs will meet R645-301-521.200 and be conspicuously placed along the edge of the blasting area or road entrance. Signs will be placed at all accessible entrances to the blasting area from public roads stating "Warning! Explosives in Use". Access control will be exercised preventing unauthorized access to the blasting area. No structures exist within a distance that would present concerns from air blast or ground vibration.

Blasting records will be kept on file for review by the Division. Blasting records will comply with R645-301-524.700. Exhibit 1 shows a typical report which will be compiled to satisfy these requirements.

Exhibit 1 Blasting Record

(R645-301-524.700)

(R645-301-524.711) Name of Operator Conducting Blast.

(Company ____________________ Name)

(Address) ____________________

(City - State) ____________________

(Telephone ____________________ Number)

(R645-301-524.712) Location, Date and Time of Blast.

(Mine) ____________________

(Location) ____________________

(Date) ____________________ (Time of Blast)

(R645-301-524.713) Name, Signature, and Certification Number of Blaster in Charge.

(Name) ____________________

(Signature) (Certification Number)

____

(R645-301-524.720) Direction and Distance, in feet from the nearest blast hole to the nearest dwelling, public building, school, church, community or institutional building outside the permit area.

(Direction) ____________________

(Distance in Feet) ____________________

(R645-301-524.730) Weather Conditions.

(Wind Direction & ______________________ Approximate Velocity)

(R645-301-524.741) Type of Material Blasted

(Material) ______________________

(R645-301-524.742) Sketchs of the blast pattern including number of holes, burden, spacing, decks, and delay pattern.

(R645-301-524.743) Diameter and Depth of Holes.

____

(R645-301-524.744) Types of Explosives Used.

____

(R645-301-524.745) Total Weight of Explosives Used.

____

(R645-301-524.746) Maximum Weight of Explosives Detonated in an Eight (8) Millisecond Period.

____

(R645-301-524.747) Initiation System.

____

(R645-301-524.748) Type and Length of Stemming.

____

(R645-301-524.749) Mats or Other Protection Used.

____

(R645-301-524.750) Seismographic Records and Airblast Information.

____

(Type of instrument, sensitivity, Certification of Calibration)

(Reading) ______________________________

(Location & ______________________________ Distance)

____

(Name of Person & Firm Analyzing Reading)

(R645-301-524.760) Reason for Unscheduled Blast

____

____

____

3.3.6 Operation Schedule

Trail Mountain Mine operated with longwalls and continuous miners for development of longwall panels and mains. The longwall operated two shifts a day or two machine shifts and the continuous miners operated two shifts a day or four machine shifts.

3.3.6.1 Annual Production Per Year for the Permit Term

The Trail Mountain Mine produced approximately 3,500,000 to 5,000,000 tons per year until notifying the Division of temporary cessation on May 4, 2001.

3.3.6.2 Operating Schedule – Days, Shifts

The Trail Mountain Mine operated as follows:

208-240 days/year
3 shifts/day
10 hours/shift
2 production shift/day
1 maintenance shift/day
2 continuous miner shifts/production shift
1 longwall shift/production shift

This schedule is a general outline and subject to change.

3.3.6.3 Operation Employment

During coal mining operations, Trail Mountain Mine employed approximately 300 people, 66 salaried and 234 hourly employees.

3.3.6.4 Temporary Cessation

Whenever it is known that operations are to be temporarily ceased for more than 30 days, the permittee shall submit to the Division a notice of intention to cease or abandon the operations, in accordance with R645-301-515.320 and to MSHA standards.

This notice will describe mitigation measures to be employed in accordance with the terms and conditions of the permit approval, such as a statement of the number of surface acres involved in the cessation, extent of sub-surface strata, prior reclamation efforts accomplished on the property, and identification of all backfilling, regarding, revegetation, environmental monitoring, underground opening closures and water treatment activities that will continue during the temporary cessation.

If underground openings are to remain inactive for a period greater than 90 days, such openings will be temporarily closed off from access. Such closures will consist of a chain link or other substantial wire mesh fabric fence placed over the portals to prevent public access while allowing for air flow. Locked gates may be installed in the portal to allow for mine inspection.

PacifiCorp notified the Division of temporary cessation of coal mining operations at the Trail Mountain Mine effective May 4, 2001. Coal mining at the Trail Mountain Mine ceased as of March 15, 2001. In preparation of temporary cessation, all mining equipment including; production (longwall and continuous miner), belt haulage and electrical were removed from the mine. Verification of equipment removal was conducted on April 6, 2001 with Bureau of Land

Management (Steve Falk) and Division of Oil, Gas and Mining (Pete Hess) participating in the review. A plan to construct permanent seals was submitted to and approved by Mine Safety Health Administration. Sealing of the mine portals was completed on May 1, 2001.

3.3.7 Mine Plan Area

The mine plan area of the Trail Mountain Mine is outlined in Plate 3-2. A total of 773.50 acres are included in the mine plan area.

3.3.7.1 Projected Mining By Year

The mine development and projected mining schedule are shown on Plate 3-2. As shown, additional permit terms will be required.

3.3.7.2 Acreage and Delineation

As described in Chapter II, the mine plan area consists of approximately 773.50 acres of fee and federal land. Federal land consists of three leases totaling 720.00 acres. The remainder of the mine plan area (53.50 acres) is fee land.

3.4 ENVIRONMENTAL PROTECTION

This section addresses the environmental concerns and impact of the mining operation. The aspects of land-use, cultural resources, hydrology, soils, vegetation, fish and wildlife, air quality, subsidence, and waste disposal are addressed. Each aspect is addressed in terms of projected impacts and control measures. For those aspects that warrant it (hydrology, vegetation, fish and wildlife, air quality, and subsidence) a discussion of monitoring procedures are also included.

3.4.1 Preservation of Land Use

The post-mining land-uses are anticipated to remain the same as the pre-mining land-uses of grazing, wildlife habitat and recreation. A full discussion of these uses area found in Chapter 4.

Following completion of the mining operations, the mine site will be reclaimed and revegetated. The area will be graded, scarified, and seeded before the next growing season. The seed mixtures to be used are discussed in Chapter 9 and Section 3.5 of this Chapter.
The site will receive treatments of fertilizer and additional seedings until it is determined stable for the bond release period.

During low run off, the stream diversion culvert will be removed and the stream channel will be restored. No reclamation work is contemplated on the access road to the site. This road has varied ownership (county, federal and private) and provides access for Forest Service and private land up Cottonwood Canyon.

Lands held by PacifiCorp are classified by Emery County, the US Forest Service, and the State of Utah as a recreation, forestry and mining area.

3.4.1.1 Projected Impacts of Mining on Current and Future Land Use

Within the permit area, approximately 10.39 acres has been disturbed by surface facilities of the mine. This disturbance has affected the soils and vegetation of the area. The effect on vegetation is temporary and will be eliminated by revegetation of the disturbed area. Wildlife loss of habitat in the riparian community has occurred. The acreage is small; however, the riparian area is considered to be of critical value to the overall density of terrestrial wildlife. Continued operation of the surface facilities will have no significant impact on the local wildlife. A full discussion can be found in Chapter 10. Discussion of the impact at the Waste Rock Disposal Site are found in Volume 4.

3.4.1.2 Control Measures to Mitigate Impacts

Careful planning of the reclamation activities will help to minimize the impact of the Mine on land-use. Return of the mine site to the premining land-use of grazing, wildlife, and recreation at the conclusion of mining will be accomplished according to the steps outlined below:

1) Seal all large diameter openings with non-combustible material.
2) Remove all surface structures, equipment and facilities, followed by trash and debris removal.
3) Re-establishment of drainages and grading and contouring of disturbed areas.
4) Establishment of a permanent diverse vegetative cover suited to the post-mining land-use on all affected land will be done as soon as practicable following reclamation.

Contemporaneous reclamation of those areas not needed during operation will take place throughout the life of the mine. All other areas (building and equipment sites, storage and parking areas) will not be reclaimed until the conclusion of mining.

3.4.2 Protection of Cultural Resources

No public parks or historical sites worthy of preservation have been found in the mine plan area. Chapter 5 contains a discussion of cultural resources.

3.4.2.1 Projected Impacts of Mining on Cultural Resources

Two types of projected impacts exist on cultural resources as a result of mining. Direct impacts are a direct result of mine development or operation. Indirect impacts result from activities that are not directly associated with the mine development or operation.

Any effect of the Trail Mountain Mine on cultural resources probably occurred during development. No cultural resources have been found in the area of the mine, therefore no direct impacts from any future development are likely to occur.

The inventory indicated two CRRS:2 sites located in the lower canyon. These sites are vulnerable to indirect impact from vandalism. During development of the canyon road by Emery County, measures to avoid impact were observed.

3.4.2.2 Control Measures to Mitigate Impacts

Measures used to mitigate the effects of the mining operation on cultural resources were implemented prior to any disturbance associated with the development. Once construction began, only avoidance procedures were the only feasible mitigation measures.

During 1985 and 1986, the proposed construction and realignment of three miles of county road from Highway 29 to the Trail Mountain Mine site was completed. Two CRRS: sites were located and all engineer and design work conducted by the Emery County Engineering departments was done in such a manner as to avoid these cultural sites.

In 1990, additional facilities were constructed at the mine site. Construction details, as well as control measures to mitigate impacts for each of these projects are described in Appendices 7-13, 3-9, 3-7, 3-8, 3-9 and 3-10 respectively.

The Mine site contains no know cultural resources that are liable to be impacted by the continued operation or compliance construction.

3.4.3 Protection of Hydrologic Balance

The Mine operates all mine activities in such a way as to minimize potential impacts to surface and groundwater resources. Drainage control facilities will contain and hold the required volume for the specified period for water flowing through or originating in the disturbed area. Suspended material will be allowed to settle in a sediment control pond before discharge into natural drainages. Such discharges will be in accordance with an approved UPDES Discharge Permit.

The protection of the hydrologic resources at the waste rock site are discussed in Volume 4.

Sedimentation production from the berm outslope to the creek has been greatly reduced by a portion of the creek being placed in a bypass culvert. This bypass culvert was installed in 1983, and extended some 300' to the north in 1990 and 70' further north in 1996.

All mine portals are designed in accordance with R645-301-731.521. This ensures that water will not discharge from the portal by gravity flow. Upon reclamation of the mine, portal seals will be placed in all entries as soon as underground reclamation has been completed. PacifiCorp notified the Division of temporary cessation of coal mining operations at the Trail Mountain Mine effective May 4, 2001. Coal mining at the Trail Mountain Mine ceased as of March 16, 2001. In preparation of temporary cessation, all mining equipment including; production (longwall and continuous miner), belt haulage and electrical were removed from the mine. Verification of equipment removal was conducted on April 6, 2001 with Bureau of Land Management (Steve Falk) and Division of Oil, Gas and Mining (Pete Hess) participating in the review. A plan to construct permanent seals was submitted to and approved by Mine Safety Health Administration. Sealing of the mine portals was completed on May 1, 2001.

3.4.3.1 Projected Impacts of Mining on the Groundwater Hydrologic Balance

Geology controls movement of groundwater. Because of the low permeability of the consolidated sedimentary rocks in the Trail Mountain area, groundwater is primarily through fractures. Data has been collected from numerous coal exploration drill holes, from within the mine workings, from surface drainages, and from spring surveys. The data have identified two separate isolated aquifer systems within the vicinity of the mine; the first is localized perched water tables in the North Horn Formation, and the second is a combination of localized perched water tables in the Blackhawk Formation and the Starpoint Sandstone which exhibits some limited potential as a regional aquifer. The generally discontinuous nature of the Blackhawk and apparent low specific yield (Cordova, 1964) indicates that the water yielding capabilities of the Blackhawk are only of local importance. A complete description of the hydrologic/geologic resources of the Trail Mountain area is discussed in Chapter 7, section 7.1, and Appendix 7-10 (PHC).

Groundwater Quantity

Mining occurs in the lower Blackhawk Formation, which consists of interbedded layers of sandstone and mudstone separated by mineable and non-minable coal seams. The sandstone beds-fluvial channel systems are generally massive while the mudstone layers are fine textured and have a tendency to swell when wet and decompose into an impervious clay. Because of the aquiclude formed by mudstone layers in the North Horn Formation, recharge to the Blackhawk Formation is limited, even along major fault systems. Due to the lithologic characteristics of the Blackhawk, both vertical and horizontal migration is constricted. Refer to Chapter 7, Hydrology, for a detailed discussion of the Hydrologic Balance.

The interception of groundwater varies and is dependent on several factors. One of the moist significant is that when the mine enters virgin country, a significant amount of water is liberated. In virtually all cases the amount of water which flows into the mine exceeds the recharge and, in time, the water inflow decreases in volume. If new areas are not mined, the discharge from the mine will decrease accordingly.

Ground Water Quality

Groundwater chemical quality is very good in strata above the Mancos Shale. The USGS reports a range in dissolved solids from 50 to 750 mg/l for samples from 140 springs in the region issuing from the Starpoint Sandstone and overlying formations (Danielson et al., 1981). Danielson et al. (1981) identified the regional trends of decreasing water quality from north to south and west to east across the Wasatch Plateau. Waters percolation through the underlying mancos Shale quickly deteriorate, with total dissolved solids concentrations frequently exceeding 3000 mg/l.

The quality also decreases vertically because of the influence of marine sediments along with the trend of decreasing quality from north to south. The predominant dissolved chemical constituents of the groundwater from both surface springs and samples collected in the mine are calcium, bicarbonate, magnesium and sulfate. Concentrations of magnesium are normally about one-half the concentration of calcium. Sulfate concentrations are typically higher in water from springs issuing from the

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Starpoint-Blackhawk aquifer zone or confined aquifers intersected by mine workings. As mentioned earlier water quality degrades from the north to the south and also vertically.

3.4.3.2 Control Measures to Mitigate Impacts

Although the analysis of the overburden samples tested has shown that no toxic or hazardous materials are present, groundwater quality will be protected by handling earth materials and runoff in a manner that minimizes infiltration to the groundwater system. Mine water encountered in the mine, which is not needed for dust suppression or mining, will be discharged according to stipulations in UPDES Permit No. UT- 0023728.

State and federal regulations (R645-301-727) require that an alternate water supply be provided to replace any water source disrupted, degraded, or diminished by the mining operation. Though the mining operation is unlikely to affect the water supplies in the Trail Mountain area, the permittee will provide this alternate supply if needed.

In the unlikely event of mining adversely affecting a water source, the permittee will review and select an alternative after considering all possibilities of each site-specific circumstance.

3.4.3.3 Groundwater Monitoring Plan

Representative springs (see Chapter 7) will be monitored in accordance with the monitoring program. In addition, data will be collected from within the mine.

3.4.3.4 Projected Impacts of Mining on the Surface Water Hydrologic Balance

As has been previously mentioned, the occurrence and quality of water in any region is highly controlled by geology. The Permittee's adjacent and permit area is located in the headwater region of the San Rafael River Basin. The surface drainage system of the permit area is within the Cottonwood Creek drainage system.

Quantity

Cottonwood Creek above Straight Canyon drains approximately 21.9 square miles. The average channel gradient of Cottonwood Creek above Straight Canyon is 300 feet/mile (5.7 percent). Only a short period of record (October 1978 to present is available for the USGS stream gaging station (09324200) on Cottonwood Creek above Straight Canyon. Danielson et al. (1981) estimate the average annual precipitation to be on the order of twenty two (22) inches, or 26,000 acre-feet, on the Cottonwood Creek drainage above Straight Canyon. Danielson et al. (1981) also estimate that only two percent of the precipitation on Cottonwood Creek above Straight Canyon leaves the basin as stream flow compared to thirty percent for Huntington Creek above Huntington. The suggested reasons for the wide difference in percent of precipitation contributing to stream flow are: 1) Cottonwood Creek Basin has a greater portion of area with southern exposure with more gradual slopes than Huntington Creek Basin and 2) possible subsurface movement of water through fractures associated with Joe's Valley Fault. About seventy percent of the total discharge at the Cottonwood Creek station above Straight Canyon for the water year 1979 occurred during the snow melt period (April-July).

Sixty years of data are available for the gaging station on Cottonwood Creek near Orangeville (9324500). The drainage area above Orangeville contributing to Cottonwood Creek is approximately 208 square miles. Cottonwood Creek has an average discharge near Orangeville of about ninety-five (95) cfs, or 69,000 acre-feet per year. The maximum and minimum discharges of record on Cottonwood Creek near Orangeville are 7,220 cfs (August 1, 1964) and 1.2 cfs (April 8, 1966), respectively.

The mine adjacent and permit area is drained by minor drainage systems associated with Cottonwood Canyon Creek. Cottonwood Canyon Creek is a major drainage system which borders the eastern limit of the mine plan area. Based on data collected by PacifiCorp, (see 1992 Annual Hydrologic Report) Cottonwood Canyon Creek is an ephemeral stream from its headwaters to the northeast quarter of Section 24 Township 17 South, Range 6 East and intermittent from that point to its confluence with Cottonwood Creek at Straight Canyon. During periods of drought, flow in Cottonwood Canyon Creek is limited to flow emanating from the alluvial deposits at the intersection with Roans Canyon. From the intersection with Roans Canyon to Section 36 the stream loses water to alluvial deposits. The drainage is dry from Section 36 to Section 6 except during spring runoff which normally occurs from late April through June or during precipitation events. Flow in the channel re-emerges in Section 6 and continues to the confluence with Cottonwood Canyon at Straight Canyon.

The quality of flow from the headwaters of the San Raffle River Basin is excellent. However, this quality rapidly deteriorates downstream as streams cross shale formations and receive irrigation return flow from Mancos-derived soils. The impact of the mining on this system will be quite limited.

The existence of runoff and sediment control structures should minimize the potential for degradation of the quality of stream waters due to runoff from disturbed areas of the Mine. The construction and upgrading of surface facilities utilized in conjunction with the Mine (yard areas, road, etc.) may result in temporary increases in the suspended sediment concentration of the adjacent stream. However, because of the regulatory requirement that sediment control be provided for all areas of surface disturbance, concentrations should be quickly normalized.

3.4.3.5 Mitigation and Control Plans

Runoff from all disturbed areas will be passed through sediment control facilities, as discussed earlier in this report. Any discharge from facilities will be monitored in accordance with UPDES permit standards and state and federal regulations.

The effects of the mining operation on the surface water system will be analyzed through the surface water monitoring plan described in Chapter 7. In the unlikely event that monitoring shows that the surface water system is being adversely affected by mining activities, additional steps will be taken to rectify the situation in consultation with state and federal regulatory agencies.

3.4.3.6 Surface Water Monitoring Plan

An ongoing hydrologic monitoring program will be conducted at each of the stations shown in Figure 7-9. Stations have been established to monitor water quality and quantity above and below the mine plan area.

3.4.4 Preservation of Soil Resources

The Mine site is a previously disturbed site. Topsoil resources were not protected during development activities from 1948 to 1967. A small amount of topsoil has been removed and stockpiled from the more recent channel/culvert construction. In the event of any future disturbances, soil resources will be protected. Protection will involve the removal, stockpiling and stabilizing of soils suitable for reclamation. Suitability will be determined by analyses of soil samples.

3.4.4.1 Projected Impacts of Mining on Soil Resources

Little soil exists on the presently disturbed mine site. What soil existed prior to commencement of mining activities has long been buried by construction of the pads and buildings.

A small pile of topsoil has been stored just northwest of the fan portal area. This material was salvaged prior to the recent installation of the 48" culvert in the side canyon. The topsoil pile has been marked and reseeded according to requirements.

The remaining surficial materials are being compacted and mixed with crushed coal and coal fines. Operation and maintenance of equipment contributes oil, gasoline and diesel fuel to the soil in some places.

3.4.4.2 Control Measures to Mitigate Impacts

As only limited amounts of soil remain on the disturbed site due to previous disturbance and no further disturbances are proposed, few, if any, mitigation measures can be implemented.

In the event future disturbances of operations uncover or encounter salvageable soils, the permittee will remove, stockpile and stabilize the soils for use in future reclamation work.

Testing is planned to determine if the surficial materials can be used for revegetation work. Historic plots were set up on the mine site in cooperation with the regulatory agency to determine the feasibility of using the existing material for revegetation.

In 1984, a test plot area was installed just north of the bathhouse at the Trail Mountain Mine site. For a complete description of this test plot and record of yearly sampling, please refer to Chapter 9.

3.4.5 Protection of Vegetative Resources

The mine site was disturbed during development activities from 1948-1967. As such no vegetative protection activities were implemented during development of the mine site. Future disturbances will require verification that threatened and endangered species do not exist on the area of proposed disturbance. If any threatened and endangered species are found, the appropriate authorities will be contacted.

3.4.5.1 Projected Impacts of Mining on Vegetative Resources

The mine has been in existence since 1948 and development work since that time has removed or covered vegetative resources. Impact has been to portions of the riparian and grassland-shrub communities. The extent of impact is not great due to the limited areal extent of the disturbance.

3.4.5.2 Mitigating Measures to be Employed to Reduce Impacts to Vegetative Resources

As previously mentioned, the mine site was disturbed during development activities for 1948-1967. Disturbance of the vegetative resources has already occurred. Any further disturbance will require the verification that threatened and endangered species do not exist on the proposed site. If any threatened and endangered species are found, the appropriate authorities will be contacted.

3.4.5.3 Monitoring Procedures – Reference Areas and Revegetation

Revegetation of the disturbed area will be undertaken following the completion of the mining activities. Success of the revegetation activities will be determined yearly through quantitative and qualitative data. The vegetation test plot methods and design that were used are described in Chapter 9.

3.4.6 Protection of Fish and Wildlife

The presence of wildlife in the mine plan area indicates their adaptability to the impacts of the mine. As a result, the overall impacts to wildlife are expected to be very minor. In addition, the permittee is committed to practical mitigation of adverse effects of construction and maintenance of the mine operation.

3.4.6.1 Projected Impacts of Mining on Fish and Wildlife

The known impacts of mining on fish and wildlife resources are many and varied according to the type, location, and age of the mine and technology used to remove the coal. Additionally the floral and faunal components in the mining area determine the resultant impact. It is desirable that environmental protection be accomplished during all aspects of the life of the mine from construction through final reclamation, but the degree of environmental protection is often difficult to determine. This is particularly true in cases where mining operations have been functioning for many years prior to serious environmental awareness and new improved standards of protection. Such mining operations do not have the benefit of modern sites, design, construction, and technology and have often already impacted the environmental resources such that continued operation will not be a serious additional consequence.

Continued operation of Mine will continue to have the same effect on the fish and wildlife resources in the area; therefore consideration of these affects is warranted. Reclamation also needs to be considered since discontinuation of the operation would potentially facilitate a return of the habitat to its "normal state". The impacts of concern that have and could result in perturbations to the environment and ultimately relate to the stability of fish and wildlife in the area of concern are directly related to: (1) surface disturbance, (2) loss of habitat, (3) noise and (4) human activity. Both aquatic and terrestrial habitats are of concern since the portals, loading facilities and haul roads occupy riparian habitat adjacent to a small stream, and the mine underlies a variety of terrestrial communities that are considered of high interest to various management agencies because these species are of economic or recreational value.

3.4.6.2 Mitigating Measures to be Employed to Protect Fish and Wildlife

The permittee will perform the following mitigation measures in order to minimize disturbances and impacts on wildlife and their habitats that could be impacted during continued operation of the mine. The mitigating measures will meet the requirements of R645-301-322 and will be consistent with the performance standards of R645-301-358.

The permittee will make significant efforts to educate all employees associated with their on-site mine operation to the intricate values of the wildlife resources within the mine plan permit and adjacent areas. High interest species, critical habitats and critical life history periods will be emphasized.

The company will maintain the relative inaccessibility of the mine plan area.

Discharge of firearms by employees will be prohibited on company controlled property during working hours.

In winter a portion of the mine plan area, particularly the canyon bottom along the stream and haul and access road is inhabited by mule deer, and the potential is present for road strikes and harassment when the animals are in a weakened energy state due to snow and cold. These impacts need to be reduced. Drivers will be informed of the concerns for protection of wildlife, and encouraged to reduce speed in the canyon between November 1 and May 15 when mule deer are abundant.

The permittee will take precautions to keep all forms of coal or other sediments generated by operation of the mine from inadvertently entering the stream.

Since the major area of concern in introduction of sediments into the stream is the portal and load-out facilities immediately adjacent to the stream, the company has put the stream into a bypass culvert. This will prevent sediment input. This was done in consultation with the appropriate management agency to alleviate the problem. The main canyon culvert was extended approximately 300' upstream in late 1990. This extension impacted approximately 0.21 acres of riparian habitat. As mitigation for this removal of riparian area, 20 small rock check dams were installed in the lower portion of Cottonwood Creek to enhance water retention and possible fish survival. This mitigation was performed in accordance with approval from DWR. Details on location and installation of these structures (as well as the culvert extension) are found in Appendix 7-13 of this MRP. All wildlife habitats will be maintained or improved if disturbed. This will be done by using native or other vegetation approved for reclamation or habitat improvement. No new actions will be undertaken that compromise wildlife or their use areas without prior approval by the appropriate management or regulatory agency.

3.4.6.3 Monitoring Procedures

There are few species that will be seriously impacted by the proposed actions. There are no identified active aeries being occupied by high interest species of raptors, nor any readily accessible reproductive sites for game species that are critical to perpetuation of the species. However, should raptors, moose or any threatened or endangered species subsequently move into or be found in the mine plan area, appropriate UDOGM, UDWR and USWS personnel will be notified and mutually agreed upon monitoring instituted.

The mitigation action planned is such that it will require little to no monitoring, but enforcement by company officials and management or law enforcement personnel will be necessary. An exception might be the activities planned to reduce sediment loads in the stream. This is covered by the surface water monitoring program.

3.4.7 Protection of Air Quality

3.4.7.1 Projected Impacts of Mining Operations on Air Quality

The mining operation has some effect on the air quality of Cottonwood Canyon. Dust production by the mining operation is the main contribution. The areas that are the highest producers of dust are coal haulage down canyon from the mine, coal handling, and surface winds over the disturbed area.

3.4.7.2 Mitigating Measures to be Employed to Control Air Quality

Several practices are incorporated in the operations of the mine to protect the air quality in the mine vicinity. Protection of the air quality is mainly accomplished by reduction of dust production by the mine operations. Practices used to reduce dust production are:

1) Periodic watering, scraping, and compaction of coal loading area and paving of the coal haulage road.
2) Wetting of coal during handling activities.
3) Keeping the size of the disturbed area to a minimum.
4) Revegetation of disturbed areas as soon as practicable.

3.4.7.3 Air Quality Monitoring Plans

Plans to monitor the air quality in the vicinity of the Mine have not been considered or incorporated in the mining and reclamation plan. The effect on air quality by the mine will be minimal due to the limited area and the mitigation measures incorporated in the operation.

3.4.8 Subsidence Control Plan

The subsidence monitoring requirements were first imposed by the 211 US Geological Survey regulations. Later with the formation of the Office of Surface Mining and the realignment of the USGS responsibilities subsidence monitoring became the authority of OSM. Chapter 11 describes in detail the Applicant's plan to ensure minimal environmental impacts from mine induced subsidence.

3.4.8.1 Projected Subsidence Effects

Several surveys have been conducted over the area presently controlled by PacifiCorp which may be affected by mining operations. Timber, wildlife, grazing areas, water seeps and springs are the renewable resources occurring within the permit and adjacent areas. There are no oil and gas wells, pipelines, utility structures or high power lines that will be affected by any surface subsidence within the permit boundary and adjacent areas. No buildings or dwellings have been constructed on any surface that will be subject to subsidence within the mine plan area. Timber growth and wildlife should not be affected as regional subsidence is anticipated rather than cracking the surface due to the thickness of overburden. Seeps and springs within mine permit and adjacent areas have been surveyed and are currently being monitored (refer to Chapter 7 - Hydrology, for a description of groundwater resources and monitoring).

3.4.8.2 Control Measures to Mitigate Impacts

Should material damage be incurred by any structure despite the planned subsidence damage prevention measures, the applicant will repair the damage caused by subsidence resulting from the applicant's activities or will compensate the owner of the structure for such damage.

Any roads, fences, stock ponds, earth dams, or water troughs which are materially damaged by subsidence will be repaired and regraded to restore them to their pre-subsidence usefulness.

Should significant subsidence impacts occur, the applicant will restore, those surface lands that were reduced in reasonably foreseeable use as a result of such subsidence to a condition capable of supporting reasonably foreseeable uses that such lands were capable of supporting before subsidence.

In order to restore any land affected by Applicant's mining operations to a condition capable of supporting the current and postmining land uses stated herein, the Applicant will replace water determined to have been lost or adversely affected as a result of Applicant's mining operations if such loss or adverse impact occurs prior to lease relinquishment. The water will be replaced from an alternate source in sufficient quantity and quality to maintain the current and postmining land uses as stated herein.

During the course of regular monitoring activities required by the permit, or as the Applicant otherwise acquires knowledge, the Applicant will advise the Division of the loss or adverse occurrence discussed above, within ten working days of having determined that it has occurred. Within ten working days after the Division notifies Applicant in writing, that it has determined that the water loss is the result of the Applicant's mining operation, the Applicant will meet with the Division to determine if a plan for replacement is necessary and, if so, establish a schedule for submittal of a plan to replace the affected water. Upon acceptance of the plan by the Division, the plan shall be implemented. Applicant reserves the right to appeal the Division's water loss determinations as well as the proposed plan and schedule for water replacement as provided by Utah Code Ann. 40-10-22(3)(a).

PUBLIC NOTICE

Applicant will not mine in any areas that would allow potential subsidence effects (as indicated by the angle of draw) to affect any area outside of the lease, and permit boundary until this constraint on coal recovery is resolved by the OSM and the BLM Branch of Solid Minerals or permission is granted by the adjacent surface agencies.

A mining schedule which details the area in which mining is to take place and the planned date of the mining activity will be submitted to the affected surface owners, following approval of the application and prior to mining.

3.4.8.3 Subsidence Monitoring

The subsidence monitoring at Trail Mountain Mine prior to PacifiCorp's acquisition (November 1992) was conducted using conventional surveying methods. Nowhere did monitoring identify subsidence greater than a few tenths of feet. PacifiCorp used aerial photogrammetric survey methods and annual helicopter reconnaissance flights to monitor subsidence. Baseline photography was conducted August 6, 1993 including color infrared (See Chapter 11 for details on subsidence monitoring.)

3.4.8.4 Slides and Other Damage

At any time a slide occurs which may have a potential adverse effect on public property, health, safety or the environment, the permittee shall notify the Division by the fastest available means and comply with remedial measures required by the Division.

3.4.9 Waste Disposal

The permittee has contracted with local firms to handle and remove all non-coal wastes from the mine site. Non-coal wastes and materials that constitute a potential fire hazard are hauled by a licensed contractor to a state approved waste disposal area.

Waste oil is collected in drums in a designated storage area at the site. A licensed contractor will pick up this material on a regular basis and remove it for recycling purposes.

It should be noted that during a spoils survey, it was pointed out that there was no evidence of toxic materials at this mine site (Mr. George Cook, SCS). Prior to reclamation, all spoil material will be re-sampled in a comprehensive random method and retested in accordance to UDOGM guidelines for acid and/or toxic forming potential. Sampling will be conducted per Appendix 9-1, Attachment C.

Sediment pond waste is removed from the site and disposed of in the Cottonwood/Wilberg Waste Rock Site in accordance with the Division's "Sediment Pond Clean out Procedural Guidelines". The Division will be notified and procedures will be approved prior to the start of pond cleaning activities. Previous analyses of this material have shown it to be non-toxic and non-acid forming. The sediment material will be sampled and tested according to Division "Title V Coal, Program Policy for Disposal of Sediment Pond Waste".

Underground development waste is kept underground as allowed by MSHA regulations. In the event this material must be brought out of the mine, it will be hauled to the Cottonwood/Wilberg Waste Rock Site and disposed of in an approved manner.

There are no coal washing facilities at this mine site; therefore, there are no refuse or other permanent waste piles located at the Mine. The waste rock temporary storage area is shown on Plate 3-1.

3.5 RECLAMATION PLAN

Reclamation of the Mine site will be accomplished in an efficient and environmentally sound manner. This section addresses the reclamation plans for the site. Seven areas are addressed: contemporaneous reclamation, soil removal and storage, final abandonment, backfilling and grading, revegetation, reclamation schedule, and reclamation cost estimate.

3.5.1 Contemporaneous Reclamation

The mine disturbs only a minimal area for surface facilities. Most of the disturbed area will be needed for operations during the life of the mine. Those areas not needed (outslopes, embankments, etc.) will be prepared, seeded with quick growing species and mulched to provide protection and cover to reduce erosion. (See following section, "Contemporaneous Reclamation Plan for Mine" and Plate 3-7 for location of contemporaneous reclamation.)

CONTEMPORANEOUS RECLAMATION PLAN FOR MINE

PLANTING DATES - Seeding will normally occur in October or November of the year, depending on climatic conditions at that time. This will allow little chance of premature germination, increase the likelihood of hibernation (or inactivity) of most seed predators and will allow seed emergence in early spring when moisture conditions are most favorable.

PLANT SPECIES - Plant species used for temporary, contemporaneous reclamation with their respective justifications are listed below:

> Agropyron dasystachyum --Thickspike Wheatgrass-- This grass species was chosen for its on-site adaptability of these climatic patterns, high salt tolerance, sod forming characteristics and rapid establishment capabilities.
>
> Oryzopsis hymenoides--Indian Rice grass-- This grass species has excellent success on spoils establishment and has moderate salt tolerance qualities.
>
> Astragalus cicer--Silklepod Milkvetch--This forb will be planted because it is sod forming, nitrogen fixing, has moderate salinity adaptation, has establishment qualities and for aesthetics values.

Melilotus officinalis--Yellow Sweetclover-- This species is an introduced forb that establishes readily on severe disturbed sites. It is also a nitrogen fixing plant that has high affinity for salt tolerance.

No shrub or tree species are included in the seed mix for contemporaneous reclamation.

SEEDING METHODS - Slopes less than 20% will be drill seeded, or seeded by hydro seeder or hand broadcast methods. Slopes greater than 20 % will be seeded by hydro seeder or hand broadcasting.

MULCH - Hydro seeded areas will be sprayed with a wood fiber mulch. Since this is temporary reclamation the application of mulch will be optional on areas of drill seeding or seeded by hand broadcasting.

FERTILIZATION - Contemporaneous reclaimed areas will be visually checked on a yearly basis to determine success. Qualitative observations of interim or contemporaneous revegetation will be submitted in the annual report. An appropriate fertilizer will be applied if it appears necessary to increase plant vigor or to obtain the desired cover.

FUTURE CONTEMPORANEOUS RECLAMATION - If additional areas are disturbed or, if current disturbed areas become idle, contemporaneous reclamation procedures (as described above) will be implemented pursuant to R645-301-352.

*Note: seeding rates of species will be in equal proportions totaling 52 PLS per square foot, with not more than 20 PLS per square foot of any one species.

3.5.2 Soil Removal and Storage

The mine was operational before the 1979 State Act or the 1977 Federal Act. Having been constructed prior to the requirement to save and stockpile topsoil, the soils on the site were used in construction of the roads and pads.

A post-law borrow pit was utilized on site to obtain fill material for the 66" culvert for Cottonwood Creek. Topsoil was salvaged from the pit area, and is stockpiled in a protected area just northwest of the intake portal for the mine. The pile has been revegetated, and is further protected by installation of a silt fence around the bottom end.

No additional area is planned <u>for disturbance</u>, therefore, it is unlikely that any topsoil will be encountered. However, if in the future, during upgrading operations or facility modifications, any salvageable topsoil is found, it will be tested in accordance with the "UDOGM Guidelines for Management of Topsoil and Overburden, Table 1", and if found satisfactory, will be saved and stockpiled in a location acceptable to the regulatory authority.

3.5.3 Final Abandonment

Upon final abandonment of the mining operation, the mine portals and openings will be sealed, the structures removed, and the drainages restored. More detailed description of the procedures to be followed will be found in the following sections. Unmined recoverable coal reserves will be protected in accordance with 43 CFR 3482.1 (c) (3) (IV). Prior to the abandonment of any part of the Mine, the permittee will get approval from authorized officers of the BLM.

The following table list the machinery abandoned at the Trail Mountain Mine.

LEASE #	LOCATION	TYPE OF EQUIPMENT	BUREAU OF LAND MANAGEMENT APPROVAL DATE
UTU-64375 (Partial relinquishment accepted 1/9/09)	10TH Right	148 Longwall Shields and Face Conveyor *Abandoned Due to Safety Concerns	September 11, 1998 - Verbal February 26, 2001 - Written
UTU-64375 (Partial relinquishment accepted 1/9/09)	3rd Right	3 Longwall Shields *Abandoned Due to Safety Concerns	December 11, 2000 - Written

Abandonment of Machinery: To comply with Section 10 of the Federal Coal Lease Stipulations the permittee will request approval prior to abandonment of machinery within the mine.

Abandonment of this machinery is insignificant compared to the other steel materials that must be left underground. Ferrous materials include steel roof bolts, steel wire ceiling mesh and steel covered longwall support cans. These materials are not removed due to safety concerns in all underground coal mines.

Although the shields contained emulsified oil which could eventually enter the hydrologic system, it will have as insignificant impact on the hydrologic balance in the area based on the following criteria:

- It will be a period of many years prior to the sediments being saturated to reach potential areas of discharge

- The combination of water chemistry, temperature, and lack of oxygen will impede the rate of oxidation of the metal
- The combination of specific gravity and dip of the geology will potentially carry any migration away from the surface waters
- The total volume of the potential contaminants is so minute it will be diluted within a short distance
- No municipal or domestic water uses exist within 8,000 feet of the sites

* DOGM Technical Findings Dated November 1, 2000 *

Temporary Cessation: PacifiCorp notified the Division of temporary cessation of coal mining operations at the Trail Mountain Mine effective May 4, 2001. Coal mining at the Trail Mountain Mine ceased as of March 15, 2001.

In preparation of temporary cessation, all mining equipment including; production (longwall and continuous miner), belt haulage and electrical were removed from the mine. The mine de-watering system was removed from the mine, except for a six (6) inch steel supply line (9066') and a twelve (12) inch PVC de-watering line (9066'), refer to Figure 3-8 for details.

3.5.3.1 Sealing of Mine Openings

A. PORTAL SEALING

Upon completion of mining activities, the portals will be sealed in accordance with State and Federal regulation. A typical drawing of portal sealing to be used is shown in Figure 3-7. Seals will be located at least 25' inside the portal entry. All loose material around the seal area will be removed for roof, rib and floor prior to installation. The mine entry seals will be made of solid concrete blocks to form a wall two blocks thick.

B. DRILL HOLE SEALING

Exploration drill holes will be sealed to BLM specifications which entails sealing each hole from total depth to the surface with cement. See (Figure 3-8).

3.5.3.2 Removal of Surface Facilities

Upon completion of mining activities, all surface structures will be removed, with the exception of portions of the culverts and the sediment pond as described in the following section. Salvageable materials will be hauled off-site to a temporary storage age for re-use or sale. Non-salvageable items will be removed to an approved land fill (i.e. - Emery County Dump). Concrete will be broken up by dozer or other equipment and either placed against the highwall prior to backfilling or hauled to an approved landfill.

3.5.3.3 Disposition of Dams, Ponds, and Diversions

Due to the close proximity of the mine site to a perennial stream, it is proposed to leave the sediment pond in place to treat reclaimed area runoff until revegetation standards are reached. To direct the runoff, a 40' length of 48" cmp will be left in place at the point where the restored side canyon drainage meets the restored main channel, as shown on Plate 3-5.

The reclaimed area will be bermed along the restored side canyon drainage where it meets the restored main channel, as shown on Plate 3-5. The reclaimed area will be bermed along the restored banks of the channels to direct runoff to the sediment pond. Approximately 300' of 66" culvert (with the 96" to 66" transition and trash rack) will be left in place beneath the pond to convey the undisturbed Cottonwood Canyon drainage. All other diversions and culverts will be removed during this Phase I of final reclamation. Once revegetation standards are reached, the sediment ponds and all remaining culvert sections will also be removed, and the remaining disturbed area will be reseeded. Additional sediment controls, such as straw bales, silt fences, berms, etc., will be placed as needed to ensure protection for the stream during this final phase of reclamation (Phase II).

3.5.4 Backfilling and Grading Plan

The surface of this area was originally disturbed in the 1940's by a previous owner. The surface is all privately owned. Since no major effort was made at that time to save or store any topsoil or other material, restoration to approximately original contour is highly impractical. However, it is the intent of the permittee is to restore the area to a topography acceptable to the Division and compatible with the post-mining land use, using such materials that are available at the site.

In general, the backfilling and regrading will proceed as follows:

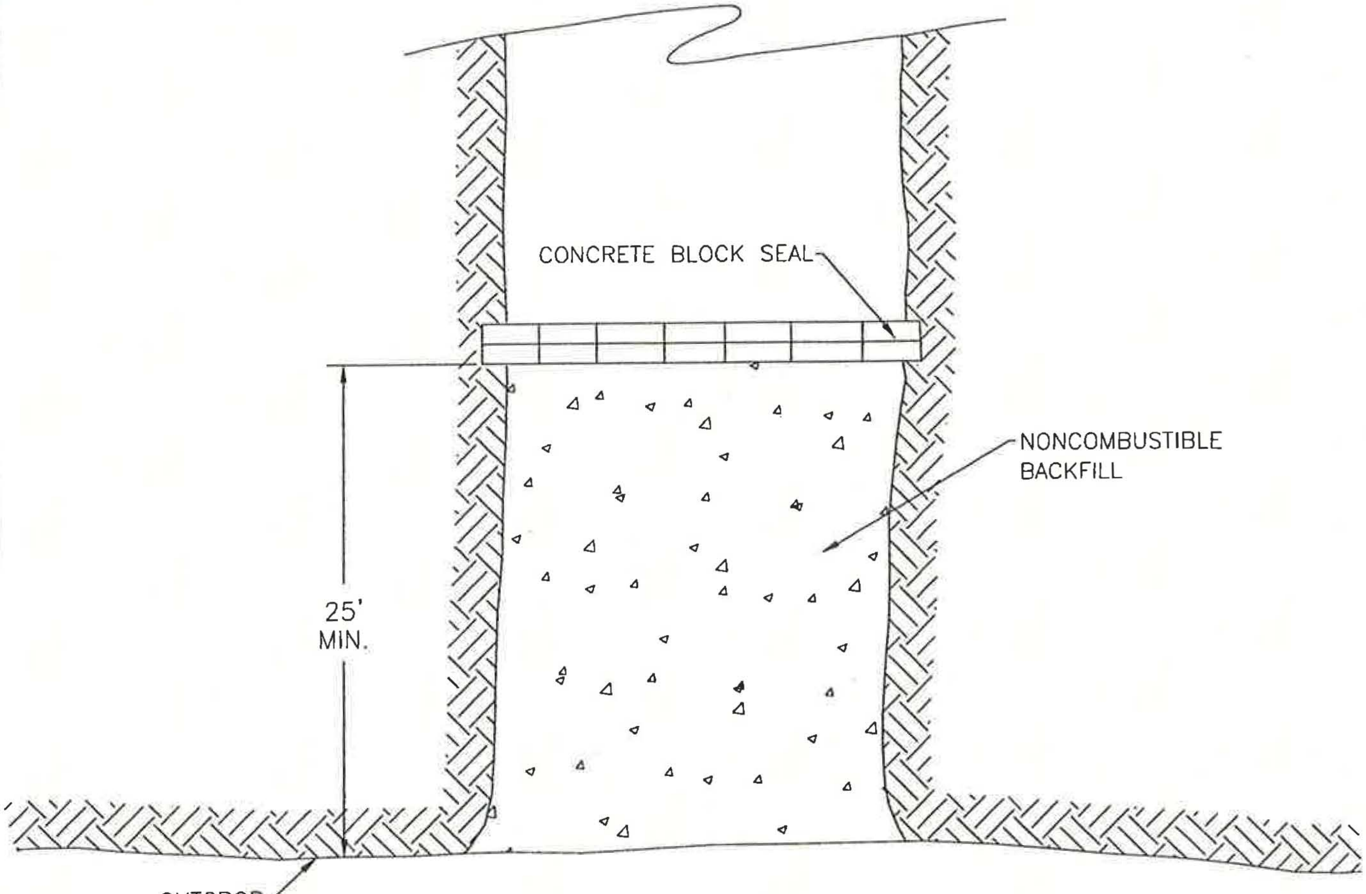
a) After sealing of the portals and removal of all structures, a backhoe will be brought to the upper (portal road) terrace.

b) The backhoe will begin by reaching down over the fill bank and retrieving as much material as can be reached. This material will be placed on the terrace.

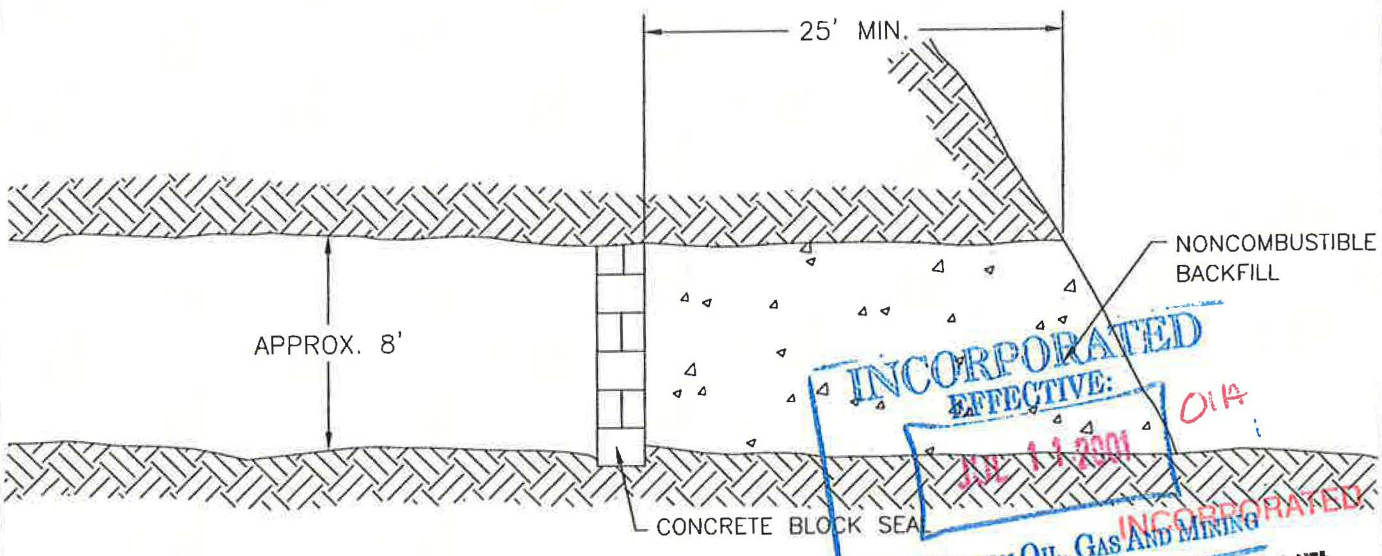
c) A Cat will work with the backhoe where possible, taking the retrieved material and spreading and compacting it from the cut outward to reach a configuration as shown on Plate 3-5, Post-Mining Topography.

d) The mine yard will then be re-sloped to drain as shown. A rock-lined natural drainage will be restored in the main and side channels as previously described.

e) The reclaimed area will be left in a roughened condition by placement of material with the backhoe and subsequent ripping and/or tracking with the dozer. This will promote moisture retention on the site to enhance vegetation.



PLAN VIEW



ELEVATION VIEW

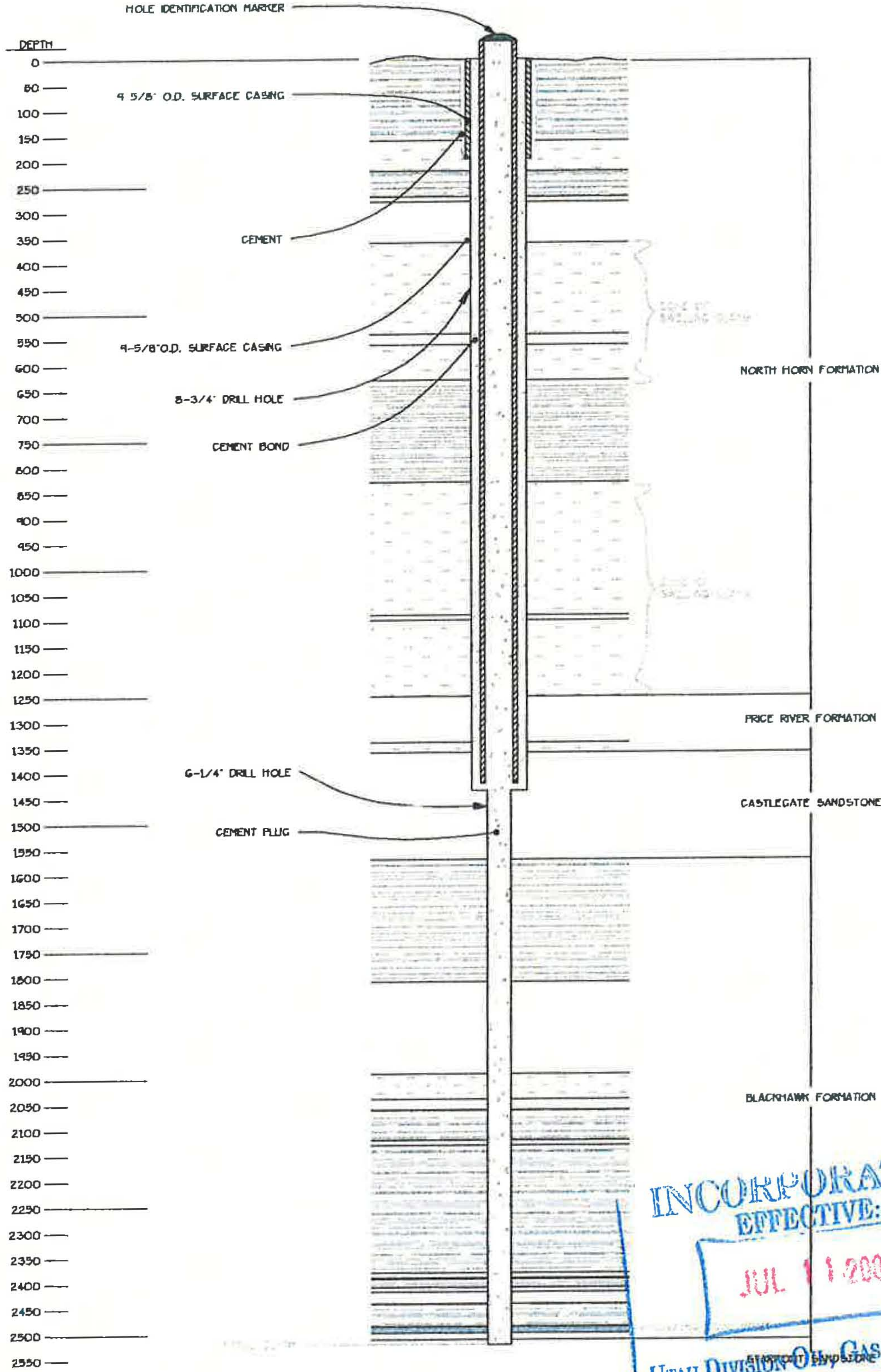
FILE NAME/DISK#: PORSEAL

ENERGY WEST
MINING COMPANY
HUNTINGTON, UTAH 84528

TRAIL MOUNTAIN MINE
TYPICAL PORTAL SEAL

DRAWN BY: P.K.B.	FIGURE 3-7		
SCALE: NONE	DRAWING #:		
DATE: OCT. 14, 1994	SHEET 1 OF 1	REV. ___	

TYPICAL CROSS SECTION
TRAIL MOUNTAIN DRILL HOLE SEALING



INCORPORATED
EFFECTIVE:
JUL 11 2001
UTAH DIVISION OIL, GAS AND MINING

INCORPORATED
APR 05 2016
Div. of Oil, Gas & Mining

FIGURE 3-8

CAD FILE NAME/DISK#: JAZ/OLD-DWGS\TMS1502A.DWG

ENERGY WEST
MINING COMPANY
HUNTINGTON, UTAH 84528

TRAIL MOUNTAIN MINE
TYPICAL CROSS SECTION
DRILL HOLE SEALING

DRAWN BY:	P. BOYLEN	TMS1502A	
SCALE:	AS NOTED	DRAWING #:	
DATE:	OCT. 13, 1994	SHEET 1 OF 1	REV.

f) Available topsoil, from the storage pile, will be redistributed to a depth of 6", starting at the north end of the storage area, and continuing down as far as material is available.

g) Upon final shaping and preparation of an area, it will be reseeded as per the plan.

h) Soil sampling of the regraded surface will be conducted as per the program described in Appendix 9-1, Attachment C.

3.5.4.1 Contouring

Plate 3-5 shows the post mining contours of the Mine. Upon abandonment, the post mining land use will not require extensive backfilling or returning the land to the original contours, however, all areas which are compacted through the reclamation activities or during mining will be "deep-ripped" utilizing a dozer ripper to a depth of 12" to 24" prior to seeding.

The drainage channels will be graded to reestablish the streams, following removal of the bypass culverts. Attempts will be made to restore the channels to the pre-mining slopes and conditions.

3.5.4.2 Removal or Reduction of Highwalls

Highwalls will be reclaimed as is practicable for the site and for the post mining land use. A static factor of a least 1.3 will be developed in the reclaimed highwall.

It should be noted that highwalls, by definition, are only those cut areas associated with portals. Other cut areas exist on this site; however, these are primarily road or pad cuts and do not fit the definition of a highwall. Portions of these areas may be retained as terraces to enhance the stability of road backfills.

3.5.4.3 Erosion Control

Measures for erosion control will be implemented on a case by case basis. Some methods which might be used are: mulching, straw dikes, water bars, silt fence, and limiting access to the area.

The berms along the reclaimed channels will be checked for erosion in the flow paths. If signs of erosion are evident, erosion controls such as loose rock check dams or silt fences will be installed along at intervals of 500' or less as necessary to control the erosion. Rills or gullies deeper than nine inches in regraded areas will be filled, graded or otherwise stabilized and reseeded as per the plan. This will be accomplished by hand, using adjacent or eroded material whenever possible. If larger gullies develop, a backhoe may be used in addition to hand work. Existing material that has been found satisfactory as a growth media through testing from the site will be used to accomplish this task.

3.5.5 Revegetation Plan

The disturbed areas of the mine will be revegetated the first normal period for favorable planting conditions after final site preparation. A suitable, diverse seed mix will be used to revegetate the disturbed area. Timing of the revegetation within the mine reclamation schedule is shown in Section 3.5.6, Schedule of Reclamation. Proposed seed mixes for the revegetation are listed in Appendix 9-1 of the MRP.

The method of revegetation will be largely determined by the results of the revegetation test plots. Those test plot methods that yield the best results will be used on the full scale reclamation of the mine site.

3.5.5.1 Soil Preparation

With special handling, the disturbed land fill should provide a suitable seed bed for revegetation. Soil sampling will be conducted per Appendix 9-1, Attachment C. Special handling will include removal of contaminated material and large coarse rock fragments (greater than 18 inches). The large rock fragments will be used as rip-rap in channel restoration, buried with the fill, or randomly placed on the reclaimed surface. The mine coal pad areas will be removed and all coal/refuse associated with the pads will be hauled to the Cottonwood Waste Rock Site for disposal.

Contaminated soil material which contains greater than 50 percent coal fines, will be disposed of at the Cottonwood Waste Rock Site. Soil contaminated with oil and grease will be disposed of at an approved site. This will be determined by visual inspection, and any material with visible oil or grease contamination will be removed. The volume of such material cannot be accurately estimated; however, it will likely be less than two percent of total volume. Material with less than 50 percent coal fines will be buried against the cut banks and covered with a minimum of four feet of incombustible material. There are no acid-or toxic-forming materials known to exist at this site. Any of these materials discovered will be disposed of on-site and covered with 4' of material or removed to the Cottonwood Waste Rock Site. Salt contamination may also be a problem in soils used for reclamation.

If visible salty areas or analyzed salty areas are found, the soils will be buried along the cut banks or other available sites to a minimum depth of 48".

Non-coal waste will be separated from the soils, loaded into trucks and hauled to an approved landfill for final disposal. All pad areas will be ripped for 12 to 24 inches to loosen the fill profile using the rippers on the dozer, and pulverized if a cloddy surface exists. Once backfilled and graded, the surface will be scarified with the teeth on the backhoe, or using the tracks of the dozer to create "pockets" for water retention and root penetration. Soil samples will be taken to identify the need for replenishment of various soil nutrients, as described in Appendix 9-1, Attachment C.

3.5.5.2 Seeding and Transplanting

Information from the test plots has been utilized together with proven reclamation results in order to arrive at the best treatment and seeding methods. After regrading and top soiling, the disturbed area will be mulched, fertilized and seeded. The steeper areas will be hydroseeded, and areas flat enough to safely allow operation of a drill seeder will be drill seeded. Regraded areas will not be smooth, but will have numerous depressions that will hold moisture and provide a micro-climate for vegetation establishment.

Riparian Community - During reclamation, the culverts will be removed, and the stream channels will be restored. The main channel will be rip-rapped with a 1.4 foot median rock size at least 4 feet above the stream. The flatter, reclaimed area is expected to be 60-70 feet west of the stream bank, and 20-40 feet east to where the public road will remain. Most of this area will consist of a slope of 5-10 degrees; therefore, drill-seeding will be used.

The riparian seed mix (see Table A9-3, Appendix 9-1) will be used approximately 20-40 feet on each side of the rip-rap, leaving a total floodplain area of 50-60 feet.

Grassland - Shrub Community - The seed mix for the grassland - shrub community will be used on the entire mine site, with the exception of the riparian area described above. See Table A9-1, Appendix 9-1 for seed mix and application rates. Portions of the grassland - shrub community area may be flat enough to safely utilize a drill-seeder; however, the majority of this area will be on the steeper slopes and will thus be hydro-seeded.

Containerized Stock - Following the seeding and mulching containerized woody plant species will be planted at a rate of 90 individuals/acre (or 2% of the undisturbed density in equal proportions). Wherever possible, this stock will be spatially arranged in clumps to maximize cover for wildlife. It is recommended (R645-301-358) that "edge effect" be optimized in support of resident wildlife species. Significant stands of coniferous plant cover (Pinion-Juniper and Douglas Fir) exist throughout the permit areas. These stands occur well within the limits of maximum distances required to optimize edge effect. A diagram illustrating the general spatial arrangement of the grassland - shrub community is included in Appendix 9-1, along with the description of the containerized stock proposed for both grassland-shrub and riparian areas.

One proposed option is that fresh-cut willow shoots be used on the riparian area in lieu of containerized stock. These shoots would be cut from local sources along Cottonwood Creek and placed on 3' centers on each side of the reclaimed channels.

3.5.5.2.1 Seed Mix and Rate/Acre

Two seed mixes are proposed for reclamation of the two vegetative communities that existed on the disturbed site. The first seed mix is for the riparian community, the second is for the grassland-shrub community. Lists of the species for both seed mixes can be found in Appendix 9-1.

3.5.5.3 Management

The reclaimed area will be protected from livestock grazing until bond release by fencing. The proposed fence is shown on Figure 3-9, and is not intended to preclude wildlife access. The revegetated area will be observed on a yearly basis. If heavy use occurs by wildlife, rodents, etc. other protection measures may be considered.

3.5.5.4 Vegetative Monitoring

Vegetation monitoring for permanent reclamation will be conducted as indicated in Table 3-2.

Revegetation success at the mine will be based on comparison with the approved reference areas. Ground cover, woody plant density, and shall be considered equal to their respective reference area counterparts, when there is 90 percent success at 90% statistical confidence.

3.5.6 Schedule of Reclamation

3.5.6.1 Detailed Timetable for Completion of Each Major Step in Reclamation (See Table 3-3).

3.5.6.2 Reclamation Monitoring

Monitoring of the success of reclamation will encompass subsidence, revegetation and water quality and quantity monitoring.

- Annual surveys will be conducted to determine surface deformation due to subsidence and possible movement of surface subsidence monuments.

- Water Quality and quantity monitoring will continue until reclamation has been accomplished as approved by the regulatory authority.

- All seeded areas will be inventoried to determine success of seeding.

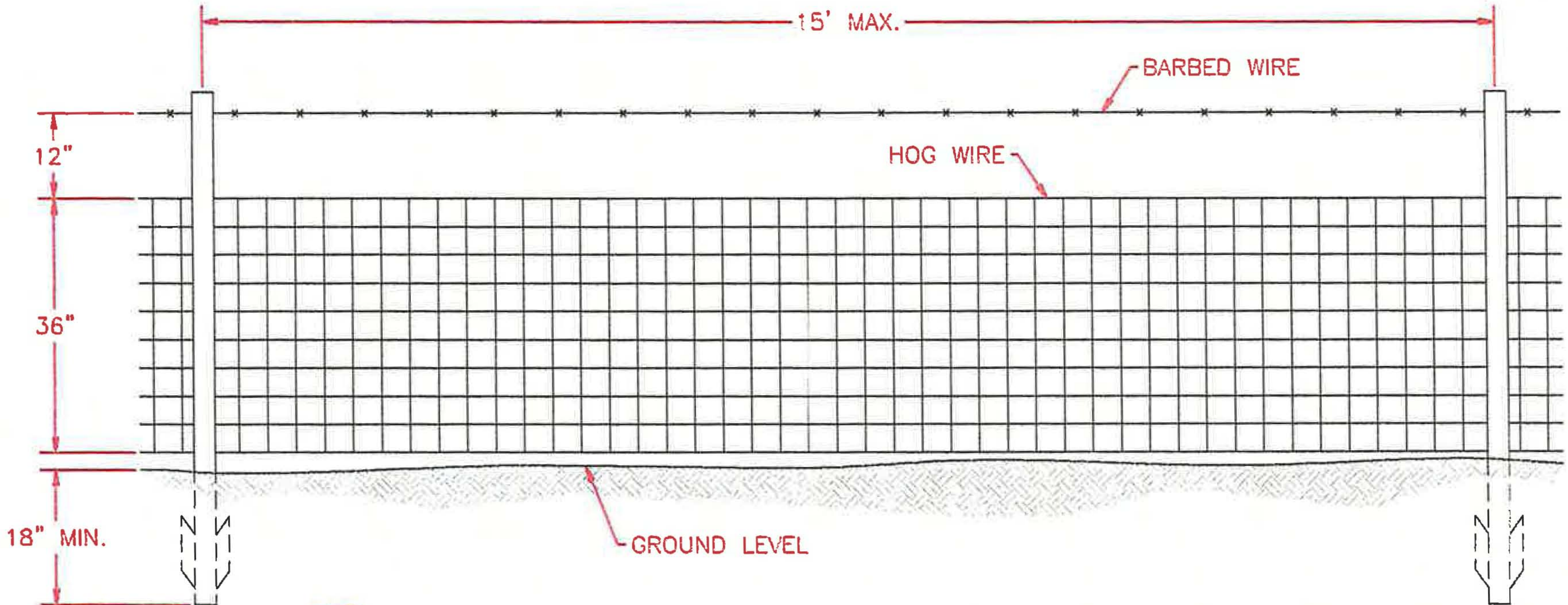
3.5.7 Cost Estimate for Reclamation

The 1979 Act "Regulation of Coal Mining and Reclamation Operations" requires the operator of a coal mine to file with the Utah Division of Oil, Gas and Mining (DOGM) a bond in the amount equal to the estimated cost of completing the work described in the operator's reclamation plan. The bond is to ensure the State of Utah that in the event of the operator being financially unable to reclaim the disturbed areas, such areas can and will be restored by the DOGM at no cost to state residents.

The strata characteristics above the coal seam, the slow and uniform rate of subsidence will not affect the surface terrain to such an extent that reclamation will be necessary. As such, a reclamation bond is not required for the surface lands over the underground workings.

An estimate of the cost of reclamation of the Mine site is shown in Appendix 1. This table reflects the required bond increase from all additions. Supporting cost calculations for each major reclamation step is also presented. The amount of the bond posted for this operation is broken down in Appendix 1.

Earthwork estimates for final reclamation are summarized in the Mass Balance Table 3-4. The quantities are taken from cross-sectional areas shown on Plate 3-6. Cross section locations are shown on Plates 3-1 and 3-5. Estimates indicate a cut volume of 38,579 cubic yards and a required fill volume of 39,719 cubic yards for final mine site reclamation.



**Mine Reclamation
Fencing Typical**

CAD FILE NAME/DISK#: USERS\KJL\TRAIL\FIGURE 3-9.DWG

ENERGY WEST
MINING COMPANY
HUNTINGTON, UTAH 84528

TRAIL MOUNTAIN MINE
MINE RECLAMATION
FENCING TYPICAL

DRAWN BY: K. LARSEN	FIGURE 3-9
SCALE: 1"=2'	DRAWING #:
DATE: MAY 8, 2001	SHEET 1 OF 1 REV.

Table 3-2

TRAIL MOUNTAIN MINE
FINAL RECLAMATION MONITORING

TEN YEAR RESPONSIBILITY PERIOD	1st YEAR	2nd YEAR	3rd YEAR	4th YEAR	5th YEAR	6th YEAR	7th YEAR	8th YEAR	9th YEAR	10th YEAR
QUALITATIVE OBSERVATIONS										
SPRING SITE VISIT		■	■	■	■	■	■	■	■	■
FALL SITE VISIT		■	■	■	■	■	■	■	■	■
QUANTITATIVE OBSERVATIONS										
COVER		■	■		■				■	■
FREQUENCY		■	■		■				■	■
WOODY PLANT DENSITY		■	■		■				■	■
PRODUCTIVITY									■	■

TABLE 3-3

Typical Reclamation schedule for the Trail Mountain Mine. Categorical correspond to the "Revegation Plan" (see text) and the "Bonding Estimate" (see table)

RECLAMATION TIMETABLE

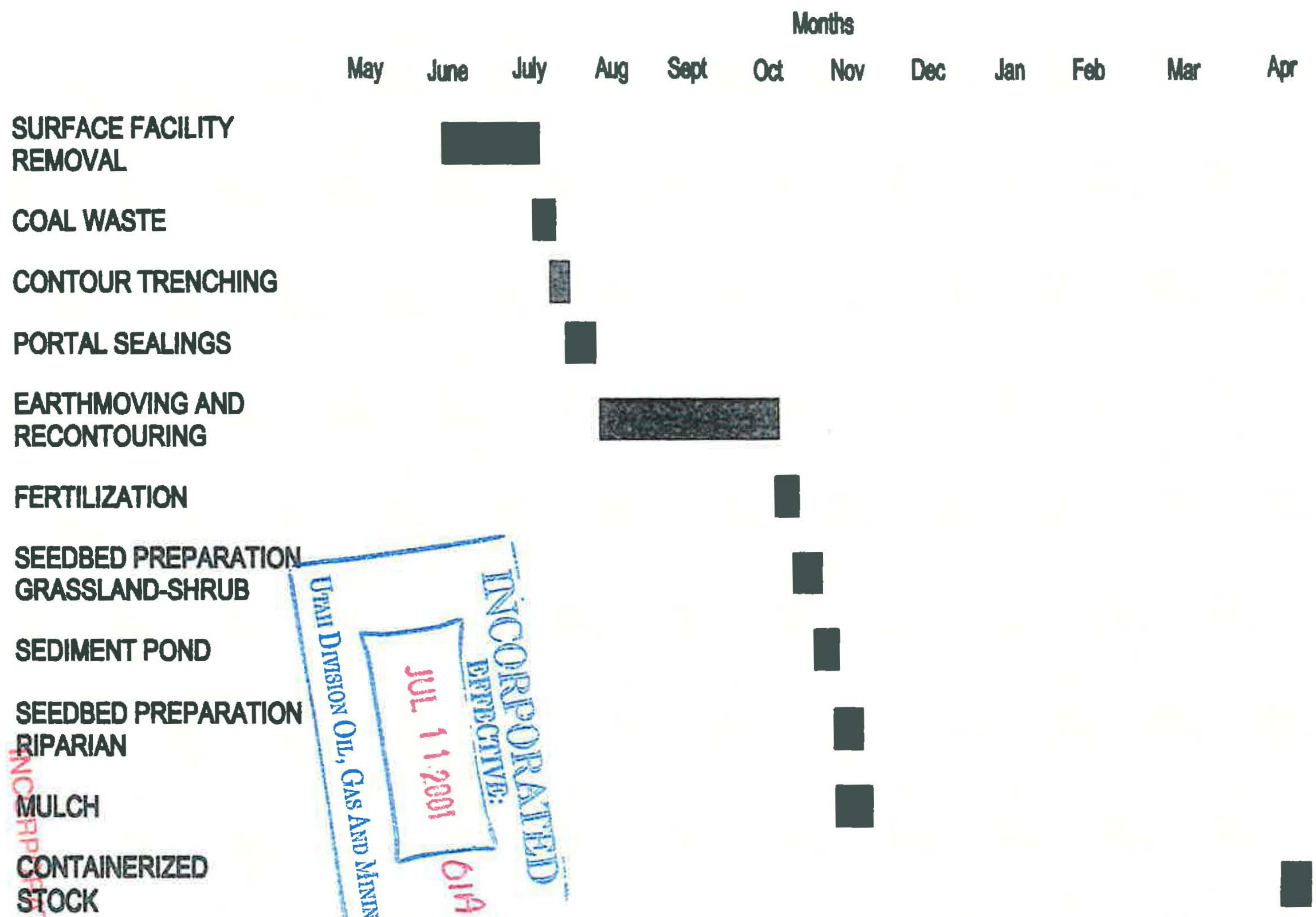


TABLE 3-4 MASS BALANCE

STATION	CUT VOLUME CU. YDS.	FILL VOLUME CU. YDS.	ACC. CUT VOLUME CU. YDS.	ACC. FILL VOLUME CU. YDS.
0+00	0	0	0	0
2+00	1,556	1,467	1,556	1,467
4+00	3,778	3,022	5,334	4,489
6+00	4,889	4,519	10,223	9,008
8+00	6,222	6,148	16,445	15,156
10+00	5,511	5,482	21,956	20,638
12+00	4,341	3,259	26,297	23,897
14+00	3,719	3,170	30,016	27,067
16+00	2,533	3,926	32,549	30,993
18+00	3,185	3,511	35,734	34,504
20+00	2,415	2,400	38,149	36,904
22+00	430	1,200	38,579	38,104
24+00	0	1,274	38,579	39,378
25+00	0	341	38,579	39,719
TOTALS	38,579	39,719	38,579	39,719

NOTES: (1) Refer to Plates 3-1 and 3-5 for cross sections. (2) Refer to Plate 3-6 for cross section

APPENDIX 1 – RECLAMATION BOND

Direct Costs / Trail Mine Facilities Area		
Subtotal Demolition and Removal	$369,084.00	
Subtotal Backfilling and Grading	$203,096.83	
Subtotal Revegetation	$38,547.16	
Direct Costs	$610,728.76	
Indirect Costs / Trail Mine Facilities Area		
Mob/Demob	$61,072.88	10.0%
Contingency	$30,536.44	5.0%
Engineering Redesign	$15,268.22	2.5%
Main Office Expense	$41,529.56	6.8%
Project Mainagement Fee	$15,268.22	2.5%
Subtotal Indirect Costs	$163,675.31	26.8%
Total Cost 2012 Dollars / Trail Mine Facilities Area	$774,404.06	
Add Reclamation Cost Waste Rock Site /CWW Vol 10		
Reclamation Cost 2011 Dollars		
Demolition	$10,618.49	
Earthwork	$231,606.96	
Rip-Rap	$24,151.09	
Revegetation	$33,342.25	
Subtotal Diect Costs for Waste Rock Site (2011 Dollars)	$299,718.79	
Escalation Factor for 2011		1.012
Number of Years to 2012 (Escalation Dollars = $ 3596)		1
Escalation Total Dollar Amount for 2012	$303,315.42	
Total of Mine Facilities + Waste Rock Site (2012 $'s)	$1,077,719.00	
Escalate to 2015 (Current Review Year) (ESF=1.015)		1.045678
Number of Years		3
Escalation Dollars	$49,228.00	
Total Cost Trail Mtn Disturbed Areas	$1,126,947.00	
Escalate to 2017 (Next Midterm Review) (ESF= 1.012 for 2015)		1.02414
		2
Escalation Dollars	$27,205.00	
Escalated Reclamation Cost to 2017*	$1,154,152.00	
Bond Amount (rounded to nearest $1,000)	$1,154,000.00	
Posted Bond 10 / 09 / 2012	$822,000.00	
Difference Between Cost Estimate and Bond**	-$332,000.00	

* As calculated by Division

** A bond rider in this amount was effective April 15, 2015 to increase the total bond for the Trail Mountain mine to $1,154,000.00

Errata Sheet Pertaining to Proposed Transfer of Permit From PacifiCorp to Fossil Rock Resources, LLC

This sheet is to be placed at the beginning of Chapters 1 thru 12 of the Trail Mountain Permit C/015/0009, the associated binders containing appendices, tables, figures, drawings, maps and to remain until such time that the permit is transferred and amended to reflect the information for the new permittee, Fossil Rock Resources, LLC (Fossil Rock Mine). This sheet is to be placed in the Waste Rock Site binder at the beginning of sections containing text, appendices and maps.

The facilities have changed hands multiple times, which means there are various references in the text, reports, studies, right-of-ways, leases and laboratory analyses which refer to the company owning or operating the mine facilities during a specific period of time. To provide clarification the following table lists the various names used through the life of the permit (to the best of our knowledge) and what entity under the new ownership those references will refer to.

Names Existing	Following Permit Transfer	
PacifiCorp	Fossil Rock Resources, LLC	
Beaver Creek Coal Company		
Interwest Mining		
Energy West Mining Company		
Arco Mining		
Arch Minerals		
Ark Land		
Trail Mountain Coal Company		
Utah Power & Light Company		
Utah Power & Light Mining Division		
Trail Mountain Mine	Fossil Rock Mine	
Trail Mountain Mine No. 9		
Cottonwood/Wilberg Waste Rock		
Natomas Mine		
Utah Power & Light Mining Division		
Cottonwood Mine		
Grimes Wash Facility		

When use of the above referenced names appear in the permit documents to describe events which would be considered historic they will remain the same. When the names are used to imply a commitment or ownership the names will be changed or amended where possible as designated in this table.

Errata Sheet Pertaining to Proposed Transfer of Permit From PacifiCorp to Fossil Rock Resources, LLC

This sheet is to be placed at the beginning of Chapters 1 thru 12 of the Trail Mountain Permit C/015/0009, the associated binders containing appendices, tables, figures, drawings, maps and to remain until such time that the permit is transferred and amended to reflect the information for the new permittee, Fossil Rock Resources, LLC (Fossil Rock Mine). This sheet is to be placed in the Waste Rock Site binder at the beginning of sections containing text, appendices and maps.

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PacifiCorp	Fossil Rock Resources, LLC	
Beaver Creek Coal Company		
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Arch Minerals		
Ark Land		
Trail Mountain Coal Company		
Utah Power & Light Company		
Utah Power & Light Mining Division		
Trail Mountain Mine	Fossil Rock Mine	
Trail Mountain Mine No. 9		
Cottonwood/Wilberg Waste Rock		
Natomas Mine		
Utah Power & Light Mining Division		
Cottonwood Mine		INCORPORATED
Grimes Wash Facility		APR 0 5 2016
		Div. of Oil, Gas & Mining

When use of the above referenced names appear in the permit documents to describe events which would be considered historic they will remain the same. When the names are used to imply a commitment or ownership the names will be changed or amended where possible as designated in this table.

INCORPORATED

OCT 0 8 2015

Div. of Oil, Gas & Mining

Demolition Cost Summary		
Item #	**Description**	**Cost**
1	Substation, Powerline, & Poles	$ 4,273.22
2	Shop, Bathhouse	$ 21,014.10
3	Water Treatment Plant, Tanks, Fuel	$ 4,637.30
4	Sewer System	$ 4,523.24
5	Miscellaneous Concrete	$ 23,760.80
6	Concrete Pads	$ 28,232.64
7	Waste and Salt Bunkers	$ 3,360.30
8	Truck Loadout and Silo	$ 24,191.60
9	Chutes and Trusses	$ 21,814.12
10	Mine Fan	$ 30,514.76
11	Storage Shed	$ 4,000.08
12	ROM Transfer Building	$ 28,156.48
13	ROM Overland Conveyor	$ 25,084.20
14	Loading Dock and Tank Farm	$ 8,910.04
15	Coal Pile Retaining Wall	$ 3,974.16
16	Sediment Pond	$ 1,250.04
17	Portals	$ 41,600.00
18	Culvert Removal	$ 32,534.86
19	Portal Liners	$ 5,903.04
20	Gunite Removal	$ 4,501.84
21	Rock Dust Tank	$ 1,287.84
22	Fence Removal	$ 3,343.52
23	Asphalt Removal	$ 42,216.59
	Total	**$ 369,084.77**

01 - Substation, Powerline, & Poles											
Description **Substation, Powerline, & Poles**	**Means Reference Number (2012 Heavy Construction Cost Data)**	**Equipment**	**Labor**	**Quantity (number)**	**Volume (cy)**	**Weight (tons)**	**Time (hr)**	**Unit**	**Cost**	**Total Cost**	**Ref.**
Steel Demolition Cost						15					
	01 54 33 20 0300	Excavator - 2.0 CY		1			4.0	hr	$ 156.62	$ 626.48	
	01 54 33 20 0342	Bucket Thumb		1			4.0	hr	$ 21.05	$ 84.20	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	Foreman Average, Outside		Foreman	1			4.0	hr	$ 73.30	$ 293.20	
	Common Building Labor		CLAB	2			4.0	hr	$ 54.00	$ 432.00	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			4.0	hr	$ 13.14	$ 52.56	
Concrete Demolition Cost					98.8						2, 3
	01 54 33 20 0300	Excavator - 2.0 CY		1			2.0	hr	$ 156.62	$ 313.24	
	01 54 33 20 0347	Hydraulic Hammer		1			2.0	hr	$ 45.57	$ 91.14	
	Equipment Operator, Medium Equipment		Eqmd	1			2.0	hr	$ 70.25	$ 140.50	
	Foreman Average, Outside		Foreman	1			2.0	hr	$ 73.30	$ 146.60	
	Common Building Labor		CLAB	2			2.0	hr	$ 54.00	$ 216.00	
	01 54 33 40 0700	Compressor - 600 CFM		1			2.0	hr	$ 58.45	$ 116.90	4
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			2.0	hr	$ 1.22	$ 2.44	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		1			2.0	hr	$ 0.38	$ 0.76	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			2.0	hr	$ 13.14	$ 26.28	1
Transportation Costs	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			4.0	hr	$ 73.07	$ 292.28	5
	Truck Driver, Heavy		Drhv	1			4.0	hr	$ 53.55	$ 214.20	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					15		ton	$ 15.00	$ 225.00	
Demolished Concrete Handling					128.44						6
	01 54 33 20 4760	Loader - 8 CY		1			2.0	hr	$ 232.00	$ 464.00	
	Equipment Operator, Medium Equipment		Eqmd	1			2.0	hr	$ 70.25	$ 140.50	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			6.0	hr	$ 17.37	$ 104.22	
	01 54 33 40 6410	Toilet, portable chemical		1			6.0	hr	$ 1.62	$ 9.72	
Total										$ 4,273.22	

Reference Information
1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 01)
(Concrete Ref - 01)

02 - Office, Shop, Bathhouse, Warehouse											
Description Shop, Bathhouse	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						30					
	Foreman Average, Outside		Foreman	1			16.0	hr	$ 73.30	$ 1,172.80	
	Common Building Labor		CLAB	3			16.0	hr	$ 54.00	$ 2,592.00	
	01 54 33 20 0300	Excavator - 2.0 CY		1			16.0	hr	$ 156.62	$ 2,505.92	
	Equipment Operator, Medium Equipment		Eqmd	1			16.0	hr	$ 70.25	$ 1,124.00	
	01 54 33 20 0342	Bucket Thumb		1			16.0	hr	$ 21.05	$ 336.80	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			16.0		$ 13.14		
Concrete Demolition Cost					259						
	Foreman Average, Outside		Foreman	1			10.0	hr	$ 73.30	$ 733.00	
	Common Building Labor		CLAB	2			10.0	hr	$ 54.00	$ 1,080.00	
	01 54 33 20 0300	Excavator - 2.0 CY		1			10.0	hr	$ 156.62	$ 1,566.20	
	Equipment Operator, Medium Equipment		Eqmd	1			10.0	hr	$ 70.25	$ 702.50	
	01 54 33 20 0347	Hydraulic Hammer		1			10.0	hr	$ 45.57	$ 455.70	
	01 54 33 20 0300	Excavator - 2.0 CY		1			10.0	hr	$ 156.62	$ 1,566.20	
	01 54 33 20 0342	Bucket Thumb		1			10.0	hr	$ 21.05	$ 210.50	
	Equipment Operator, Medium Equipment		Ecmd	1			10.0	hr	$ 21.05	$ 210.50	
	01 54 33 40 0700	Compressor - 600 CFM		1			10.0	hr	$ 58.45	$ 584.50	4
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			10.0	hr	$ 1.22	$ 12.20	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		4			10.0	hr	$ 0.38	$ 15.20	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			10.0	hr	$ 13.14	$ 131.40	
Transportation Costs	01 54 33 20 5300	Dump Truck - 3 axle, 12 CY		2			16.0	hr	$ 73.07	$ 2,338.24	5
	Truck Driver, Heavy		Drhv	2			16.0	hr	$ 53.55	$ 1,713.60	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					30		ton	$ 15.00	$ 450.00	
Demolished Concrete Handling					336.7						3
	01 54 33 20 4760	Loader - 8 CY		1			4.0	hr	$ 232.00	$ 928.00	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			16.0	hr	$ 17.37	$ 277.92	1
	01 54 33 40 6410	Toilet, portable chemical		1			16.0	hr	$ 1.62	$ 25.92	
Total										$ 21,014.10	

Reference Information
1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 02)
(Concrete Ref - 02)

03 - Water Treatment Plant, Water StorageTanks and Fuel Storage Facility											
Description Water Treatment Plant, Tanks, Fuel	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						10					
	01 54 33 20 0300	Aeriel Lift, 60 feet		1			4.0	hr	$ 55.92	$ 223.68	
	01 54 33 20 0342	Crane - 25 ton		1			4.0	hr	$ 87.15	$ 348.60	
	Equipment Operator, Crane or Shovel		Eqhv	1			4.0	hr	$ 72.15	$ 288.60	
		Excavator - 2.0 CY		1			4.0	hr	$ 156.62	$ 626.48	
	01 54 33 20 0342	Bucket Thumb		1			4.0	hr	$ 21.05	$ 84.20	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	Foreman Average, Outside		Foreman	1			4.0	hr	$ 73.30	$ 293.20	
	Common Building Labor		CLAB	2			4.0	hr	$ 54.00	$ 432.00	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			4.0	hr	$ 13.14	$ 52.56	
Concrete Demolition Cost											
(Refer to 05 - Concrete Pads)											
Transportation Costs	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			2.0	hr	$ 73.07	$ 146.14	5
	Truck Driver, Heavy		Drhv	2			2.0	hr	$ 53.55	$ 214.20	
	01 54 33 40 7300	Tractor, 4x2, 220hp		1			4.0		$ 39.35	$ 157.40	5
	01 54 33 40 6500	Trailer, platform, flush deck, 2 axle, 25 ton		1			4.0		$ 13.57	$ 54.28	5
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					10		ton	$ 15.00	$ 150.00	
Demolished Concrete Handling					0						
	01 54 33 20 4760	Loader - 8 CY		1			4.0	hr	$ 232.00	$ 928.00	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			4.0	hr	$ 17.37	$ 69.48	1
	01 54 33 40 6410	Toilet, portable chemical		1			4.0	hr	$ 1.62	$ 6.48	
Total										$ 4,637.30	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 03)
(Concrete Ref - 05)

04 - Sewer Collection and Pumping System											
Description Sewer System	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						15					
	01 54 33 20 0342	Crane - 25 ton		1			4.0	hr	$ 87.15	$ 348.60	
	Equipment Operator, Crane or Shovel		Eqhv	1			4.0	hr	$ 72.15	$ 288.60	
	Foreman Average, Outside		Foreman	1			4.0	hr	$ 73.30	$ 293.20	
	Common Building Labor		CLAB	2			4.0	hr	$ 54.00	$ 432.00	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			4.0	hr	$ 13.14	$ 52.56	
Concrete Demolition Cost					30.4						2,3
	01 54 33 20 0300	Excavator - 2.0 CY		1			2.0	hr	$ 156.62	$ 313.24	
	01 54 33 20 0347	Hydraulic Hammer		1			2.0	hr	$ 45.57	$ 91.14	
	Equipment Operator, Medium Equipment		Eqmd	1			2.0	hr	$ 70.25	$ 140.50	
	Foreman Average, Outside		Foreman	1			2.0	hr	$ 73.30	$ 146.60	
	Common Building Labor		CLAB	2			2.0	hr	$ 54.00	$ 216.00	
	01 54 33 40 0700	Compressor - 600 CFM		1			2.0	hr	$ 58.45	$ 116.90	4
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			2.0	hr	$ 1.22	$ 2.44	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		1			2.0	hr	$ 0.38	$ 0.76	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			2.0	hr	$ 13.14	$ 26.28	
Transportation Costs	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			4.0	hr	$ 73.07	$ 292.28	5
	Truck Driver, Heavy		Drhv	1			4.0	hr	$ 53.55	$ 214.20	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					15		ton	$ 15.00	$ 225.00	
Demolished Concrete Handling					39.52						6
	01 54 33 20 4760	Loader - 8 CY		1			4.0	hr	$ 232.00	$ 928.00	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			6.0	hr	$ 17.37	$ 104.22	1
	01 54 33 40 6410	Toilet, portable chemical		1			6.0	hr	$ 1.62	$ 9.72	
Total										$ 4,523.24	

Reference Information
1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 04)
(Concrete Ref - 04)

05 - Miscellaneous Concrete											
Description Miscellaneous Concrete	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost											
Concrete Demolition Cost					596.3						2,3
	01 54 33 20 0300	Excavator - 2.0 CY		1			40.0	hr	$ 156.62	$ 6,264.80	
	01 54 33 20 0342	Bucket Thumb		1			40.0	hr	$ 21.05	$ 842.00	
	Equipment Operator, Medium Equipment		Eqmd	1			40.0	hr	$ 70.25	$ 2,810.00	
	Foreman Average, Outside		Foreman	1			40.0	hr	$ 73.30	$ 2,932.00	
	Common Building Labor		CLAB	1			40.0	hr	$ 54.00	$ 2,160.00	
	01 54 33 40 0700	Compressor - 600 CFM		1			40.0	hr	$ 58.45	$ 2,338.00	4
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			40.0	hr	$ 1.22	$ 48.80	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		1			40.0	hr	$ 0.38	$ 15.20	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			40.0	hr	$ 13.14	$ 525.60	
Transportation Costs	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			40.0	hr	$ 73.07	$ 2,922.80	5
	Truck Driver, Heavy		Drhv	1			40.0	hr	$ 53.55	$ 2,142.00	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					0		ton	$ 15.00	$ -	
Demolished Concrete Handling					775.19						6
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			40.0	hr	$ 17.37	$ 694.80	1
	01 54 33 40 8410	Toilet, portable chemical		1			40.0	hr	$ 1.62	$ 64.80	
Total										$ 23,760.80	

Reference Information
1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet

(Concrete Ref - 05)

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APR 05 2013
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06 - Pumphouse, Tanks, and Concrete Pads											
Description Concrete Pads	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						55					
		Aerial Lift, 60 feet		1			40	hr	$ 55.92	$ 2,236.80	
		Crane - 25 ton		1			40	hr	$ 87.15	$ 3,486.00	
	Equipment Operator, Crane or Shovel			1			40	hr	$ 72.15	$ 2,886.00	
		Excavator - 2.0 CY		1			4	hr	$ 156.62	$ 626.48	
		Bucket Thumb		1			4	hr	$ 21.05	$ 84.20	
	Equipment Operator, Medium Equipment			1			4	hr	$ 70.25	$ 281.00	
	Foreman Average, Outside			1			40	hr	$ 73.30	$ 2,932.00	
	Common Building Labor			3			40	hr	$ 54.00	$ 6,480.00	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			40	hr	$ 13.14	$ 525.60	
Concrete Demolition Cost					151.3						2,3
	01 54 33 20 0300	Excavator - 2.0 CY		1			8.0	hr	$ 156.62	$ 1,252.96	
	01 54 33 20 0347	Hydraulic Hammer		1			8.0	hr	$ 45.57	$ 364.56	
	Equipment Operator, Medium Equipment		Eqmd	1			8.0	hr	$ 70.25	$ 562.00	
	Foreman Average, Outside		Foreman	1			8.0	hr	$ 73.30	$ 586.40	
	Common Building Labor		CLAB	2			8.0	hr	$ 54.00	$ 864.00	
	01 54 33 40 0700	Compressor - 600 CFM		1			8.0	hr	$ 58.45	$ 467.60	4
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			8.0	hr	$ 1.22	$ 9.76	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		1			8.0	hr	$ 0.38	$ 3.04	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			8.0	hr	$ 13.14	$ 105.12	
Transportation Costs	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			6.0	hr	$ 73.07	$ 438.42	5
	Truck Driver, Heavy		Drhv	2			6.0	hr	$ 53.55	$ 642.60	
	01 54 33 40 7300	Tractor, 4x2, 220hp		1			24.0	hr			5
	01 54 33 40 6500	Trailer, platform, flush deck, 2 axle, 25 ton		1			24.0	hr			5
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					55		ton	$ 15.00	$ 825.00	
Demolished Concrete Handling					196.69						6
	01 54 33 20 4760	Loader - 8 CY		1			6.0	hr	$ 232.00	$ 1,392.00	
	Equipment Operator, Medium Equipment		Eqmd	1			6.0	hr	$ 70.25	$ 421.50	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			40.0	hr	$ 17.37	$ 694.80	1
	01 54 33 40 8410	Toilet, portable chemical		1			40.0	hr	$ 1.62	$ 64.80	
Total										$ 28,232.64	

Reference Information
1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 06)
(Concrete Ref - 06)

07 - Non Coal Waste and Salt Bunkers											
Description Waste and Salt Bunkers	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						30					
	01 54 33 20 0342	Crane - 25 ton		1			2.0	hr	$ 87.15	$ 174.30	
	Equipment Operator, Crane or Shovel		Eqhv	1			2.0	hr	$ 72.15	$ 144.30	
	Foreman Average, Outside		Foreman	1			2.0	hr	$ 73.30	$ 146.60	
	Common Building Labor		CLAB	2			2.0	hr	$ 54.00	$ 216.00	
	01 54 33 40 6380	Torch, cutting, acetylene-oxygen 150' hose		1			2.0	hr	$ 13.14	$ 26.28	
Concrete Demolition Cost					16.7						2,3
	01 54 33 20 0300	Excavator - 2.0 CY		1			2.0	hr	$ 156.62	$ 313.24	
	01 54 33 20 0347	Hydraulic Hammer		1			2.0	hr	$ 45.57	$ 91.14	
	Equipment Operator, Medium Equipment		Eqmd	1			2.0	hr	$ 70.25	$ 140.50	
	Foreman Average, Outside		Foreman	1			2.0	hr	$ 73.30	$ 146.60	
	Common Building Labor		CLAB	2			2.0	hr	$ 54.00	$ 216.00	
	01 54 33 40 0700	Compressor - 600 CFM		1			2.0	hr	$ 58.45	$ 116.90	4
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			2.0	hr	$ 1.22	$ 2.44	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		1			2.0	hr	$ 0.38	$ 0.76	
	01 54 33 40 6380	Torch, cutting, acetylene-oxygen 150' hose		1			2.0	hr	$ 13.14	$ 26.28	
Transportation Costs	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			4.0	hr	$ 73.07	$ 292.28	5
	Truck Driver, Heavy		Drhv	1			4.0	hr	$ 53.55	$ 214.20	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					30		ton	$ 15.00	$ 450.00	
Demolished Concrete Handling					21.71						6
	01 54 33 20 4760	Loader - 8 CY		1			2.0	hr	$ 232.00	$ 464.00	
	Equipment Operator, Medium Equipment		Eqmd	1			2.0	hr	$ 70.25	$ 140.50	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			2.0	hr	$ 17.37	$ 34.74	1
	01 54 33 40 6410	Toilet, portable chemical		1			2.0	hr	$ 1.62	$ 3.24	
Total										$ 3,360.30	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.

2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.

3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.

4 - Added 5% for larger size compressor.

5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.

6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 07)
(Concrete Ref - 07)

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08 - Truck Loadout and Silo											
Description Truck Loadout and Silo	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						30					
	01 54 33 20 0342	Crane - 25 ton		1			40.0	hr	$ 87.15	$ 3,486.00	
	Equipment Operator, Crane or Shovel		Eqhv	1			40.0	hr	$ 72.15	$ 2,886.00	
	Foreman Average, Outside		Foreman	1			40.0	hr	$ 73.30	$ 2,932.00	
	Common Building Labor		CLAB	3			40.0	hr	$ 54.00	$ 6,480.00	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		2			40.0	hr	$ 13.14	$ 1,051.20	
Concrete Demolition Cost					22.8						2,3
	01 54 33 20 0300	Excavator - 2.0 CY		1			4.0	hr	$ 156.62	$ 626.48	
	01 54 33 20 0347	Hydraulic Hammer		1			4.0	hr	$ 45.57	$ 182.28	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	Foreman Average, Outside		Foreman	1			4.0	hr	$ 73.30	$ 293.20	
	Common Building Labor		CLAB	2			4.0	hr	$ 54.00	$ 432.00	
	01 54 33 40 0700	Compressor - 600 CFM		1			4.0	hr	$ 58.45	$ 233.80	4
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			4.0	hr	$ 1.22	$ 4.88	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		1			4.0	hr	$ 0.38	$ 1.52	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			4.0	hr	$ 13.14	$ 52.56	
Transportation Costs	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			8.0	hr	$ 73.07	$ 584.56	5
	01 54 33 40 7300	Tractor, 4x2, 220hp		1			8.0	hr	$ 39.35	$ 314.80	5
	01 54 33 40 6500	Trailer, platform, flush deck, 2 axle, 25 ton		1			16.0	hr	$ 13.57	$ 217.12	5
	Truck Driver, Heavy		Drhv	2			16.0	hr	$ 53.55	$ 1,713.60	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					30		ton	$ 15.00	$ 450.00	
Demolished Concrete Handling					29.64						6
	01 54 33 20 4760	Loader - 8 CY		1			4.0	hr	$ 232.00	$ 928.00	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			40.0	hr	$ 17.37	$ 694.80	1
	01 54 33 40 6410	Toilet, portable chemical		1			40.0	hr	$ 1.62	$ 64.80	
Total										$ 24,191.60	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.

2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.

3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.

4 - Added 5% for larger size compressor.

5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.

6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 08)
(Concrete Ref - 08)

09 - Chutes and Trusses from Crusher											
Description Chutes and Trusses	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						30					
	01 54 33 20 0342	Crane - 25 ton		1			40.0	hr	$ 87.15	$ 3,486.00	
	Equipment Operator, Crane or Shovel		Eqhv	1			40.0	hr	$ 72.15	$ 2,886.00	
	Foreman Average, Outside		Foreman	1			40.0	hr	$ 73.30	$ 2,932.00	
	Common Building Labor		CLAB	3			40.0	hr	$ 54.00	$ 6,480.00	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		2			40.0	hr	$ 13.14	$ 1,051.20	
Concrete Demolition Cost											
Transportation Costs											
	01 54 33 40 7300	Tractor, 4x2, 220hp		1			16.0	hr	$ 39.35	$ 629.60	5
	01 54 33 40 6500	Trailer, platform, flush deck, 2 axle, 25 ton		1			16.0	hr	$ 13.57	$ 217.12	5
	Truck Driver, Heavy		Drhv	2			16.0	hr	$ 53.55	$ 1,713.60	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					30		ton	$ 15.00	$ 450.00	
Demolished Concrete Handling					0						6
	01 54 33 20 4760	Loader - 8 CY		1			4.0	hr	$ 232.00	$ 928.00	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			40.0	hr	$ 17.37	$ 694.80	1
	01 54 33 40 6410	Toilet, portable chemical		1			40.0	hr	$ 1.62	$ 64.80	
Total										$ 21,814.12	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 09)

10 - Mine Fan											
Description Mine Fan	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						30					
	01 54 33 20 0342	Crane - 25 ton		1			40.0	hr	$ 87.15	$ 3,486.00	
	Equipment Operator, Crane or Shovel		Eqhv	1			40.0	hr	$ 72.15	$ 2,886.00	
	Foreman Average, Outside		Foreman	1			40.0	hr	$ 73.30	$ 2,932.00	
	Common Building Labor		CLAB	3			40.0	hr	$ 54.00	$ 6,480.00	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		2			40.0	hr	$ 13.14	$ 1,051.20	
Concrete Demolition Cost					158.7						2,3
	01 54 33 20 0300	Excavator - 2.0 CY		1			16.0	hr	$ 156.62	$ 2,505.92	
	01 54 33 20 0347	Hydraulic Hammer		1			16.0	hr	$ 45.57	$ 729.12	
	Equipment Operator, Medium Equipment		Eqmd	1			16.0	hr	$ 70.25	$ 1,124.00	
	Foreman Average, Outside		Foreman	1			16.0	hr	$ 73.30	$ 1,172.80	
	Common Building Labor		CLAB	2			16.0	hr	$ 54.00	$ 1,728.00	
	01 54 33 40 0700	Compressor - 600 CFM		1			16.0	hr	$ 58.45	$ 935.20	4
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			16.0	hr	$ 1.22	$ 19.52	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		1			16.0	hr	$ 0.38	$ 6.08	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			16.0	hr	$ 13.14	$ 210.24	
Transportation Costs	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			8.0	hr	$ 73.07	$ 584.56	5
	01 54 33 40 7300	Tractor, 4x2, 220hp		1			8.0	hr	$ 39.35	$ 314.80	5
	01 54 33 40 6500	Trailer, platform, flush deck, 2 axle, 25 ton		1			16.0	hr	$ 13.57	$ 217.12	5
	Truck Driver, Heavy		Drhv	2			16.0	hr	$ 53.55	$ 1,713.60	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					30		ton	$ 15.00	$ 450.00	
Demolished Concrete Handling					206.31						6
	01 54 33 20 4760	Loader - 8 CY		1			4.0	hr	$ 232.00	$ 928.00	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			40.0	hr	$ 17.37	$ 694.80	1
	01 54 33 40 6410	Toilet, portable chemical		1			40.0	hr	$ 1.62	$ 64.80	
Total										$ 30,514.76	

Reference Information
1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 10)
(Concrete Ref - 10)

11 - Storage Shed											
Description Storage Shed	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						15					
	01 54 33 20 0300	Excavator - 2.0 CY		1			4.0	hr	$ 156.62	$ 626.48	
	01 54 33 20 0342	Bucket Thumb		1			4.0	hr	$ 21.05	$ 84.20	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	Foreman Average, Outside		Foreman	1			4.0	hr	$ 73.30	$ 293.20	
	Common Building Labor		CLAB	2			4.0	hr	$ 54.00	$ 432.00	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			4.0	hr	$ 13.14	$ 52.56	
Concrete Demolition Cost											
Transportation Costs											
	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			4.0	hr	$ 73.07	$ 292.28	5
	Truck Driver, Heavy		Drhv	2			4.0	hr	$ 53.55	$ 428.40	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					15		ton	$ 15.00	$ 225.00	
Demolished Concrete Handling					0						6
	01 54 33 20 4760	Loader - 8 CY		1			4.0	hr	$ 232.00	$ 928.00	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			4.0	hr	$ 17.37	$ 69.48	1
	01 54 33 40 6410	Toilet, portable chemical		1			4.0	hr	$ 1.62	$ 6.48	
Total										$ 4,000.08	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.

2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.

3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.

4 - Added 5% for larger size compressor.

5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.

6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 11)

Description ROM Transfer Building	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
12 - ROM Transfer Building											
Steel Demolition Cost						50					
	Foreman Average, Outside		Foreman	1			40.0	hr	$ 73.30	$ 2,932.00	
	Common Building Labor		CLAB	3			40.0	hr	$ 54.00	$ 6,480.00	
	01 54 33 60 2720	Crane 100 ton		1			40.0	hr	$ 193.37	$ 7,734.80	
	Equipment Operator, Crane or Shovel		Eqhv	1			40.0	hr	$ 72.15	$ 2,886.00	
	01 54 33 40 6380	Torch, cutting, acetylene-oxygen 150' hose		2			40.0	hr	$ 13.14	$ 1,051.20	
Concrete Demolition Cost					0						2,3
Transportation Costs	01 54 33 40 6500	Trailer, platform, flush deck, 2 axle, 25 ton		1			16.0	hr	$ 13.57	$ 217.12	
	01 54 33 40 7300	Tractor, 4x2, 220hp		1			16.0	hr	$ 39.35	$ 629.60	
	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			8.0	hr	$ 73.07	$ 584.56	5
	Truck Driver, Heavy		Drhv	2			16.0	hr	$ 53.55	$ 1,713.60	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					50		ton	$ 15.00	$ 750.00	
Demolished Concrete Handling					0						6
	01 54 33 20 4760	Loader - 8 CY		1			8.0	hr	$ 232.00	$ 1,856.00	
	Equipment Operator, Medium Equipment		Eqmd	1			8.0	hr	$ 70.25	$ 562.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			40.0	hr	$ 17.37	$ 694.80	1
	01 54 33 40 6410	Toilet, portable chemical		1			40.0	hr	$ 1.62	$ 64.80	
Total										$ 28,156.48	

Reference Information
1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 12)

13 - ROM Overland Tube Conveyor											
Description ROM Overland Conveyor	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						30					
	Foreman Average, Outside		Foreman	1			28.0	hr	$ 73.30	$ 2,052.40	
	Common Building Labor		CLAB	3			28.0	hr	$ 54.00	$ 4,536.00	
	01 54 33 60 2720	Crane 100 ton		1			28.0	hr	$ 193.37	$ 5,414.36	
	Equipment Operator, Crane or Shovel		Eqhv	1			28.0	hr	$ 72.15	$ 2,020.20	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		2			28.0	hr	$ 13.14	$ 735.84	
Concrete Demolition Cost					88.5						2,3
	Foreman Average, Outside		Foreman	1			8.0	hr	$ 73.30	$ 586.40	
	Common Building Labor		CLAB	2			8.0	hr	$ 70.25	$ 1,124.00	
	01 54 33 20 0300	Excavator - 2.0 CY		1			8.0	hr	$ 156.62	$ 1,252.96	
	Equipment Operator, Medium Equipment		Eqmd	1			8.0	hr	$ 70.25	$ 562.00	
	01 54 33 20 0347	Hydraulic Hammer		1			8.0	hr	$ 45.57	$ 364.56	
	01 54 33 40 0700	Compressor - 600 CFM		1			16.0	hr	$ 58.45	$ 935.20	
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			16.0	hr	$ 1.22	$ 19.52	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		1			16.0	hr	$ 0.38	$ 6.08	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			16.0	hr	$ 13.14	$ 210.24	
Transportation Costs	01 54 33 40 6500	Trailer, platform, flush deck, 2 axle, 25 ton		1			8.0	hr	$ 13.57	$ 108.56	
	01 54 33 40 7300	Tractor, 4x2, 220hp		1			8.0	hr	$ 39.35	$ 314.80	
	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			8.0	hr	$ 73.07	$ 584.56	5
	Truck Driver, Heavy		Drhv	2			8.0	hr	$ 53.55	$ 856.80	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					30		ton	$ 15.00	$ 450.00	
Demolished Concrete Handling					115.05						6
	01 54 33 20 4760	Loader - 8 CY		1			8.0	hr	$ 232.00	$ 1,856.00	
	Equipment Operator, Medium Equipment		Eqmd	1			8.0	hr	$ 70.25	$ 562.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			28.0	hr	$ 17.37	$ 486.36	1
	01 54 33 40 6410	Toilet, portable chemical		1			28.0	hr	$ 1.62	$ 45.36	
Total										$ 25,084.20	

Reference Information
1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 13)
(Concrete Ref - 13)

Description Loading Dock and Tank Farm	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
14 - Loading Dock and Tank Farm											
Steel Demolition Cost						5					
	Foreman Average, Outside		Foreman	1			2.0	hr	$ 73.30	$ 146.60	
	Common Building Labor		CLAB	1			2.0	hr	$ 54.00	$ 108.00	
	01 54 33 20 0300	Excavator - 2.0 CY		1			2.0	hr	$ 156.62	$ 313.24	
	01 54 33 20 0342	Bucket Thumb		1			2.0		$ 21.05	$ 42.10	
	Equipment Operator, Medium Equipment		Eqhv	1			2.0	hr	$ 70.25	$ 140.50	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			2.0	hr	$ 13.14	$ 26.28	
Concrete Demolition Cost					49.3						2,3
	Foreman Average, Outside		Foreman	1			8.0	hr	$ 73.30	$ 586.40	
	Common Building Labor		CLAB	2			8.0	hr	$ 70.25	$ 1,124.00	
	01 54 33 20 0300	Excavator - 2.0 CY		1			8.0	hr	$ 156.62	$ 1,252.96	
	Equipment Operator, Medium Equipment		Eqmd	1			8.0	hr	$ 70.25	$ 562.00	
	01 54 33 20 0347	Hydraulic Hammer		1			8.0	hr	$ 45.57	$ 364.56	
	01 54 33 40 0700	Compressor - 600 CFM		1			8.0	hr	$ 58.45	$ 467.60	4
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			8.0	hr	$ 1.22	$ 9.76	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		1			8.0	hr	$ 0.38	$ 3.04	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			8.0	hr	$ 13.14	$ 105.12	
Transportation Costs											
	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			8.0	hr	$ 73.07	$ 584.56	5
	Truck Driver, Heavy		Drhv	1			8.0	hr	$ 53.55	$ 428.40	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					5		ton	$ 15.00	$ 75.00	
Demolished Concrete Handling					64.09						6
	01 54 33 20 4760	Loader - 8 CY		1			8.0	hr	$ 232.00	$ 1,856.00	
	Equipment Operator, Medium Equipment		Eqmd	1			8.0	hr	$ 70.25	$ 562.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			8.0	hr	$ 17.37	$ 138.96	1
	01 54 33 40 6410	Toilet, portable chemical		1			8.0	hr	$ 1.62	$ 12.96	
Total										$ 8,910.04	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.

2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.

3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.

4 - Added 5% for larger size compressor.

5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.

6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet

(Steel Ref - 14)

(Concrete Ref - 14)

15 - Coal Pile Retaining Wall

Description Coal Pile Retaining Wall	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						5					
Concrete Demolition Cost					29.8						2,3
	01 54 33 20 0300	Excavator - 2.0 CY		1			4.0	hr	$ 156.62	$ 626.48	
	01 54 33 20 0347	Hydraulic Hammer		1			4.0	hr	$ 45.57	$ 182.28	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	Foreman Average, Outside		Foreman	1			4.0	hr	$ 73.30	$ 293.20	
	Common Building Labor		CLAB	2			4.0	hr	$ 54.00	$ 432.00	
	01 54 33 40 0700	Compressor - 600 CFM		1			4.0	hr	$ 58.45	$ 233.80	4
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			4.0	hr	$ 1.22	$ 4.88	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		1			4.0	hr	$ 0.38	$ 1.52	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			4.0	hr	$ 13.14	$ 52.56	
Transportation Costs	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			4.0	hr	$ 73.07	$ 292.28	5
	Truck Driver, Heavy		Drhv	1			4.0	hr	$ 53.55	$ 214.20	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					5		ton	$ 15.00	$ 75.00	
Demolished Concrete Handling					38.48						6
	01 54 33 20 4760	Loader - 8 CY		1			4.0	hr	$ 232.00	$ 928.00	
	Equipment Operator, Medium Equipment		Eqmd	1			4.0	hr	$ 70.25	$ 281.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			4.0	hr	$ 17.37	$ 69.48	1
	01 54 33 40 6410	Toilet, portable chemical		1			4.0	hr	$ 1.62	$ 6.48	
Total										$ 3,974.16	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.

2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.

3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.

4 - Added 5% for larger size compressor.

5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.

6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 15)
(Concrete Ref - 15)

16 - Sediment Pond											
Description Sediment Pond	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						5					
	Foreman Average, Outside		Foreman	1			2.0	hr	$ 73.30	$ 146.60	
	Common Building Labor		CLAB	1			2.0	hr	$ 54.00	$ 108.00	
	01 54 33 20 0300	Excavator - 2.0 CY		1			2.0	hr	$ 156.62	$ 313.24	
	01 54 33 20 0342	Bucket Thumb		1			2.0	hr	$ 21.05	$ 42.10	
	Equipment Operator, Medium Equipment		Eqhv	1			2.0	hr	$ 70.25	$ 140.50	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			2.0	hr	$ 13.14	$ 26.28	
Concrete Demolition Cost											
Transportation Costs	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			2.0	hr	$ 73.07	$ 146.14	5
	Truck Driver, Heavy		Drhv	2			2.0	hr	$ 53.55	$ 214.20	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0850					5		ton	$ 15.00	$ 75.00	
Demolished Concrete Handling					0						
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			2.0	hr	$ 17.37	$ 34.74	1
	01 54 33 40 6410	Toilet, portable chemical		1			2.0	hr	$ 1.62	$ 3.24	
Total										$ 1,250.04	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.

2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.

3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.

4 - Added 5% for larger size compressor.

5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.

6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 16)

17 - Portal											
Description Portals	Reference Number (Personal Communications with Division)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost	(see note)										
Concrete Demolition Cost	(see note)										
Miscellaneous											
Portal Closure	AML1			8				ea	$ 5,200.00	$ 41,600.00	
Total										$ 41,600.00	

Note: Costs are all inclusive of equipment and labor to backfill and seal portal.

18 - Culvert Removal											
Description Culvert Removal	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						104.5					
		Excavator - 2.0 CY		1			40.0	hr	$ 158.62	$ 6,264.80	
	01 54 33 20 0342	Bucket Thumb		1			40.0	hr	$ 21.05	$ 842.00	
	Equipment Operator, Medium Equipment		Eqmd	1			40.0	hr	$ 70.25	$ 2,810.00	
	Foreman Average, Outside		Foreman	1			40.0	hr	$ 73.30	$ 2,932.00	
	Common Building Labor		CLAB	2			40.0	hr	$ 54.00	$ 4,320.00	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			40.0	hr	$ 13.14	$ 525.60	
Concrete Demolition Cost											
Transportation Costs											
	01 54 33 40 7300	Tractor, 4x2, 220hp		1			8.0		$ 39.35	$ 314.80	5
	01 54 33 40 6500	Trailer, platform, flush deck, 2 axle, 25 ton		1			8.0		$ 13.57	$ 108.56	5
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					104.5		ton	$ 15.00	$ 1,567.50	
Demolished Concrete Handling					0						
	01 54 33 20 4760	Loader - 8 CY		1			40.0	hr	$ 232.00	$ 9,280.00	
	Equipment Operator, Medium Equipment		Eqmd	1			40.0	hr	$ 70.25	$ 2,810.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			40.0	hr	$ 17.37	$ 694.80	1
	01 54 33 40 6410	Toilet, portable chemical		1			40.0	hr	$ 1.62	$ 64.80	
Total										$ 32,534.86	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.

2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.

3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.

4 - Added 5% for larger size compressor.

5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.

6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 18)

19 - Portal Liners											
Description Portal Liners	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost											
Concrete Demolition Cost					20.5						2,3
	01 54 33 20 0300	Excavator - 2.0 CY		1			12.0	hr	$ 156.62	$ 1,879.44	
	01 54 33 20 0347	Hydraulic Hammer		1			12.0	hr	$ 45.57	$ 546.84	
	Equipment Operator, Medium Equipment		Eqmd	1			12.0	hr	$ 70.25	$ 843.00	
	Foreman Average, Outside		Foreman	1			12.0	hr	$ 73.30	$ 879.60	
	Common Building Labor		CLAB	1			12.0	hr	$ 54.00	$ 648.00	
	01 54 33 40 0700	Compressor - 600 CFM		1			12.0	hr	$ 58.45	$ 701.40	4
	01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.		1			12.0	hr	$ 1.22	$ 14.64	
	01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.		1			12.0	hr	$ 0.38	$ 4.56	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			12.0	hr	$ 13.14	$ 157.68	
Transportation Costs											
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					0		ton	$ 15.00		
Demolished Concrete Handling					26.65						6
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			12.0	hr	$ 17.37	$ 208.44	1
	01 54 33 40 6410	Toilet, portable chemical		1			12.0	hr	$ 1.62	$ 19.44	
Total										$ 5,903.04	

Reference Information
1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: Portal liner is based on (2) wing walls 8'x12'x6" either side portal opening and 1 header 2'x28'x12" across the top of the wing wall (3 portals)

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet

(Concrete Ref - 19)

20 - Gunite Removal											
Description Gunite Removal	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						5					
	Foreman Average, Outside		Foreman	1			8.0	hr	$ 73.30	$ 586.40	
	Common Building Labor		CLAB	1			8.0	hr	$ 54.00	$ 432.00	
	01 54 33 20 0300	Excavator - 2.0 CY		1			8.0	hr	$ 156.62	$ 1,252.96	
	01 54 33 20 0342	Bucket Thumb		1			8.0	hr	$ 21.05	$ 168.40	
	Equipment Operator, Medium Equipment		Eqhv	1			8.0	hr	$ 70.25	$ 562.00	
	01 54 33 40 0190	Aerial Lift, 60 feet		1			8.0		$ 55.92	$ 447.36	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			8.0	hr	$ 13.14	$ 105.12	
Concrete Demolition Cost											
Transportation Costs	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			4.0	hr	$ 73.07	$ 292.28	5
	Truck Driver, Heavy		Drhv	2			4.0	hr	$ 53.55	$ 428.40	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					5		ton	$ 15.00	$ 75.00	
Demolished Concrete Handling					0						
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			8.0	hr	$ 17.37	$ 138.96	1
	01 54 33 40 6410	Toilet, portable chemical		1			8.0	hr	$ 1.62	$ 12.96	
Total										$ 4,501.84	

Reference Information
1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 20)

21 - Rock Dust Tank											
Description Rock Dust Tank	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						15					
	Foreman Average, Outside		Foreman	1			2.0	hr	$ 73.30	$ 146.60	
	Common Building Labor		CLAB	1			2.0	hr	$ 54.00	$ 108.00	
	01 54 33 60 2720	Crane 100 ton		1			2.0	hr	$ 193.37	$ 386.74	
	Equipment Operator, Crane or Shovel		Eqhv	1			2.0	hr	$ 72.15	$ 144.30	
	01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose		1			2.0	hr	$ 13.14	$ 26.28	1
Concrete Demolition Cost	N/A										2, 3
Transportation Costs	01 54 33 40 6500	Trailer, platform, flush deck, 2 axle, 25 ton		1			2.0	hr	$ 13.57	$ 27.14	5
	01 54 33 40 7300	Tractor, 4x2, 220hp		1			2.0	hr	$ 39.35	$ 78.70	5
	Truck Driver, Heavy		Drhv	1			2.0	hr	$ 53.55	$ 107.10	
Miscellaneous											
Disposal Fee - Metal	02 41 19 23 0950					15		ton	$ 15.00	$ 225.00	
Demolished Concrete Handling	N/A										
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			2.0	hr	$ 17.37	$ 34.74	1
	01 54 33 40 6410	Toilet, portable chemical		1			2.0	hr	$ 1.62	$ 3.24	
Total										$ 1,287.84	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.

2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.

3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.

4 - Added 5% for larger size compressor.

5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.

6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 21)

22 - Fence Removal											
Description Fence Removal	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost						10					
	Foreman Average, Outside		Foreman	1			8.0	hr	$ 73.30	$ 586.40	
	Common Building Labor		CLAB	2			8.0	hr	$ 54.00	$ 864.00	
	01 54 33 40 0470	Back-hoe 112hp		1			8.0	hr	$ 84.65	$ 677.20	
	Equipment Operator, Light Equipment		Eqlt	1			8.0	hr	$ 67.55	$ 540.40	
	01 54 33 40 6380	Torch, cutting, acetylene-oxygen 150' hose		1			8.0	hr	$ 13.14	$ 105.12	1
Concrete Demolition Cost	N/A										2, 3
Transportation Costs											
	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		1			4.0	hr	$ 13.57	$ 54.28	5
	Truck Driver, Heavy		Drhv	1			4.0	hr	$ 53.55	$ 214.20	
Miscellaneous											
Disposal Fee - Metal	02 41 19.23 0950					10		ton	$ 15.00	$ 150.00	
Demolished Concrete Handling	N/A										
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			8.0	hr	$ 17.37	$ 138.96	1
	01 54 33 40 6410	Toilet, portable chemical		1			8.0	hr	$ 1.62	$ 12.96	
Total										$ 3,343.52	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.
4 - Added 5% for larger size compressor.
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip.
6 - A swell factor of 1.3 is used for crushed concrete.

Note: For concrete volumes and steel weights, refer to Concrete and Steel Estimations sheet
(Steel Ref - 22)

23 - Asphalt Removal											
Description Asphalt Removal	Means Reference Number (2012 Heavy Construction Cost Data)	Equipment	Labor	Quantity (number)	Volume (cy)	Weight (tons)	Time (hr)	Unit	Cost	Total Cost	Ref.
Steel Demolition Cost											
Concrete Demolition Cost	N/A										
Transportation Costs					838.37						6
	01 54 33 40 6500	Dump Truck - 3 axle, 12 CY		3			36.0	hr	$ 73.07	$ 7,891.56	5
	Truck Driver, Heavy		Drhv	3			36.0	hr	$ 53.55	$ 5,783.40	
Miscellaneous											
Disposal Fee - Asphalt	02 41 19 23 0950					1131.8		ton	$ 15.00	$ 16,976.99	7
Demolished Concrete Handling	N/A										
	01 54 33 20 4760	Loader - 8 CY		1			36.0	hr	$ 232.00	$ 8,352.00	
	Equipment Operator, Medium Equipment		Eqmd	1			36.0	hr	$ 70.25	$ 2,529.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			36.0	hr	$ 17.37	$ 625.32	1
	01 54 33 40 6410	Toilet, portable chemical		1			36.0	hr	$ 1.62	$ 58.32	
Total										$ 42,216.59	

Reference Information

1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.

2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.

3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com). Time increases depending on complexity of job.

4 - Added 5% for larger size compressor.

5 - For haul of asphalt demolition material to Nielsen's landfill. Distance is approximately 16.0 miles one-way. Time estimate is 1.5 hours for one round trip. Transportation dictates all machinery and labor times.

6 - A swell factor of 1.3 is used for asphalt.

7 - Assume weight of crushed asphalt is approximately 3510 lbs/cy (Ref. US Federal Highway Administration, Publication Number: FHWA-RD-97-148). Original quantity is 644.9 cy.
Asphalt will be hauled to Nielson Construction landfill and permanently disposed (Ref. personal communication with Nielson Construction). This landfill is a class 1 landfill.

Wage and Equipment Rates

Ref. - RSMeans Heavy Construction Data Handbook - 2012

Wage Rates	Abbrv.	Hourly Rate (includes O&P)	
Foreman Average, Outside	Foreman	$73.30	
Common Building Labor	CLAB	$ 54.00	
Equipment Operator, Crane or Shovel	Eqhv	$ 72.15	
Equipment Operator, Medium Equipment	Eqmd	$ 70.25	
Equipment Operator, Light Equipment	Eqlt	$ 67.55	
Truck Driver, Light	Trlt	$ 52.10	
Truck Driver, Heavy	Trhv	$ 53.55	

Equipment Rental Rates - Means Code	Description	Hourly Rate (includes O&P)	
01 54 33 20 0200	Excavator - 1.5 CY	$ 120.05	
01 54 33 20 0300	Excavator - 2.0 CY	$ 156.62	
01 54 33 20 0320	Excavator - 2.5 CY	$ 206.50	
01 54 33 20 0342	Bucket Thumb	$ 21.05	
01 54 33 20 0347	Hydraulic Hammer	$ 45.57	
01 54 33 20 1930	Grader 55,000 lbs.	$ 177.50	
01 54 33 20 3300	Sheepsfoot Vibratory Roller	$ 137.62	
01 54 33 20 3350	Smooth Drum Vibratory Roller	$ 64.35	
01 54 33 20 3525	Scraper - selp prop single 14 CY	$ 192.12	
01 54 33 20 3550	Scraper - selp prop duale 21 CY	$ 246.75	
01 54 33 20 3600	Scraper - selp prop duale 31 CY	$ 358.50	
01 54 33 20 4150	Dozer - 105hp	$ 68.85	
01 54 33 20 4310	Dozer - 300hp	$ 214.75	
01 54 33 20 4360	Dozer - 410hp	$ 284.00	
01 54 33 20 4760	Loader - 5.5 CY	$ 120.00	
01 54 33 20 4810	Loader - 8 CY	$ 232.00	
01 54 33 20 5300	Dump Truck - 3 axle, 12 CY	$ 73.07	
01 54 33 20 5310	Dump Truck - 4 axle, 18 CY	$ 93.12	
01 54 33 40 0460	Back-hoe 80hp	$ 45.47	
01 54 33 40 0470	Back-hoe 112hp	$ 84.65	
01 54 33 40 0600	Compressor - 600 CFM	$ 58.45	
01 54 33 40 0940	Air tools, breaker, pavement, 60 lb.	$ 1.22	
01 54 33 40 1000	Hose w/couplings 50 ft., 1" dia.	$ 0.38	
01 54 33 40 5800	Chain Saw, 18"	$ 3.42	
01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4	$ 17.37	Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
01 54 33 40 6500	Trailer, platform, flush deck, 2 axle, 25 ton	$ 13.57	
01 54 33 40 6950	Water Truck, Off-Highway 6000 gal.	$ 135.62	
01 54 33 40 7290	Flat Bed Truck	$ 26.97	
01 54 33 40 7300	Tractor, 4x2, 220hp	$ 39.35	
01 54 33 40 0190	Aeriel Lift, 60 feet	$ 55.92	
01 54 33 60 2500	Crane - 25 ton	$ 87.15	
01 54 33 60 2720	Crane - 100 ton	$ 193.37	
01 54 33 50 2200	Hydromulcher 3000 gal	$ 37.97	
01 54 33 40 6360	Torch, cutting, acetylene-oxygen 150' hose	$ 13.14	

Equipment Mobilization	up to 50 miles RT	RT Cost each
01 54 36.50 0020	Equipment - 70 to 150hp	$ 246.00
01 54 36.50 0100	Equipment - over 150hp	$ 455.00
01 54 36.50 0600	Scraper - Self propelled 24 CY	$ 680.00
01 54 36.50 2100	Crane - over 75 ton	$ 460.00

Miscellaneous	Description	Cost / ton	
Nielson Construction	Disposal Fee	$ 15.00	Personal Communication w/Nielson Construction
01 54 33 40 6410	Toilet, portable chemical	$ 1.62	
01 54 33 40 2700*	Portable ventilation fan	$ 45.43	

*Substitute 100 kw genator for portable ventilation fan. Assuming a comparable cost.

Concrete Volume Estimation[1]/Steel Demolition[2]

Ref Sheet	Facility Description	Length	Width	Height	Area	Radius	CF	CY	Tons	Notes
01	Substation								15	
	Retaining Wall	275	0.67	5			921.25	34.1		Estimated and average height of 5'
	Pads		1		920		920	34.1		
	Foundation	275	3	1			825	30.6		
	Total							98.8	15	
02	Office/Shop/Bathhouse/Warehouse								30	considers metal in office, bathhouse, and shop plus includes demo of wood framed office
	Pads		0.5		4904		2452	90.8		
	Retaining Wall	25	0.67	5			83.75	3.1		
	Foundation	362	2	1			724	26.8		
	Concrete Block Walls	520	0.67	16			5574.4	138.3		CY multiplied by .67 to account for air space of blocks
	Total							259.1	30	
03	Water Treatment Plant, Water StorageTanks and Fuel Storage Facility								10	
04	Sewer System/Collection Pumping								15	misc equipment
	Walls	90	0.67	8			482.4	17.9		
	Pads		0.33		476		157.08	5.8		
	Foundation	90	2	1			180	6.7		
	Total							30.4	15	
05	Concrete Pads									
	Curb and Gutter	1300	2	1			2600	96.3		
	Miscellaneous Other							500.0		Arbitrarily added yardage to cover all miscellaneous concrete
	Total							596.3		
06	Pumphouse, Tanks and Concrete Pads								55	Steel demo includes raw water tank, lines, and pumphouse building
	Pumphouse - foundation	140	2	1			280	10.4		
	Pumphouse - stemwall	140	3	0.67			281.4	10.4		
	Pumphouse - pad	45	20	0.5			450	16.7		
	Area Pad			0.5	5062.1		2531.05	93.7		includes pads around pumphouse, tanks, and water treatment building
	Tank - foundation			1	188.5	15	188.5	7.0		perimeter is equal to approx 100'
	Tank - pad		0.5		706.85		353.425	13.1		pad around water treatment, water tank, and pumphouse
	Total							151.3	55	
07	Non Coal Waste Bunker and Salt Bunkers	84	0.67	8			450.24	16.7	30	
08	Truck Loadout Silo (pad)		1		615.734	14	615.734	22.8	30	misc equipment, rebar, etc.
09	Chute and Trusses from Crusher								30	
10	Main Fan								30	
	Walls	245	0.67	8			1313.2	48.6		
	Pads		0.5		4304		2152.0	79.7		
	Top		0.33		2484		819.7	30.4		
	Total							158.7	30	
11	Storage Shed								15	
12	ROM Transfer Building								50	
13	ROM Overland Tube Conveyor								30	
	Bent Structure Foundation	34.5	15	4			2070.0	76.7		
	Support Platform	20	4	4			320.0	11.9		
	Total							88.5	30	
14	Loading Dock/Tank Farm								5	Steel estimates include rebar and steel edge protectors
	Pads		0.33		1492		492.4	18.2		
	Walls	175	0.67	4			469.0	17.4		
	Foundation	175	2	1			350.0	13.0		
	Stairs	14	4	0.33			18.5	0.7		
	Total							49.3	5	
15	Coal Pile Retaining Wall - includes all	150	0.667	8			800.4	29.6	5	Steel estimates include rebar and steel edge protectors
16	Sediment Pond								5	
17	Portals - Sealing									Not applicable to demolition costs
18	Culvert Removal									
	12" - 326' @ 12lbs/ft								2	weights based on Hanson Corrugated Steel Pipe chart 2 2/3" x 1/2" (avg. of all thicknesses)
	18" - 60' @ 18lbs/ft								0.5	weights based on Hanson Corrugated Steel Pipe chart 2 2/3" x 1/2" (avg. of all thicknesses)
	48" - 136' @ 76lbs/ft								5	weights based on Hanson Corrugated Steel Pipe chart 3" x 1" (avg. of all thicknesses)
	66" - 1914' @ 101lbs/ft								97	weights based on Hanson Corrugated Steel Pipe chart 3" x 1" (avg. of all thicknesses)
	Total								104.5	
19	Portal Liners	40	8	1			320.0	11.9		
20	Gunite Removal								5	fencing
21	Rock Dust Tank								15	
N/A	Concrete Barriers									Mobile items. Will be removed from site by others prior to reclamation
22	Fence Removal								10	
23	Asphalt		0.33		52761		17411.1	644.9		Transported to Nielson's Landfill
	Grand Total						Total	1513.2	435	Grand total does not include volume of asphalt

1 Concrete quantity estimates are based on volumes generated from an AutoCAD drawing of the surface facilities at Trail Mountain Mine, or actual field measurements, and not actual pour tickets or contractor invoices.
2 Steel weights for demolition are estimated.

Earthwork Cost Summary	
Description	**Cost**
Earthwork	$ 138,709.25
Riprap	$ 64,387.58
Total	**$ 203,096.83**

Earthwork - Dozer/Track-Hoe Work														
Means Reference Number	Station Location/Type Equipment	Hourly Equipment Cost	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
01 54 33 20 4360	Dozer - 410hp	$ 284.00	$ 70.25	$ 354.25	1	$ 354.25	$/HR	39,710.0	CY	158.0	CY/HR	251.3	HR	$ 89,023.03
01 54 33 20 0300	Excavator - 2.0 CY	$ 156.62	$ 70.25	$ 226.87	1	$ 226.87	$/HR			(see note)		125.65	HR	$ 28,506.22
	Sub-Totals													$ 117,529.25
Miscellaneous														
	Foreman Average, Outside			$ 71.20	1	$ 71.20	$/HR					251.3	HR	$ 17,893.00
01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4			$ 13.08	1	$ 13.08	$/HR					251.3	HR	$ 3,287.00
	Total Earthwork													$ 138,709.25

Note: Track-hoe is utilized to support Dozer activities. Usage is dictated by 1/2 Dozer hours.

Earthwork - Rip Rap												
Description Riprap Channel	Means Reference	Equipment Cost/hour	Operator's Hourly Wage Rate^	Number of Men or Eq.	Units	Quantity (CY)	Quantity (Tons)	Production Rate	Units	Equipment Time	Units	Cost
								50	LF/hr			
Loader - 5.5 CY	01 54 33 20 4760	$ 120.00		1	$/HR					41.3	HR	$ 4,956.00
Equipment Operator, Medium Equipment	Eqmd		$ 70.25	1	$/HR					41.3	HR	$ 2,901.33
Excavator - 2.0 CY	01 54 33 20 0300	$ 156.62		1	$/HR					41.3	HR	$ 6,468.41
Equipment Operator, Medium Equipment	Eqmd		$ 70.25	1	$/HR					41.3	HR	$ 2,901.33
Pickup Truck - 3/4 ton 4x4	01 54 33 40 7200	$ 17.37		1	$/HR					41.3	HR	$ 717.38
CLAB	Common Building Labor		$ 54.00	1	$/HR					41.3	HR	$ 2,230.20
Foreman Average, Outside	Foreman Average, Outside		$73.30	1	$/HR					41.3	HR	$ 3,027.29
Riprap Sizes												
D50 = 1.0 feet						122	165					$ 3,294.00
D50 = 1.5 feet						1867	2520					$ 42,847.65
Total												$ 64,387.58

^ RSMeans Heavy Construction Cost Data 2011 - Refer to Wage and Rate Sheet

Note - Riprap costs are based off Nielson Construction rates (8/2012) of 1 ft = $20/ton and 1.5 ft = $17/ton

Trail Mountain Mine Revegetation

Pocking	Equipment Rental (hr) (Includes O & P)^A	Operator's Hourly Wage RateA	Material Cost	Labor Hourly Cost ^A	Unit	Number	Area (AC)	Quantity	Units	Production Rate	Units	Time	Units	Cost
							10.4		AC					
Volume								3532.6	CY	340	CY/AC			
Excavator, 2 CY	$ 156.62	$ 67.75				1				180	CY/HR	19.6	HR	$4,403
Subtotal														**$4,403**
Seeding/Planting														
Seed Mix - Riparian			$ 438.85		$/AC	2	0.78	26.5	LBS					$ 684.61
Seed Mix - Grassland/Shrub			$ 452.83		$/AC	2	9.61	403.6	LBS					$ 8,703.30
CLAB				$ 54.00		4				4	Acre/HR	2.6		$ 561.06
Container plants			$ 4.50					1006	Containers					$ 4,527.00
CLAB				$ 54.00		4				48	Cont/HR	20.95833		$ 4,527.00
Intermediate Total														$ 19,002.96
Add 25% Reseeding Cost														$ 4,750.74
Subtotal														**$ 23,753.70**
Mulching														
Hay			$ 100.00					10.39	AC	0.67	AC/HR	6.9		
Hay Quantity***								4000	LBS/AC					$ 2,078.00
Mulcher, Diesel powered	$ 37.97					1						6.9	HR	$ 263.01
Flat Bed Truck	$ 26.97	$ 52.10				1						6.9	HR	$ 547.69
CLAB				54.00		2						6.9	HR	$ 748.08
Hydromulch								10.39	AC	0.67	AC/HR			
Truck 4 x 2, 220hp	$ 39.35	$ 52.10				1						6.9	HR	$ 633.44
Hydromulcher, 3000 gal	$ 37.97	$ 53.55				1						6.9	HR	$ 633.93
Wood Fiber Mulch****			$ 10.50	per 50 lb. bag				2000	LBS/AC					$ 4,363.80
CLAB				54.00		3						6.9	HR	$ 1,122.12
Subtotal														**$ 10,390.07**
Total														**$ 38,547.16**

* Seedmix prices based on Stevenson Intermountain Seed Prices quoted in August 2012. See attached.
** Seedling tree prices based on High Mountain Nursery Prices in August 2012 (http://www.highmtnnursery.com/servlet/StoreFront).
*** Cost of Hay is based on local prices of $100/ton (Personal Communication).
**** Current (1/2012) price for woodfiber mulch from Granite Seed, Lehi, Utah. Phone contact.
^A RSMeans Heavy Construction Cost Data 2012 - Refer to Wage and Rate Sheet

Price Quotation

Date: 8/2/2012
Quoted By: Jason

STEVENSON INTERMOUNTAIN SEED, INC.

P.O. Box 2, Ephraim, UT 84627
Phone: (435) 283-6639 Fax:(435) 283-4155
Email:sales@siseed.com

Quote to (Company): Energy West
Address: 1407 West North Temple
Suite 310, SLC 84116

Contact Person: Dennis Oakley
Phone: 1801.220.4607
Fax: 801.220.4725
Email: dennis.oakley@pacificorp.com

Quantity Pounds	Bulk-PLS	Lot No.	Species	Variety	Additional Information	Price /Pound	Total Cost
2.7	PLS		Slender Wheatgrass			$ 3.50	$ 9.45
1.21	PLS		Mountain Brome			$ 6.50	$ 7.87
3.3	PLS		Great Basin Wildrye			$ 12.00	$ 39.60
2.3	PLS		Indian Ricegrass			$ 7.00	$ 16.10
0.08	PLS		Western Yarrow			$ 27.00	$ 2.16
0.5	PLS		Cicer Milkvetch			$ 4.50	$ 2.25
0	pls		Nuttall Lomatium			NA	NA
0.3	PLS		Yellow Sweet Clover			$ 4.00	$ 1.20
0.1	PLS		Palmer Penstemon			$ 21.00	$ 2.10
3.3	PLS		Utah Service Berry			$ 49.00	$ 161.70
5.6	PLS		Antelope Bitterbrush			$ 19.00	$ 106.40
1.6	pls		Silvery Lupine		*Substitute for Nuttal Lomatium	$ 65.00	$ 104.00
							$ -
						$ 218.50	$ -
							$ -
							$ -
							$ -
							$ -
							$ -

Project Name/No.: Grasslands/Shrub Community (9.61ac)
Mix: X **Separates:**
Shipped Via: Best Way
FOB: Origin
Terms: Net 30
Additional Information: Price is per ac

Thank You!

We appreciate your request
for a price quotation and your business.

Sub Total:	$ 452.83
Tax:	None
Mixing/Handling:	None
Shipping:	TBD
Total:	$ 452.83

Price Quotation

Date: 8-2-2012
Quoted By:Jason

STEVENSON
INTERMOUNTAIN SEED, INC.
P.O. Box 2, Ephraim, UT 84627
Phone: (435) 283-6639 Fax:(435) 283-4155
Email:sales@siseed.com

Quote to (Company): Energy West
Address: 1407 West Nnorth Temple
Suite 310, SLC 84116

Contact Person: Dennis Oakley
Phone: 801.220.4607
Fax: 801.220.4725
Email: dennis.oakley@pacificorp.com

Quantity Pounds	Bulk-PLS	Lot No.	Species	Variety	Additional Information	Price /Pound	Total Cost
3.2	PLS		Mt. Brome			$ 6.50	$ 20.80
8	PLS		Great Basin			$ 12.00	$ 96.00
0.5	PLS		Kentucky Bluegrass			$ 2.50	$ 1.25
0.5	PLS		Pacific Aster			$ 110.00	$ 55.00
N/A			Western Virginblower			NA	NA
1	PLS		White Sweetclover			$ 4.00	$ 4.00
0.2	PLS		Eaton Penstemon			$ 79.00	$ 15.80
1	PLS		Golden Current			$ 89.00	$ 89.00
1.6	PLS		Blue Elderberry			$ 55.00	$ 88.00
0.6	PLS		BlueAster		*Substitute for Western Virginblower	$ 115.00	$ 69.00
							$ -
							$ -
							$ -
							$ -
							$ -
							$ -
							$ -
							$ -
							$ -

Project Name/No.: Riparian Community Seed Mix (.78ac)
Mix: X **Separates:**
Shipped Via: Best Way
FOB: Origin
Net 30
Additional Information: Price is per ac

Sub Total:	$ 438.85
Tax:	None
Mixing/Handling:	None
Shipping:	TBD
Total:	$ 438.85

Thank You!

We appreciate your request
for a price quotation and your business.

Waste Rock Site Cost Summary		
Description	**Cost**	
Demolition	$	10,618.49
Earthwork	$	231,606.96
Riprap	$	24,151.09
Revegetation	$	33,342.25
Total	$	299,718.79

Total Cost (2011 Dollars)	$	299,718.79	
Escalation factor			0.012
Number of years			1
Escalation	$	3,597.00	
Bond Amount (2012 Dollars)	$	303,315.79	

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Waste Rock Site											
Description Waste Rock Site	**Means Reference Number (2011 Heavy Construction Cost Data)**	**Equipment**	**Labor**	**Quantity (number)**	**Volume (cy)**	**Weight (tons)**	**Time (hr)**	**Unit**	**Cost**	**Total Cost**	**Ref.**
Steel Demolition Cost						5					
	Foreman Average, Outside		Foreman	1			8.0	hr	$ 71.20	$ 569.60	
	Common Building Labor		CLAB	2			8.0	hr	$ 52.70	$ 843.20	
	01 54 33 20 0300	Excavator - 2.0 CY		1			8.0	hr	$ 153.00	$ 1,224.00	
	Equipment Operator, Medium Equipment		Eqmd	1			8.0	hr	$ 67.75	$ 542.00	
	01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4		1			8.0	hr	$ 13.08	$ 104.64	1
Concrete Demolition Cost											2, 3
Transportation Costs	01 54 33 40 6500	Trailer, platform, flush deck, 2 axle, 25 ton		1			1.0	hr	$ 13.90	$ 13.90	5
	01 54 33 40 7300	Tractor, 4x2, 220hp		1			1.0	hr	$ 34.90	$ 34.90	
	Truck Driver, Heavy		Drhv	1			1.0	hr	$ 52.25	$ 52.25	
Miscellaneous											
Disposal Fee - Metal	02 41 19.23 0950					5		ton	$ 90.00	$ 450.00	
Net Fence Removal[4]	02 41 13.60 1600		CLAB	2			64.0	hr	$ 52.70	$ 6,745.60	
	01 54 33 40 6410	Toilet, portable chemical		1			24.0	hr	$ 1.60	$ 38.40	
Total										$ 10,618.49	

Reference Information
1 - From Nielson Construction services contract with Energy West Mining - Includes 3/4 ton 4x4 truck, metal tool box, acetylene kit, rack for oxygen and acetylene, 1/2" electric drill, 71/4 " circular saw, 9" grinder.
2 - Concrete rubble disposed of as fill or permanently backfilled inside portals.
3 - Base on a concrete demolition production of 200 cubic yards per 8 hour shift. (Reference: http://www.indeco-breakers.com).
4 - Net Fence, 3500 linear feet. Demolition production rate is 430/day
5 - For haul of steel demolition material to Nielsen's landfill. Distance is approximately 11.0 miles one-way. Time estimate is 1.0 hours for one round trip.

Waste Rock Site Dozer/Track-Hoe Work - Phase 1														
Means Reference Number	Station Location/Type Equipment	Hourly Equipment Cost	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
01 54 33 20 4360	Dozer - 410hp	$ 263.13	$ 67.75	$ 330.88	1	$ 330.88	$/HR	54,500.0	CY	158.0	CY/HR	344.9	HR	$ 114,120.51
01 54 33 20 0320	Excavator - 2.5 CY	$ 201.63	$ 67.75	$ 269.38	1	$ 269.38	$/HR			(see note)		172.45	HR	$ 46,454.58
	Sub-Totals													$ 160,575.09
Miscellaneous														
	Foreman Average, Outside			$ 71.20	1	$ 71.20	$/HR					344.9	HR	$ 24,557.00
01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4			$ 13.08	1	$ 13.08	$/HR					344.9	HR	$ 4,511.00
	Total Phase 1 Earthwork													$ 189,643.09

Waste Rock Site Dozer/Track-Hoe Work - Phase 2														
Means Reference Number	Station Location/Type Equipment	Hourly Equipment Cost	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
01 54 33 20 4360	Dozer - 410hp	$ 263.13	$ 67.75	$ 330.88	1	$ 330.88	$/HR	6,233.0	CY	158.0	CY/HR	39.4	HR	$ 13,036.67
01 54 33 20 0320	Excavator - 2.5 CY	$ 201.63	$ 67.75	$ 269.38	1	$ 269.38	$/HR			(see note)		19.7	HR	$ 5,306.79
	Sub-Totals													$ 18,343.46
Miscellaneous														
	Foreman Average, Outside			$ 71.20	1	$ 71.20	$/HR					39.4	HR	$ 2,805.00
01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4			$ 13.08	1	$ 13.08	$/HR					39.4	HR	$ 515.00
	Total Phase 2 Earthwork													$ 21,663.46

Waste Rock Site Dozer/Track-Hoe Work - Access Road														
Means Reference Number	Station Location/Type Equipment	Hourly Equipment Cost	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
01 54 33 20 0320	Excavator - 2.5 CY	$ 201.63	$ 67.75	$ 269.38	1	269.38	$/HR	1,435.0	LF	200	LF/day	57.40	HR	$ 15,462.41
	Sub-Totals													$ 15,462.41
Miscellaneous														
	Foreman Average, Outside			$ 71.20	1	$ 71.20	$/HR					57.4	HR	$ 4,087.00
01 54 33 40 7200	Pickup Truck - 3/4 ton 4x4			$ 13.08	1	$ 13.08	$/HR					57.4	HR	$ 751.00
	Total Access Road Earthwork													$ 20,300.41
													Total Cost	$ 231,606.96

Note: Track-hoe is utilized to support Dozer activities. Usage is dictated by 1/2 Dozer hours.

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Riprap Channels	Means Reference Number	Equipment Rental (hr) (Includes O & P)^A	Operator's Hourly Wage RateA	Material Cost	Labor Hourly Cost ^A	Number	Length (LF)	Quantity	Units	Production Rate	Units	Time	Units	Cost
							660			50	LF/Hr	13.2	Hr	
3/4" Rock*				$ 27.00				216	Tons					$ 5,832.00
6" Rock*				$ 22.00				459.0	Tons					$ 10,098.00
Loader - 5.5 CY	01 54 33 20 4760	$ 116.68	$ 67.75			1								$ 2,434.48
Dump Truck - 4 axle, 18 CY	01 54 33 20 5310	$ 82.60	$ 50.75			1								$ 1,760.22
Excavator, 2 CY	01 54 33 20 0300	$ 153.00	$ 67.75			1								$ 2,913.90
Foreman Average, Outside	Foreman				$ 71.20	1								$ 939.84
Pickup Truck - 3/4 ton 4x4	01 54 33 40 7200	$ 13.08				1								$ 172.66
Total														$ 24,151.09

* Based on Nielson's Construction current (1/2012) prices.

^A RSMeans Heavy Construction Cost Data 2011 - Refer to Wage and Rate Sheet

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Pocking	Equipment Rental (hr) (Includes O & P)^A	Operator's Hourly Wage RateA	Material Cost	Labor Hourly Cost ^A	Number	Area (AC)	Quantity	Units	Production Rate	Units	Time	Units	Cost
						18		AC					
Volume							6120.0	CY	340	CY/AC			
Excavator, 2 CY	$ 153.00	$ 67.75			1				180	CY/HR	34.0	HR	$ 7,505.50
Subtotal													**$ 7,505.50**
Seeding*/Planting**													
Final Reclamation Seed Mix			$ 823.23	$ 52.70		18	810	lbs	1	Acre/HR	18		$ 1,771.83
Subtotal													**$ 1,771.83**
Mulching													
Hay			$ 100.00				18	AC	0.67	AC/HR	26.9		
Hay Quantity***							2000	LBS/AC					$ 1,800.00
Mulcher, Diesel powered	$ 34.75				1						26.9	HR	$ 933.58
Flat Bed Truck	$ 23.75	$ 50.75			1						26.9	HR	$ 2,001.49
CLAB				52.70	2						26.9	HR	$ 2,831.64
Hydromulch							18	AC	0.67	AC/HR			
Truck 4 x 2, 220hp	$ 34.90	$ 52.70			1						26.9	HR	$ 2,353.43
Hydromulcher, 3000 gal	$ 34.75	$ 52.25			1						26.9	HR	$ 2,337.31
Wood Fiber Mulch****			$ 10.50	per 50 lb. bag			2000	LBS/AC					$ 7,560.00
CLAB				52.70	3						26.9	HR	$ 4,247.46
Subtotal													**$ 24,064.93**
Total													**$ 33,342.25**

* Seedmix prices based on Stevenson Intermountain Seed Prices quoted in February 2011. See attached.
** Seedling tree prices based on Lone Peak Conservation Nursery (now contracted to High Mountain Nursery) Prices in February 2011 (http://www.highmtnnursery.com/servlet/StoreFront).
*** Cost of Hay is based on local prices of $100/ton (Personal Communication).
**** Current (1/2012) price for woodfiber mulch from Granite Seed, Lehi, Utah. Phone contact.
[A] RSMeans Heavy Construction Cost Data 2011 - Refer to Wage and Rate Sheet

CHAPTER 4

LAND STATUS, LAND USE, AND POST MINING LAND USE

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LAND USE

4.1 SCOPE

This chapter of the mining and reclamation plan describes the status of lands in and adjacent to the mine plan permit and adjacent areas. Present and post-mining land-uses will also be discussed with emphasis on how mining can be integrated in the multiple land-use of the area.

4.2 METHODOLOGY

Information used in preparing this chapter of the mining and reclamation plan has been gathered from published sources and from discussions with the relevant land-management agencies.

4.3 LAND STATUS

4.3.1 Mine Plan Area Surface Land Status

Land status within the mine plan area is separated into two areas: private, and federal (Refer to Plate 4-1 in Volume 3).

4.3.1.1 Ownership

PacifiCorp owned 53.35 acres of private land surrounded by federal land of the Manti-LaSal National Forest. Ownership of land was obtained by Beaver Creek Coal Company in October, 1987, through purchase of the mine from the Arch Minerals Company of St. Louis, MO. A legal description of the extent of the property is given below. Also refer to the Legal and Financial Volume for more details:

Beginning point SW corner of NW1/4 SE1/4, Sec. 25, T17S, R6E, SLB&M, thence North 160 rods, thence East 44 rods to center Cottonwood Creek, Southward along creek to a point 76 rods East of the beginning, thence West 76 Rods to the point of beginning.

4.3.1.2 Surface Managing Authorities

Historically and/or presently, the surface lands of the mine plan area have been or are currently managed by the State of Utah, Division of State Lands and United States of America, US Forest Service. Section 36, Township 17 South, Range 6 East, part of the mine plan area, is managed by the Utah Division of State Lands (relinquishment for ML-22603 effective 01/31/1996). Areas within Township 17 South, Range 6 East, Sections 25, 26, 27, 34 and 35, Township 18 South, Range 6 East, Sections 1, 2, and 3, and Township 18 South, Range 7 East are managed by the Manti-LaSal National Forest, US Forest Service. The majority of these lands have been mined out and relinquished. Refer to Legal and Financial Volume for lease area, permit area, and adjacent area details.

4.3.1.3 Special Use Permits and Leases

The US Forest Service Manti-LaSal National Forest has issued a special use permit to the Trail Mountain Mine for a right-of-way to the mine property. As discussed previously, the Mine is surrounded by Forest Service land; therefore, the special use permit was required. A copy of the permit can be found in Appendix 4-1.

4.3.2 Mineral Ownership

4.3.2.1 Coal Ownership and Mines

The Mine is located in an area of intermixed state (relinquished), federal, and fee coal. Plate 4-1 shows the ownership of the area surrounding the mine plan area. Those areas not outlined are unleased federal coal.

4.3.2.2 Coal Leases

PacifiCorp was granted federal coal lease U-082996 for 80 acres, U-49332 for 641.47 acres (partial relinquishment of 261.47 acres accepted as of 01/09/09) 380 acres remain and lease U-64375 for 2,630.81 acres (partial relinquishment of 2,504.01 acres accepted as of 01/09/09) 260 acres remain. These mineable leases are located in:

Township 17 South, Range 6 East, SLB&M Section 25, (80 acres); T17S. R6E, Sections 25, 26 and 35 (380.00 acres), T17S. R6E, Sections 26, 27 (260.00 acres); Copies of the leases are found in Appendix 4-2.

4.3.2.3 Mineral Ownership

Ownership of 53.35 acres of surface and mineral rights is held by the permittee. A description of the extent of the mineral ownership is given below:

"Beginning point SW corner of NW1/4, SE1/4, Section 25, T17S, R6E, SLB&M, Thence North 160 rods, thence East 44 rods, to center of Cottonwood Creek, southward along creek to a point 76 rods east of the beginning, thence West 76 rods to the point of beginning."

4.3.2.4 Mineral Leases

A copy of the lease agreements can be found in Appendix 4-2.

4.3.2.5 Oil and Gas Wells

No oil and gas wells have been or are presently being drilled on or adjacent to the mine plan area.

4.3.2.6 Oil and Gas Leases

Oil and gas lease are held on the mine plan area. A state lease ML-31104 is held by Placid Oil Company, filed in September, 1974. Leases held on federal land are shown in Table 4-1.

4.4 LAND USE

4.4.1 Regional Land Use

Traditionally land use in the Wasatch Plateau has been mining, grazing, recreation, wildlife habitat and timber harvesting. Generally land management of the plateau has been controlled by the Manti-LaSal National Forest due to the large portion of the plateau within the forest boundaries.

Table 4-1: Oil and Gas Lease Ownership for Mine Area. (See Plate 4-1)

Location	Ownership	Lease
T 17 S, Section 24		**U-15200**
Southland Royalty Company	25%	
Enterprise Gas Company	37½ %	
El Paso Exploration Company	37½ %	
T 17 S, Section 25		**U-24355**
Hawthorn Oil Company		
T17 S Sections 26 & 35		**U-15197**
Southland Royalty Company	25 %	
Enterprise Gas Company	37½ %	
El Paso Exploration Company	37½ %	
T 18 S, R 6 E, Section 1		**U-23208**
Edward Mike Davis	47½ %	
T 18 S, R 6 E, Section 2		**U-15195**
El Paso Exploration Company	37½ %	
Southland Royalty Company	25 %	
Enterprise Gas Company	37½ %	

4.4.2 Mine Plan Area Land Use

4.4.2.1 Existing Use

Existing land uses of the Mine permit and adjacent areas consist of grazing, wild life habitat and recreation. No commercial forest uses have existed on the privately owned or National Forest lands within the permit or adjacent areas. No farming has or is being done on the permit or adjacent areas.

Grazing - The National Forest land within the mine plan area is considered as unsuitable range (Niebergall, 1981). Since 1981 when John Niebergall made the preceeding statement, lease U-64375 was added to the mine plan area. Much of this lease, issued in 1990 (2,504.01 acres relinquished effective 01/09/09), is used as rangeland for both domestic livestock and wildlife. Section 36 (relinquished 01/31/1996), owned by the State of Utah, is leased by Emile Luke. Eight cows are allowed on the property from June 21 through September 20 (24 AUM's). The actual land within this section utilized for grazing is probably limited to 120 acres or less in the west portion of the section. The remainder of the area is unsuitable for range due to the cliff-like nature of the area. A map showing the US Forest Service grazing allotments is provided (see Figure 4-3). Livestock are also trailed on the road in Cottonwood Canyon (Niebergall, 1981). Cattle are moved to summer range at the higher elevations above the mine plan area.

It should be noted, that PacifiCorp has provided for the US Forest Service and the Trail Mountain Cattleman's Association, fences and gates at the Roan Canyon location and the adjacent Cottonwood Canyon location. The company has provided a cattle guard and a stock corral at the Cottonwood Canyon location, (see Figure 4-3) to aid the cattlemen in their efforts to trail cattle to and from summer ranges above the permit areas.

Recreation - Recreational use of the area consists primarily of sightseeing by people traveling up Cottonwood Canyon to the Upper Joes Valley area. Limited hunting also occurs on the small section of the mine plan area on the plateau. Most of the area is characterized by steep and extremely rugged cliffs which are not conductive to recreational uses (Niebergall, 1981). There is no fishing in the canyon near the mine (Niebergall, 1981).

Access to the mine plan area is by the paved road in Cottonwood Canyon. Jeep trails allow access to the mine plan or adjacent areas on the high plateau above the Trail Mountain Mine. Access is gained via road on the upper end of Trail Mountain.

Farming - Farming is not practical within the permit or adjacent area. Farming is impractical due to the steep and rocky terrain, and therefore, no future farm use is expected within the permit or adjacent area.

4.4.2.2 Previous Mining

Underground Mined Areas - The Johnson mines, located across the canyon from the Mine facilities were active from 1909 to 1948. The Cottonwood Canyon prospects are located across Cottonwood Canyon from the Mine. The Cottonwood Canyon prospects were active from 1946 to 1948. No other known minerals of value have been mined within the permit or adjacent area.

Production from the earlier mines was from the Hiawatha seam by room and pillar mining. An estimated production of 96,000 tons is reported by Doelling (1972) for all mining in the area. Of this, the Cottonwood Canyon mines produced approximately 54,000 tons.

Surface Mined Areas - There have been no previous surface mines located within the mine permit or adjacent areas.

4.4.3 Land Use During Operations

Land use in the area has not changed greatly in the past 20 to 50 years. The following section will look at the potential effects of the operation on the use of the land. At the present time, Applicant has no plans to disturb any additional surface area during the mining permit term.

4.4.3.1 Effect of Operation on Land Use

The Trail Mountain Mine has operated in the Cottonwood Canyon since 1946. Land use in the canyon has adapted to the existence of the mining operation. As described previously, the majority of the mine plan area is not suitable for grazing or forestry. The uses affected are wildlife habitat and recreation. Recreationalists and ranchers use the canyon for access to the upper parts of Cottonwood Canyon and the top of the plateau. Sightseeing and seasonal cattle drives are the only major activity, other than mining, in the lower canyon.

Access up the canyon is not obstructed by the mining operation and facilities. Traffic on the county access road is not a problem. In 1987, three miles of the Cottonwood Canyon road from Highway 29 to the Trail Mountain Mine site was surfaced with six inches of asphalt.

4.4.3.2 Mitigation of Effects of Operation

The realignment and surfacing of the access road has greatly facilitated traffic flow and has mitigated any erosion or fugitive dust pollution problems.

The mine plan area due to its underground nature will have no adverse impacts other than those which may result through subsidence. Should subsidence occur and alter springs, seeps, or ponds that is used as a watering source for wildlife or cattle, the permittee will commit to mitigating the loss of seeps and springs with the installation of guzzlers. These guzzlers will be fenced to keep out cattle and allow wildlife in.

Manmade and natural stock ponds are provided on the Trail Mountain area as a source of water for grazing cattle. These ponds are supplied by snow runoff or springs. There are several developed springs in the allotment areas that have watering troughs. If subsidence affects ponds, the ponds will be rebuilt with equipment and a bentonite liner will be placed in the affected pond. Should subsidence alter a seep or spring that is supplying a water source to livestock, the permittee will, after consulting with the Forest Service and DOGM, commit to replace or relocate the trough or pond to a suitable range area. The permittee has implemented a subsidence and hydrologic monitoring program whereby, the extent and the effects of subsidence to water resources can be studied, identified, and the appropriate mitigating action taken.

4.5 POST MINING LAND USE

4.5.1 Mine Plan Area

Land use following mining will remain essentially the same on a regional basis. A combination of coal mining, grazing, wildlife habitat and recreation will tend to be the typical uses. These uses will be, as previously described, strongly influenced if not controlled by the Manti-LaSal National Forest.

The post mining use of the mine plan areas is proposed as a multiple use of grazing, wildlife habitat, hunting and recreation. All of these uses are compatible with the surrounding area.

4.5.2 Mine Site

The mine site will be reclaimed to a grazing, wildlife habitat, and recreational use. Rehabilitation of the site will include removal of all buildings and facilities, regarding the tipple pad and sediment pond, removal of the bypass culvert, and reestablishment of stream, soil preparation, and revegetation of the site.

Use of the site will probably be recreational during late spring, summer, and fall and for wildlife grazing during the winter and early spring. In this area, the recreational use should not interfere with the wildlife use due to limited access during the winter months. This will allow for protection of the deer during the crucial period while on their winter range.

4.5.3 Final Surface Configuration

The graded surface of the mine site will blend existing slopes into the surrounding terrain. The slopes will be stabilized with vegetation, and the erosion hazard reduced. (See Chapter 3.)

4.6 BIBLIOGRAPHY

US Forest Service, 1979. Land Management Plan. Ferron-Price Planning Unit, Manti-LaSal National Forest, Price, Utah.

Niebergall, John-US Forest Service, District Ranger, Manti-LaSal National Forest, Ferron, Utah - Range Improvement and Allotment Description

CHAPTER 5

HISTORICAL AND CULTURAL RESOURCES

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HISTORICAL AND CULTURAL RESOURCES

5.1 SCOPE

This chapter reviews the existence and potential for historical, archeological, and paleontological resources in the area of the Mine. Also discussed is the potential effect the mining activities will have on the cultural resources.

5.2 METHODOLOGY

The cultural evaluations of the existence and potential of historical, archeological, and paleontological resources contains information from a record and archival examination and intensive surveys of the mine plan area and all development zones.

Evaluation of cultural resources for historic and prehistoric sites is done by the use of site quality indicators. Assessment of significance of the sites discovered utilizes the Cultural Resource Rating System (CRRS). CRRS is best explained by quoting the Bureau of Land Management definition sheet:

Cultural Resource Rating System

The following criteria are established as guidelines. The Bureau recognizes that the assignment of a particular rating is a professional judgment; however, the rationale of these judgments will be explicitly documented as part of the evaluation process.

Assign an evaluation rating (S1, S2, S3, S4) to each site according to the following guidelines and record on the BLM Form 6400-3:

S1. S1 sites are those sites which are worthy of preservation in situ. In general they are sites in relatively good condition with integrity (both internal and external); and the unique or representative; and/or have associations with important events or personages; and/or have yielded, or have a clear potential for yielding, highly significant scientific or educational information.

S2. S2 sites are those sites which contain important scientific or educational data but yet are not worthy of preservation in situ. They are not generally not particularly unique, representative, nor do they have important associations. Many contemporary sites may be S2 sites because, they cannot be clearly and immediately assessed as such, and they may become highly significant when evaluated from a future historical perspective.

S3. S3 sites are those sites whose main worth is their potential for contributing data in regard to solving larger problems, such as reconstruction of paleo-environments and human use patterns. These kinds of sites generally show little concentration of artifacts, few features, no important associations, and little or no uniqueness or representativeness.

S4. S4 sites are those sites which have minimal information retrieval possibilities, or which have no integrity, uniqueness, representativeness, or no important associations.

5.3 HISTORIC RESOURCES

5.3.1 Historical Inventory

No historical resources are known to exist within the mine plan area. A study performed by Archeological Environmental Research Corporation (AERC) in July, 1979 showed no historic sites in the canyon bottom (see Plate 5-1 and Appendices 1 & 2, for a copy of Plate 5-1 and Appendix 1 [including Figure 5-1] .

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5.3.2 History of Mining

Mining activities existed on or near the site of the Trail Mountain Mine since 1898 (Doelling, 1972). The first large scale operation on the site, the Johnson Mines, opened in 1909. A series of three mines, the Johnson property operated from 1909 through 1948. The amount of coal produced during that period and the extent of the workings is unknown.

In 1946 three additional operations started in Cottonwood Canyon. Two prospects operated for a short time (1946-1952) (Doelling, 1972). Activity at the Trail Mountain Mine started in 1946 and lasted until 1967. The mine was then shut down for 10 years and reopened under the ownership for Mr. John Bell of Orangeville, Utah. Mr. Bell operated the mine until 1979. The Fetterolf Group then operated the mine until 1981, when it was purchased by Natomas Trail Mountain Coal Company. The property was subsequently purchased by Diamond Shamrock, later by Arch Minerals Corp., by Beaver Creek Coal Company (1987), and finally by PacifiCorp (1992) who presently operates the mine.

5.3.3 Effects of Mining on Historical Resources

There are no sites listed or eligible for listing in the National Register of Historic Places located within the mine plan area. Therefore, no effect will occur due to the mining.

5.4 ARCHEOLOGICAL RESOURCES

5.4.1 Archeological Inventory

Five archeological sites (279E/1 through 279E/5) and four isolated artifacts (279E/x1 through 279E/x4) were identified by AERC in the lower section of Cottonwood Canyon (see Plate 5-1: Refer to PacifiCorp Confidential and Private Information Volume: Trail Mountain tab). Two of the archeological sites, 279E/3 and 279E/5 have important data remains. Some vandalism had occurred at these sites. "The abundance of charcoal and the lack of ceramics, suggests possible datable archaic habitation. Site depths of up to a meter of fill evidently contain important statigraphic data. Both sites have register potential (CRRS: S-2) because of the scientific information potential". (AERC, 1979.)

Site 279E/2, located north of 279E/4 is something of an enigma. The site consists of a rectangular stone foundation, but the lack of other surface materials, and apparent depth, make it difficult to determine whether the site was historic or an unusual, perhaps an uncompleted prehistoric structure. Because of the stone alignments, and its pinon-juniper bench location, the site is suspected as prehistoric. It was judged not to have National Register potential and rated CRRS: S-4.

The two remaining sites 279E/1 and 2 were both CRRS: S-4 lithic scatters. No diagnostic tools were found upon them or any of the other previously described sites (for a complete discussion related to the cultural resources of Cottonwood Canyon refer to "A Preliminary Report on the Cultural Resources and Test Excavations in Cottonwood Canyon, Emery County, Utah [UP&L-79-5A, B, C]", 1979, report prepared for Utah Power & Light Company by Archeological Environmental Research Corporation, Salt Lake City, Utah).

5.4.2 Effects of Mining on Archeological Resources

The Cottonwood Creek area seems to have been the scene of limited but significant prehistoric activities. Two of the isolated artifact locations 279E/X1 and X2 had every appearance of having been sites long since eroded. These isolates compliment the two other lithic scatters and indicate limited hunting activities along the drainage. The depth of charcoal in the rock shelters indicates that their prehistoric occupation could involve a considerable chronological period.

In the area the artifacts were located, little impacts from the mining activities will occur. The sites located near the roadside will be and have been subject to vandalism. Future improvements to the road suggested by Emery County and the Forest Service may significantly impact the sites.

If such improvements occur then an intensive study will need to be undertaken to determine mitigation procedures. At the present time no significant impacts are expected.

5.5 PALEONTOLOGICAL RESOURCES

5.5.1 Paleontologic Inventory

Fossils are found on the mine plan area in nearly all of the geologic units. With the exception of dinosaur footprints found in the coal seams of the Blackhawk Formation, no significant paleontologic specimens are known to be present (US Forest Service, 1978).

5.5.2 Effects of Mining on Paleontologic Resources

No significant effects to the paleontologic resources are expected by the mining activities. The occurrence of dinosaur foot prints in the coal seams is not a unique occurrence.

5.6 PUBLIC PARKS

5.6.1 Inventory of Public Facilities

No public facilities are located within the permit area. A public road provides access to the site and the upper canyon.

5.6.2 Effect of Mining on Public Facilities

No effect on public facilities is expected from the mining operation. Access on the public road will not be affected.

5.7 BIBLIOGRAPHY

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US Forest Service, 1978. Environmental Assessment - Trail Mountain Federal Lease U-982996. Price, Utah.

US Forest Service, 1982. Environmental Assessment - Trail Mountain Coal Company, Tract 2 Coal Lease No. U-49332. Price, Utah.

Utah Power & Light, 1980. Mining and Reclamation Plan, Wilberg Mine-Cottonwood Modification. Salt Lake City, Utah.

A Preliminary Report on the Cultural Resources and Test Excavations in Cottonwood Canyon, Emery County, Utah (UP&L-79-5A, B, C)" , 1979, report prepared for Utah Power & Light Company by Archeological Environmental Research Corporation, Salt Lake City, Utah.

CHAPTER 6

GEOLOGY

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GEOLOGY INFORMATION

6.1 SCOPE

The purpose of this chapter is to explain the geologic setting and characteristics of the coal and rock units in the Mine permit area.

6.2 METHODOLOGY

General geology of the area has been described by E. M. Spieker (USGS Bulletin 316, 1931) and H. H. Doelling (Utah Geology & Mineral, Survey Monograph Series No. 3, 1972). Details of the quality and mining characteristics of the Hiawatha seam are based on experience from the Mine.

6.3 REGIONAL GEOLOGY

The Mine is located near the center of the Wasatch Plateau coal field (see Figure 6-1 Location Map), 3 miles from the mouth of Cottonwood Canyon and 11 miles from Orangeville. The coal field is oriented nearly north-south and is bounded to the east by an erosional escarpment; the west boundary roughly parallels the drainage divide of the Wasatch Plateau. The plateau has a vertical relief of up to 2,500 feet, rising from the Castle Valley below. In the vicinity of Trail Mountain, the terrain can be characterized by narrow flat-topped mesas surrounded by heavily vegetated slopes which extend to precipitous cliffs leading to the valley below.

The Wasatch Plateau coal field was formed along the western shoreline of the Cretaceous Seaway. Sediments deposited in the sea and coastal areas were derived mainly from western Utah. The Cretaceous Seaway oscillated due to tectonic events forming marine and non-marine sequences characteristic of fluvial, wave-dominated delta, and strand-plain deposits. Formations exposed in the Trail Mountain region range from Upper Cretaceous to Tertiary. Figure 6-2 (Stratigraphic Correlation Diagram) and Plate 6-1 (Geologic Cross Section) depicts the sequence of rock units which occur in the Wasatch Plateau coal field.

Older Cretaceous formations including members of the Mancos Shale are exposed in Castle Valley and extend to the escarpment at the eastern edge of the Wasatch Plateau. The steeper sections of the escarpment belong to the Mesaverde Group formations and the uppermost units on the plateau are the latest Cretaceous and early Tertiary rocks (Doelling 1972). The stratigraphy of the individual formations is discussed in the "Geology of the Permit Area - Stratigraphy."

6.4 REGIONAL STRUCTURE

Strata in the northern part of Trail Mountain are gently up-folded into the Flat Canyon anticline. In the southern part of Trail Mountain the strata gently dip into the Straight Canyon syncline. Both structures have a bearing of approximately north 50^0 east and plunge to the southeast. The dips of the strata on Trail Mountain generally are 2^0 or 3^0 and rarely exceed 5^0 (Lines 1984).

The Joe's Valley fault breaks the continuity of the geologic units along the west edge of Trail Mountain. Davis and Doelling (1977) estimate approximately 2,300 feet of vertical displacement along the fault in this area. The Joes Valley fault is the eastern fault boundary of a graben structure, approximately 2 miles in width, and extends at least 20 miles north of Trail Mountain and at least 40 miles to the south.

6.5 GEOLOGY OF THE PERMIT AREA

The following section will describe the stratigraphy and structure of the permit area. Plate 6-2 (Geologic Map - Trail Mountain Area) shows the geology of the mine plan and adjacent areas.

6.5.1 Stratigraphy of the Permit Area

The rock formations exposed in the Trail Mountain area range from Upper Cretaceous to Tertiary in age. The formations, in ascending order, are the Masuk Shale member of the Mancos Shale, Starpoint Sandstone, Blackhawk, Castlegate Sandstone, Price River, North Horn, and Flagstaff Limestone. Figure 6-3 is a generalized section of the rock units with range of thickness and a general lithologic description.

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The Masuk Shale member of the Mancos Shale, which outcrops along Cottonwood Creek, is the lowermost stratigraghic unit exposed in the permit area. The Masuk Shale member of the Mancos Shale is about 1300 feet thick and consists mostly of gray shale with occasional yellow-gray sandstone interbeds. Westward thinning wedges of the Masuk Shale interfinger with the basal tongues of the Starpoint Sandstone. It is generally void of water.

The Starpoint Sandstone, which is a prominent cliff former, consists of several eastward thinning marine sandstone tongues of medial Campanian age (Clark, 1928). The three members are the basal Panther Sandstone, the middle Storrs Sandstone, and the upper Spring Canyon Sandstone. These sandstone units are generally separated from each other by westward projecting tongues of Mancos Shale. The basal Panther Sandstone is approximately 100 feet thick and consists of massive, well indurated, cross-bedded delta front sandstones. The Storrs Sandstone is located about 120 feet above the top of the Panther Member and consists of 50 feet of soft, friable sandstone. The Spring Canyon is located about 80 feet above the top of the Storrs Member and consist of 100 feet of massive, fine to medium grain, cross-bedded delta front sandstones. Even though the Starpoint formation exists throughout the entire Trail Mountain property, the low permeability and lack of recharge limit its usefulness as a water producing aquifer. Permeability and the limiting factors of recharge, i.e., very little outcrop exposure and limited vertical groundwater migration, are caused by the mudstone layers of the North Horn formation. Locally, the Starpoint Sandstone exhibits aquifer characteristics. These are isolated occurrences where regional faults have created secondary permeability and have been intersected by major canyons with perennial streams. An example is Little Bear spring located in Huntington Canyon.

The Blackhawk Formation overlies the Starpoint Sandstone and is 625-800 feet thick in the Trail Mountain area. The Blackhawk consists of alternating sandstones, siltstones, shales and coal deposited in a deltaic environment. Although coal is generally found throughout the Blackhawk Formation, the economic seams are restricted to the lower 150 feet of the formation. The seam mined at Trail Mountain is the Hiawatha seam, which occurs at the contact between the Blackhawk Formation and the Starpoint Sandstone. The sandstones contained within the Blackhawk Formation are fluvial and increase in number in the upper portions of the formation. Many of the tabular sandstone channels form local perched water tables.

The Castlegate Sandstone immediately overlies the Blackhawk; it is 250-300 feet thick and consists of mostly coarse-grained often conglomeratic sandstones. The Castlegate normally forms a massive cliff on the canyon walls. The formation is considered to be fairly permeable but, where it has been intersected by drill holes, has never been found to be water-saturated. It is oftentimes dry or slightly damp in some zones. It is void of significant water because it lacks adequate recharge.

The Price River Formation overlies the Castlegate and consist mainly of medium- to coarse-grained sandstone with occasional interbeds of shale and carbonaceous shale. Individual beds are not as massive as the Castlegate Formation and are more friable, thus eroding more easily and forming step-like outcrops (Doelling, 1972). It is generally void of water because it lacks adequate recharge.

The top of the plateau consist mostly of the North Horn Formation. The North Horn Formation straddles the Cretaceous/Tertiary boundary. According to Spieker (1931), the Wasatch Formation (North Horn) contains a highly varied assemblage of rock types. In the central part of the plateau the lower member of the North Horn consists predominantly of varicolored shale, in which the combinations of various shades of red, purple, chocolate-brown, green and gray are characteristic of the coloring of Wasatch rocks in the general region, but it contains many irregular beds of gray, brown and cream colored sandstone of various texture and thin beds of fresh water limestone. The thickness of the North Horn Formation on Trail Mountain ranges from 750 to 800 feet and increases to the west.

Lenticular sandstone channels are oftentimes present in the upper and lower portions of the formation. Water which percolates down fractures from the overlying Flagstaff Limestone works its way into the sandstones, forming the perched water tables. The actual lateral extent, or correlation, between the perched water tables has not been identified; and it is not practical to do so because the tables are limited in extent and variable in stratigraphic location. Many springs have been identified where the sandstone channels intersect the land surface.

The lower two-thirds (upper Cretaceous in age) of the formation is generally highly bentonitic mudstone, which is impermeable. It is likely that this material is acting as an aquiclude, preventing adequate recharge from reaching the Price River Formation or Castlegate Sandstone below. The mudstones present swell when they come in contact with water; therefore, vertical migration of water along fractures through this material is limited because the fractures are sealed by the swelling clays.

The depths of the aquifers in the North Horn Formation are variable due to the rugged topography. The localized perched water tables may either intersect the surface of the ground or be covered by as much as 1,000 feet of overburden. They are located at least 1,400 feet above the coal seam to be mined. Communication of water between the perched aquifers in the North Horn Formation and the water flowing into the mine is limited in quantity and occurs very slowly. The monitoring of the numerous springs located on Trail Mountain gives PacifiCorp the ability to assess any effects that mining might have on the North Horn Formation perched aquifers.

The Flagstaff Limestone forms the uppermost peaks and caps on the Wasatch Plateau. It is a light-medium gray, fine-grained, occasionally fossiliferous limestone. This formation displays a strong joint pattern which permits good groundwater movement both vertically and horizontally through the formation.

6.5.2 Structure - Permit Area

There are no identified faults or major folds within the permit area. As mentioned earlier, both the Joe's Valley fault and the Straight Canyon Syncline lie west of the permit area (See Plate 6-3 Structural Contour Map - Hiawatha Seam). Data gathered by PacifiCorp indicate that the strike-slip component of the Roans Canyon Fault encountered in the East Mountain property may extend into the Trail Mountain area west of the permit area. On East Mountain both the Straight Canyon Syncline and the Roans Canyon Fault have a bearing of north 50° east. The Hiawatha seam in the permit area appears to be free from faulting and has a general dip of approximately 3° to the west-southwest. Depth of cover over the Hiawatha seam ranges from zero at the outcrop to approximately 2000 feet in the west-central portion of Section 36, T 17 S, R 6 E. (See Plate 6-4 Overburden Isopach Map - Hiwawtha).

6.6 GEOLOGY OF THE COAL BED AND ADJACENT STRATIGRAPHIC UNITS

6.6.1 Exploration and Drilling

There are a total of 21 drill holes on and adjacent to the permit area. Hole locations are shown on the Geology Map, Plate 6-2. Due to the competitive nature of the coal lease sales and the fact that unleased federal coal exist adjacent to the current lease, drillhole logs, coal thicknesses and quality information are considered proprietary at this time. Only general information will be submitted with this application.

6.6.2 Stratigraphy- Mine Horizon

The Hiawatha seam generally lies directly on the top of the Star Point Sandstone, although 1 to 15 feet of intervening shale is present in some locations. The coal seam has a mineable thickness of 6.5 to 13.5 feet in the Trail Mountain permit area. The immediate roof varies in lithology in the mine area and consists of 1 to 5 feet of alternating mudstone, thin coals, and fine-grained sandstone. Above this variable zone is a thick-bedded fluvial sandstone which forms a competent roof (see Figure 6-4 Detailed Column of Interest). The nature of the coal seam outcrop is concealed by slump and/or natural burn along much of the west side of Cottonwood Canyon.

6.6.3 Structure - Permit Area

The Hiawatha seam in the permit area appears to be free from faulting and major folds (see Plate 6-3 Structural Contour of the Hiawatha Seam). The dip in the mine permit area is approximately 3^0 west-southwest and is part of the east limb of the Straight Canyon Syncline. The Joe's Valley Fault lies approximately 2 miles west of the lease boundary as does the Joe's Valley Reservoir. The fault and resulting syncline influences the dip of the coal seam, ultimately placing the mining elevation below the level of the Joe's Valley Reservoir. It is recognized that this circumstance will likely increase ground water flows into the mine. Further discussion of potential hydrologic impacts can found in Section 7.1.5 of this application.

6.6.4 Coal Reserves

6.6.4.1 Reserve Calculations

Mine measurements, outcrop measurements and thicknesses penetrated in drill holes were used to construct a mineable coal isopach map of the Hiawatha seam. (See Plate 6-5 Isopach Map - Hiawatha Seam).

No reserves were calculated within 100 feet of property lines. Minimum coal thickness used is 5 feet for in-place and 6 feet for recoverable reserves. Various recovery factors were used reflecting mining conditions and mine development areas. Coal density of 80 lbs/ft^3 was used. Reserve estimates are shown on Table 3-1 in Chapter 3.

6.6.4.2 Coal Quality

The Hiawatha seam is the only mineable seam within the permit area. The seam has had the following quality characteristics:

TABLE 6-2 QUALITY

COAL QUALITY CHARACTERISTICS	
PARAMETER	PROXIMATE ANALYSIS (As Rec'd)
% Moisture	7.5%
%Ash	9.3%
% Sulfur	0.57%
BTU	12,063
Volitile Matter	38.90
Fixed Carbon	43.85

6.6.5 Pyrite Content and Alkalinity

Core Laboratories, Inc. performed an analysis on a sample of the floor and roof material in the center of the permit area at Section 1 West and 40th cross-cut. The results indicate very low pyritic sulfur and high neutralization potential of high C_1CO_3 equivalent; therefore, mine acid drainage is not a potential problem. (See Table 6-3, end of text.)

Two additional sets of samples have been taken from the northwest and southwest areas of Lease 49332 (Main North and 2nd Left). Analyses of the roof and floor material from these areas were run in accordance with the Division Guidelines. Results of these analyses are in Appendix 6-2.

Samples will be taken of the roof and floor material and analyzed for toxic and acid forming potential. These samples will be collected on an annual basis in areas mined within the past year and will be analyzed in accordance with DOGM Guidelines.

6.6.6 Pyritic Content of Coal Seam

The following table lists the sulfur forms of the Hiawatha Seam based on samples collected in March 1983.

TABLE 6-4 PYRITE CONTENT

PYRITE CONTENT - HIAWATHIA SEAM		
SULFUR FORMS	% WEIGHT	
	As Received	Dry Basis
Pyrite Sulfur	0.10	0.11
Sulfate Sulfur	0.00	0.00
Organic Sulfur	0.41	0.43
Total Sulfur	0.51	0.54

6.6.7 Intercepted Groundwater

Within the current mine workings there were only two long-term water producing areas. These areas are designated as UG-2 and UG-3 on Plate 7-3. Former monitoring point UG-1 is in an area that was sealed, and monitoring was discontinued in early 1988. Monitoring point UG-2 has been sampled since 1988; however, the flow decreased to less than 0.1 gallons per minute. This station may be discontinued if the flow continues at this level.

Two types of ground water occurrences have been recognized within the current mine workings. (See Figure 6-5 Ground Water Occurrences).

1. Fractures and joints (lineaments).
2. Roofbolt and in-mine drillholes.

During the mining process ground water encountered from fractures, joints and in-mine drillholes has been very minimal and dries up in the span of a few days, which indicates the presence of small pockets of perched water and not an underground aquifer. (Greg Lines, USGS.) Whenever sufficient quantities of ground water are encountered in new mining activities, (flows exceeding 3 GPM for a least 30 days) PacifiCorp will collect and analyze the samples and incorporate locations and sample analysis into the monitoring program. Groundwater monitoring for the permit areas will also consist of collecting water quality and quantity data from points of significant inflow to the underground workings. An inventory of the active portion of the mine will be conducted on a quarterly basis to identify the location and geologic occurrence of mine inflows that exceed three gallons per minute. In consultation with DOGM, certain of these inflows (if they occur) will be selected for continued monitoring. Samples from all monitoring stations will be collected and analyzed according to DOGM Guidelines. Groundwater monitoring data collected during the calendar year will be summarized and submitted to DOGM on an annual basis. Included in the annual report will be an analysis of the mine working water balance, accounting for mine inflows, outflows, consumptive uses, and sump storage.

6.7 GEOLOGIC EFFECTS OF MINING

A complete description of the geologic effects of mining is found in Chapter 11, Geotechnical.

6.8 BIBLIOGRAPHY

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Spieker, E.M., 1931. The Wasatch Plateau Coal Field. USGS Bulletin 819.

Open Field Report 81-559, Water Resources Investigation USGS 1981.

ANALYTIC REPORT

APRIL 20, 1983

ATOMAS COAL COMPANY

Job No.: 6303-S83027
Chemist: LLZ
Location: Casper, WY

Client I.D.	Interval	Sample Number	% Pyritic Sulfur	Acid Base* Potential	Neutralization* Potential	meq H+/100 gr.	% Clay Fraction
ample No. TMM 1 W,40 Down	0.0-2.7 Ft.	1	0.18	+81.6	+87.5	11.9	2.0
ample No. TMM 1 W, 40 Up	2.0-4.0 Ft.	2	0.33	+90.2	+106.5	32.5	

$\pm$ Tons $CaCO_3$ Equivalent/1000 Tons Material

TABLE 6-3

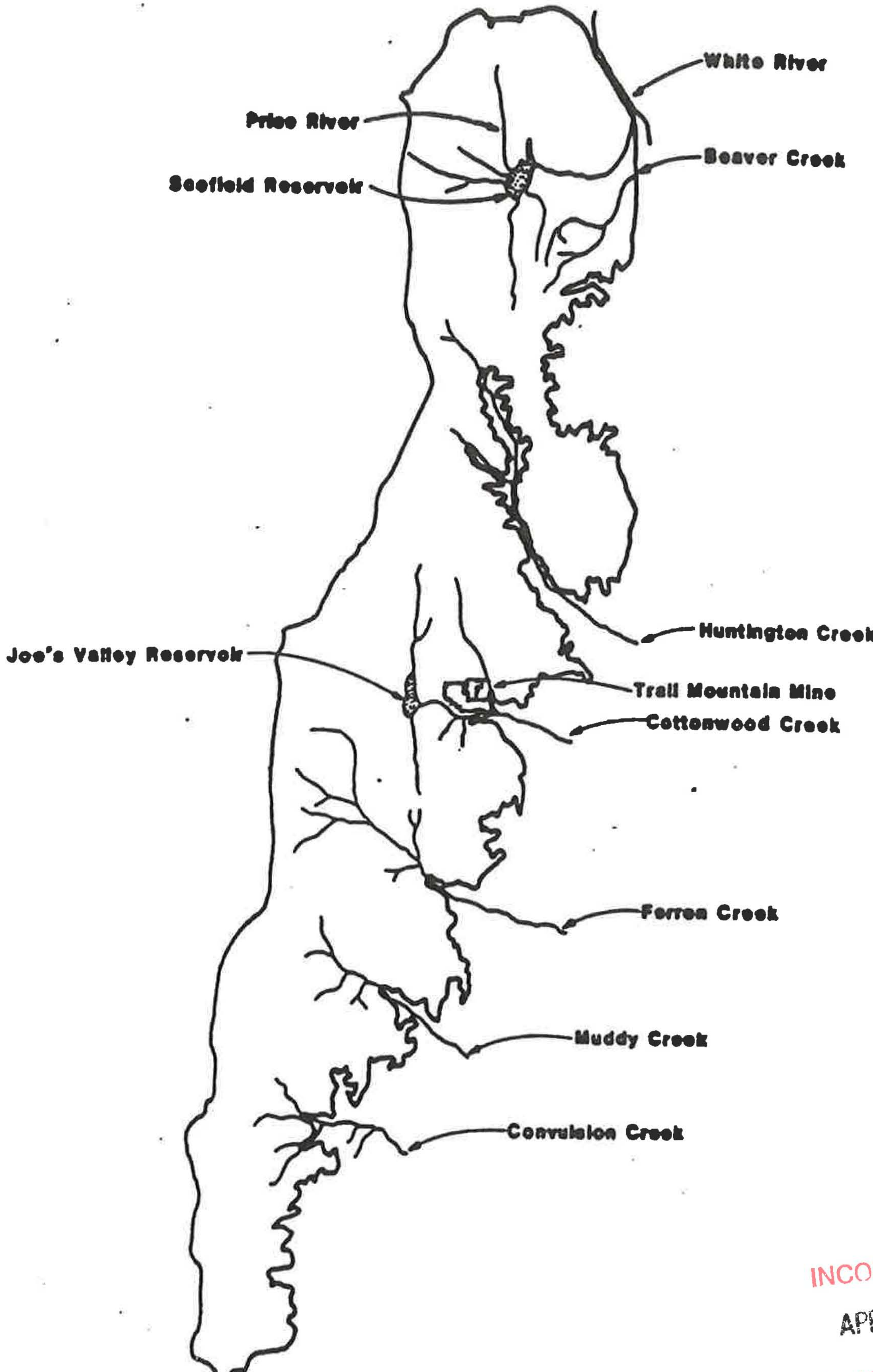


FIGURE 6-1 LOCATION MAP

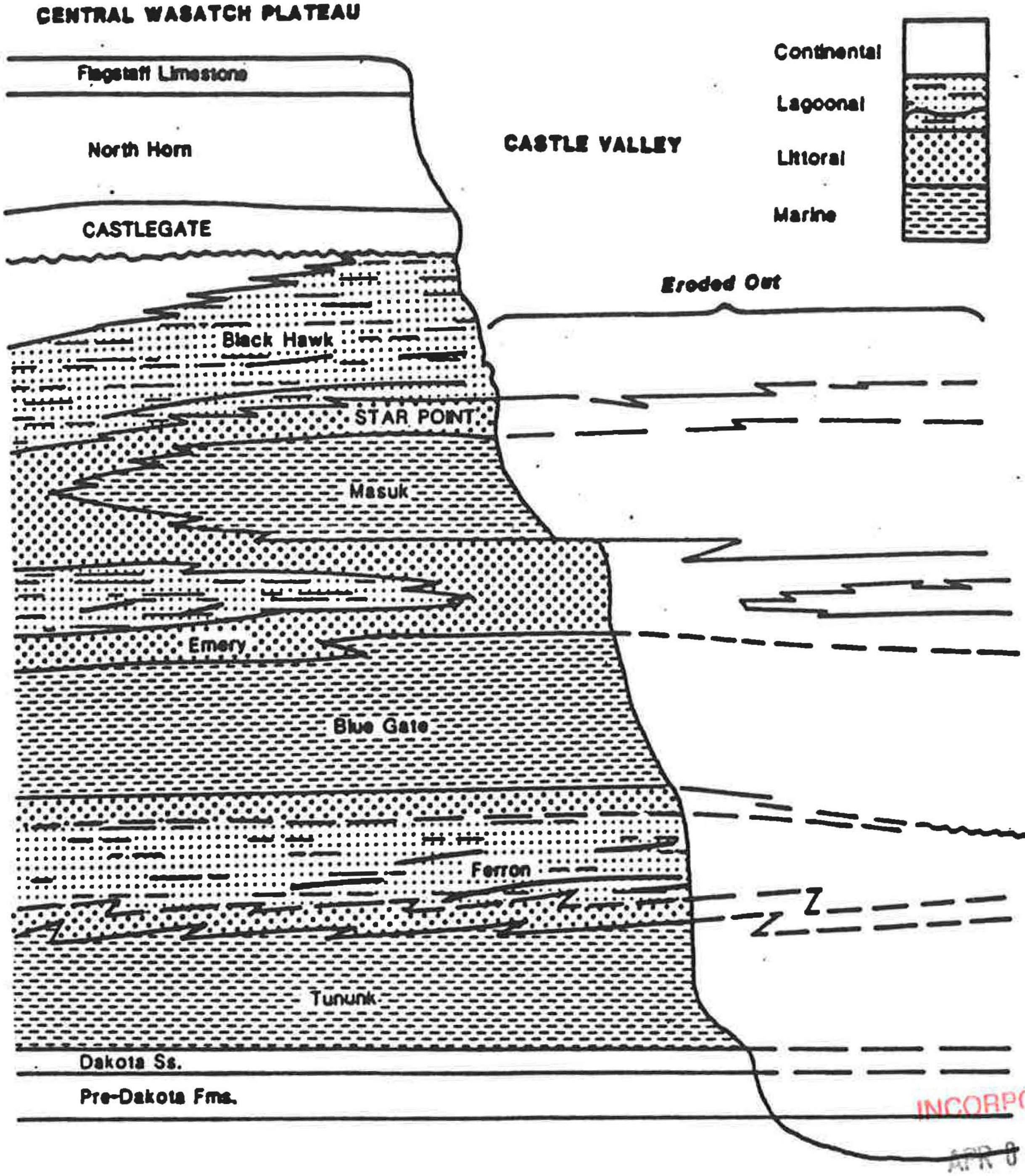


FIGURE 6-2
Stratigraphic correlation diagram from central Wasatch Plateau to the Castle Valley.

FIGURE 6-3

Stratigraphy of Trail Mountain (Doelling, 1972)

System	Series	Group	Stratigraphic Unit	Thickness (feet)	Description
TERTIARY	Eocene		Green River Formation	–	Chiefly greenish lacustrine shale and siltstone.
TERTIARY		Wasatch Group	Colton Formation	300-1,500	Varicolored shale with sandstone and limestone lenses, thickest to the north.
TERTIARY	Paleocene	Wasatch Group	Flagstaff Limestone	200-1,500	Dark yellow-gray to cream limestone, evenly bedded with minor amounts of sandstone, shale and volcanic ash, ledge former.
CRETACEOUS	? Maestrichthian	Wasatch Group	North Horn Formation (Lower Wasatch)	500-2,500	Variegated shales with subordinate sandstone, conglomerate and freshwater limestone, thickens to north, slope former.
CRETACEOUS		Mesaverde Group	Price River Formation	600-1,000	Gray to white gritty sandstone interbedded with subordinate shale and conglomerate, ledge and slope former.
CRETACEOUS		Mesaverde Group	Castlegate Sandstone	150- 500	White to gray, coarse-grained often conglomeratic sandstone, cliff former, weathers to shades of brown.
CRETACEOUS		Mesaverde Group	Blackhawk Formation *MAJOR COAL SEAMS*	700-1,000	Yellow to gray, fine- to medium-grained sandstone, interbedded with subordinate gray and carbonaceous shale, several thick *coal* seams.
CRETACEOUS	Campanian	Mesaverde Group	Star Point Sandstone	90-1,000	Yellow-gray massive cliff-forming sandstone, often in several tongues separated by Masuk Shale, thickens westward.
CRETACEOUS	Santonian	Mancos Shale	Masuk Shale	300-1,300	Yellow to blue-gray sandy shale, slope former, thick in north and central plateau area, thins southward.
CRETACEOUS		Mancos Shale	Emery Sandstone *COAL (?)*	50- 800	Yellow-gray friable sandstone tongue or tongues, cliff former, may contain *coal* (?) in south part of plateau if mapping is correct, thickens to west and south. *Coal* may be present in subsurface to west.
CRETACEOUS	Coniacian	Mancos Shale	Blue Gate Member	1,500-2,400	Pale blue-gray, nodular and irregularly bedded marine mudstone and siltstone with several arenaceous beds, weathers into low rolling hills and badlands, thickens northerly.
CRETACEOUS	Turonian	Mancos Shale	Ferron Sandstone Member *MAJOR COAL SEAMS*	50- 950	Alternating yellow-gray sandstone, sandy shale and gray shale with important *coal* beds of Emery coal field, resistant cliff former, thickens to the south.
CRETACEOUS	Cenomanian	Mancos Shale	Tununk Shale Member	400- 650	Blue-gray to black sandy marine slope forming mudstone.
CRETACEOUS	Albian		Dakota Sandstone *MINOR COAL*	0- 60	Variable assemblages of yellow-gray sandstone, conglomerate shale and *coal*. Beds lenticular and discontinuous.

Generalized section of rock formations, Wasatch Plateau coal field.

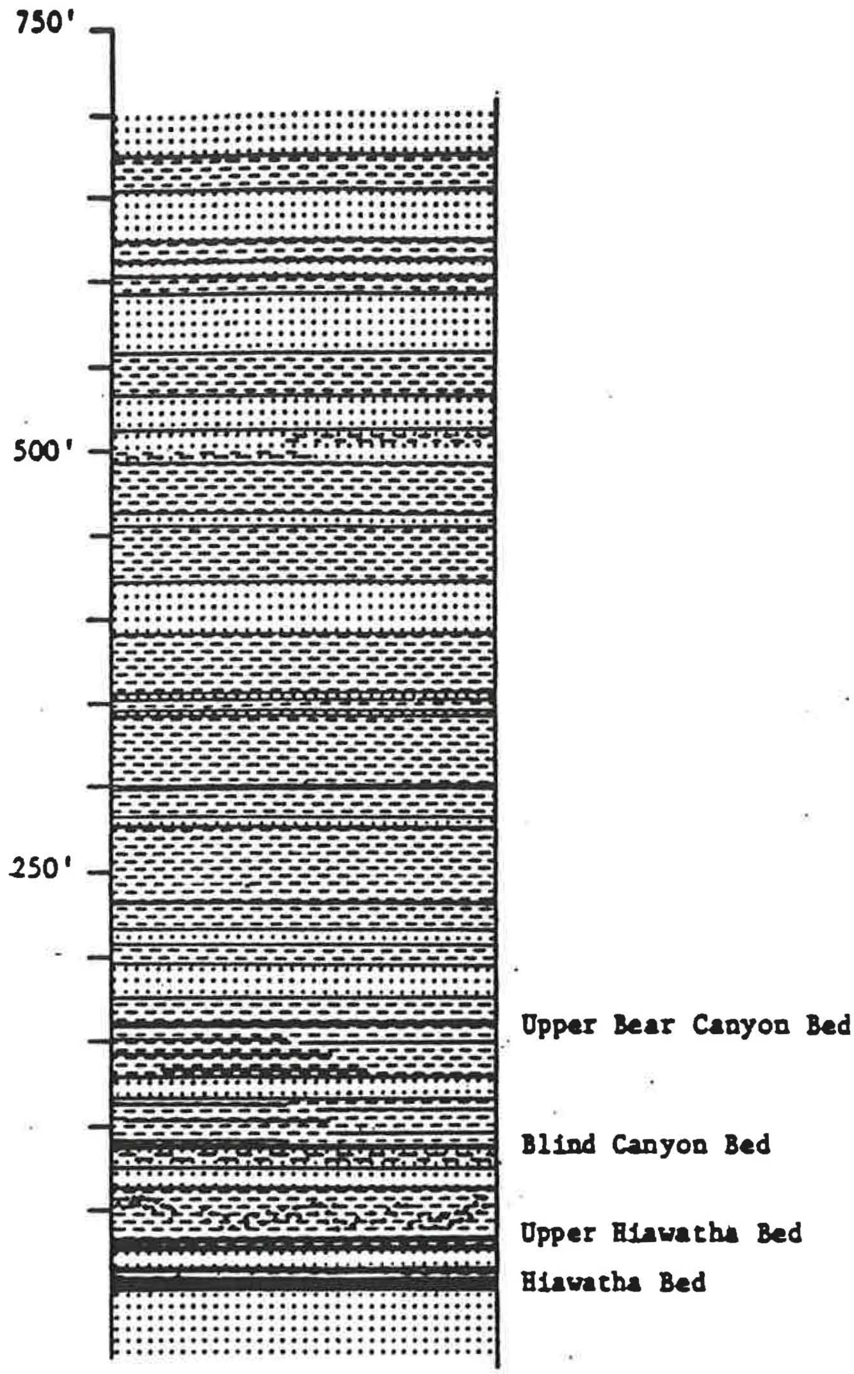
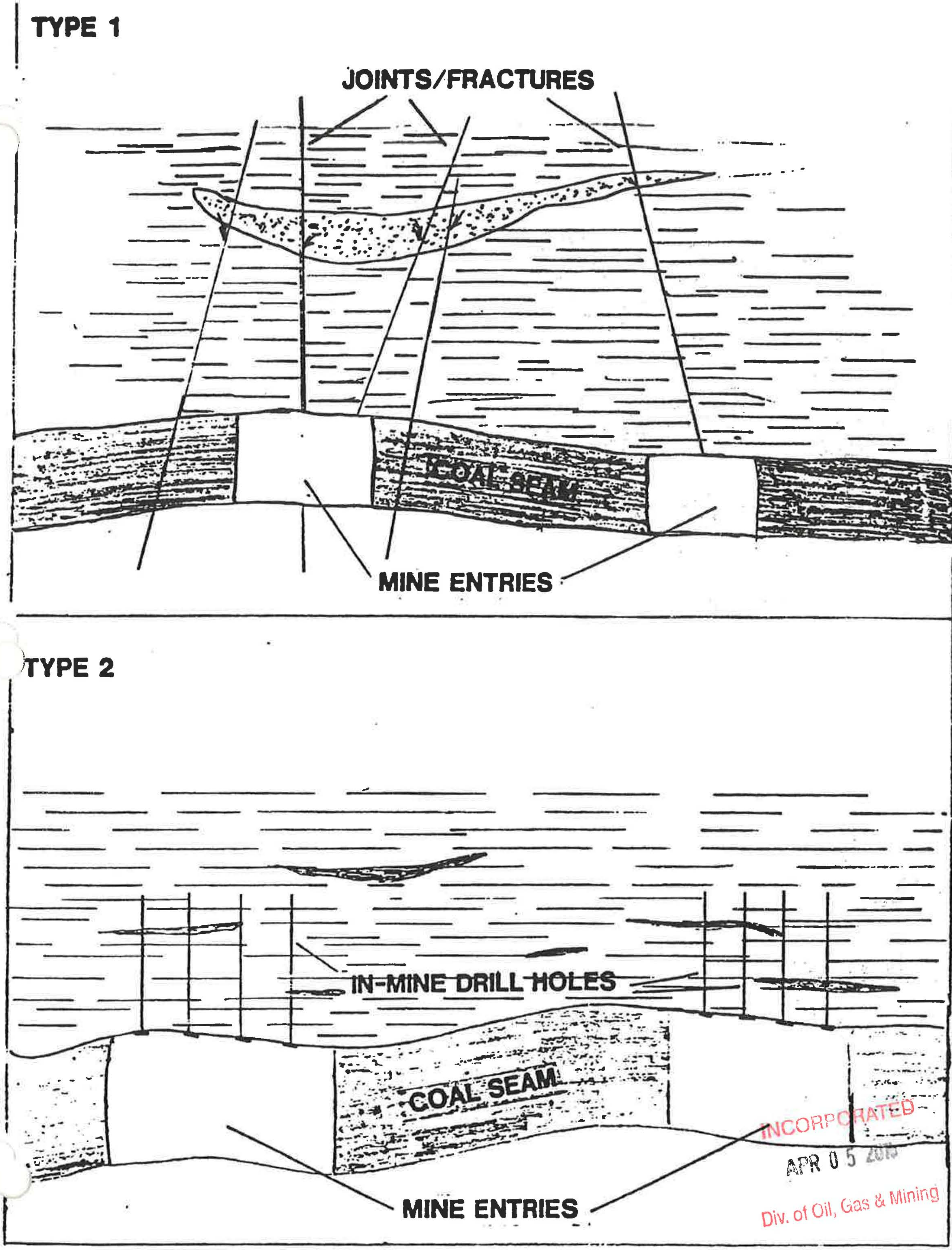


FIGURE 6-4 Detailed Stratigraphic Section SW 1/4, NE 1/4, Sec. 25, Township 17 S, Range 6 E, SLB&M.



TYPE 1
JOINTS/FRACTURES
COAL SEAM
MINE ENTRIES
TYPE 2
IN-MINE DRILL HOLES
COAL SEAM
MINE ENTRIES

FIGURE 6-5

CHAPTER 7
HYDROLOGY

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HYDROLOGY

7.1 GROUNDWATER HYDROLOGY

7.1.1 Scope

The scope of the groundwater section of this report is to describe the existing groundwater hydrologic conditions of the mine plan area and adjacent areas and to describe the methods that have been and will be used to predict and monitor the impacts from mining (see Figure 7-1 for location of the Permit Area). Sections within the groundwater section of this report will cover the following major topics: methodology, existing groundwater resources, groundwater hydrologic balance, mitigation and control plans, and groundwater monitoring plans.

7.1.2 Methodology

Information used in preparing the groundwater hydrologic section of this report has been gathered by field investigations conducted on the ground and in the mine. Water quality samples have been collected and analyzed. Pertinent literature has been examined. In addition, experience of personnel working in the mine has been utilized to obtain estimates of the quantity of water encountered in the mine.

A seep and spring survey was conducted on October 29, 1985 in the vicinity of lease UTU-64375 (previously referred to as Tract 2). Data collected from this survey are supplemental to data collected in June 1981 as part of the investigation conducted for leases U-49332, U-082996, ML-22603 (previously referred to as Tract 1) for the PAP.

All water quality samples have been and will continue to be analyzed by a certified laboratory. Water rights were determined by examining current records of the Utah Division of Water Rights.

7.1.3 Existing Groundwater Resources

This section of the report deals with the groundwater resources of the mine plan area as well as the region as a whole.

7.1.3.1 Regional Groundwater Hydrology

Geology, an important factor in the groundwater hydrology, is discussed briefly in this section to provide a basis for better understanding of the groundwater hydrologic regime.

Geology - The Mine plan area is located in the central portion of the Wasatch Plateau coal field (Doelling, 1972). The dip of the strata is generally toward the southwest, ranging from approximately five to eleven percent (three to six degrees) over the mine plan area. The geologic formations exposed on or adjacent to the mine plan area are Cretaceous members of the Mesaverde group, overlain by the North Horn and Flagstaff Limestone formations, which are Tertiary Formations (see Plate 6-2).

Star Point Sandstone - The Star Point Sandstone, the basal formation of the Mesaverde group (Doelling, 1972), is a light colored, massive, medium to fine-grained sandstone (Spieker, 1931). The Star Point ranges in thickness from 250 to 450 feet (Doelling, 1972, and Spieker, 1931). The sandstone is relatively impermeable with groundwater movement occurring mainly in fractures.

Blackhawk Formation - Overlying the Star Point is the Blackhawk Formation which is the middle and coal-bearing division of the Mesaverde group. The Blackhawk consists of alternating sandstone, shale and coal beds and is approximately 700 to 800 feet thick with the valuable coal seams located within the lower 400 feet (Doelling, 1972).

The sandstone beds are fine to medium-grained (Spieker, 1931) and yellow-gray to tan in color (Doelling, 1972). The sands of the Blackhawk are cemented by calcium carbonate or silica with the exception of a few localized areas in which the cement consists almost entirely of clay. Iron is also present in the cement of all but the pure white sandstones (Spieker, 1931). The generally discontinuous nature of the Blackhawk and apparent low specific yield (Cordova, 1964) indicates that the water yielding capabilities of the Blackhawk are only of local importance.

Spieker (1931) identifies three general types of shale in the Blackhawk Formation: ordinary clay shale, carbonaceous shale, and smoke-gray shale (all continental in origin). The ordinary clay shale is gray to green, granular and normally soft at the outcrop; the carbonaceous shale is brown to black, massive and laminated; and the smoke-gray shale is tough and leathery, and in its unweathered state is hard and homogeneous (Spieker, 1931). The presence of shale acts as a significant barrier to the vertical movement of water within the Blackhawk Formation.

Castlegate Sandstone - The Castlegate Sandstone, generally considered a member of the Price River Formation (Spieker, 1931), consists of massive, medium to coarse-grained sandstone beds, containing conglomerate with a matrix of grit (Doelling, 1972) in places. The Castlegate overlies the Blackhawk Formation, and its beds are occasionally broken by sandy, hard, gray shale and at times by thin lenses of coal (Doelling, 1972).

Price River Formation - The lithologic characteristics of both the Price River Formation and the underlying Castlegate Sandstone are similar. The Castlegate member is separated from the Price River due to its cliff-forming characteristics (Spieker, 1931). Like the Castlegate, the Price River Formation consists of medium- to coarse-grained sandstone beds with occasional lenses of shale. Although the unit has a high porosity, its apparent low permeability (Cordova, 1964) reduces its water-yielding capabilities except through fractures.

North Horn Formation - The North Horn is the lowermost member of the Wasatch Group, consisting of variegated shales, irregular beds of gray, brown or cream-colored sandstone of various texture and thin beds of steel gray and cream-colored limestone (Spieker, 1931). Like the Blackhawk Formation, the shales in the Castlegate, Price River, and North Horn formations act as significant barriers to the vertical movement of water within the formations; therefore, a significant portion of the water which reaches these underlying formations percolates downward until encountering a shale layer, which then causes horizontal movement to the surface or another "drain," i.e., sandstone finger within the formation.

Flagstaff Limestone - Although not located within the mine plan area, erosional remnants of the Flagstaff Limestone are located on summits and ridges adjacent to the Trail Mountain Mine (Davis and Doelling, 1977). The unit forms a white cliff, consisting of white, light gray and thin-bedded lacustrine limestone with some thin beds of gray shale and white volcanic ash. On top of Trail Mountain in the NW 1/4 of Section 22, T17S, R6E the thickness of the Flagstaff Limestone was measured at 105 feet (Davis and Doelling, 1977).

Faults - No major faults have been found to extend into the mine plan area. The Joe's Valley fault zone, trending north to south, is located approximately three miles to the west of the PHI area; therefore, no major faults are anticipated to be encountered in the Trail Mountain Mine.

Groundwater - The principal factor controlling the occurrence and availability of groundwater in any area is geology. As noted by Price and Waddell (1973), nearly all of the region surrounding the mine plan area is underlain by rocks of continental and marine origin, consisting predominantly of interbedded sandstones and shales. Although some of the sandstones in the region serve as the principal water-bearing strata, their ability to yield water for extended periods of time is largely controlled by the existence of the relatively impermeable interbedded shale layers, which prevent the downward movement of a significant amount of water.

According to the US Geological Survey (1979), groundwater in the region exists under water table, artesian, and perched conditions. Water table conditions exist primarily in shallow alluvial deposits along larger perennial streams and in relatively flat lying sedimentary rocks. Artesian conditions exist at greater depths where a confining layer overlies a more permeable member; however, pressures are generally not sufficient to produce flowing wells. Perched or impeded conditions exist where the confining layer lies beneath the water-bearing stratum.

As noted by Lines (1985), the Blackhawk Formation and the Star Point Sandstone are considered together in the region as an aquifer. These formations are typically saturated where they exist sufficiently far from the edges of canyons; however, the Blackhawk Formation tends to be drained near the canyons, as is the case in the existing Trail Mountain Mine workings.

Strata that overly the Blackhawk Formation are not completely saturated but do contain perched aquifers (Lines, 1985), which provide water locally to springs and base flow to some streams.

Investigations in the vicinity of the Trail Mountain Mine by Danielson et al (1981) indicated that most, if not all, groundwater in the region is derived from snowmelt. Recharge tends to be limited in areas underlain by younger rocks due to slope steepness and relative imperviousness, both of which promote runoff rather than infiltration of snowmelt.

The predominant chemical constituents in most springs in the region are calcium, magnesium, and bicarbonate (Lines, 1985). Dissolved solids concentrations generally range from about 250 to 750 milligrams per liter. Regionally, the concentrations of major dissolved constituents in water from individual geologic units are highly variable, due to lithologic complexity in the area.

Spring inventories of the mine plan areas were conducted in 1981 and 1985. The springs within and adjacent to the mine plan areas, shown in Plate 7-1, exist under perched conditions because of the existence of relatively impermeable interbedded shales within the North Horn, Price River, Castlegate and Blackhawk Formations. Springs issue from a sandstone layer underlain by shale adjacent to and downslope from a local recharge basin where more than average snow can accumulate. Recharge zones for these local springs are nearby flats along ridges. Springs generally do not occur along narrow ridges with steep side slopes where little opportunity for groundwater recharge exists.

Another interesting groundwater characteristic deals with the origin of springs with regard to geologic formations. The springs sampled on Trail Mountain were associated with the North Horn Formation. As mentioned previously, the North Horn Formation consists of variegated shale, sandstone, and thin-bedded limestone. The shale layers act as impeding members to deep percolation, diverting a significant portion of water which percolates through the soil mantle and forcing it to move somewhat horizontally to be discharged at the surface as spring water. Most of the springs are located at higher elevations. The North Horn Formation lacks distinct and persistent lithologic units (Spieker, 1931); therefore, the sandstone of water-bearing lenses of the formation is somewhat discontinuous. This fact, coupled with the fact that recharge zones for the springs are in the nearby flats along the ridges, implies that springs are local in extent as opposed to a larger more regional system.

7.1.3.2 Mine Plan Area Aquifers

Seeps and Springs - As indicated previously, springs and seeps within and adjacent to the mine plan area have been inventoried. The mine plan area was walked over and springs and seeps identified. Water quality samples were collected from the springs associated with the mine plan area and analyzed.

Springs on Trail Mountain generally issue from sandstone overlying a shale layer. Lines (1985) found that the laboratory hydraulic conductivity of the sandstone and shale units within the Blackhawk Formation varies by four to six orders of magnitude. The relative magnitude of the hydraulic conductivity of local sandstones compared with siltstones and shales indicates that the finer grained sediments of the formations serve as barriers to the downward movement of water.

Recharge into local formations, either through snowmelt, rainfall, or subsurface seepage from an adjacent formation, percolates downward within the sandstone beds; however, upon reaching a less-permeable siltstone or shale layer, the water is forced to flow downdip to the surface, issuing at the interface between the two units. Four wells have been drilled to monitor groundwater conditions in the Star Point Sandstone. The following table lists the well completion data and the status of each well:

WELL ID.	DRILL DEPTH (ft)	STRATA MONITORED	POTENTIMETRIC ELEVATION (ft)	MONITORING STATUS
TM-1	650	Star Point Sandstone (See Notes Below)	7259	Abandoned Relocated to TM-1B (See Notes Below)
TM-1B	480	Star Point Sandstone (See Notes Below)	7272	Monthly See Monitoring Plan
TM-2	60	Spring Canyon Member Star Point Sandstone	7151	Abandoned In-Mine Well Area Sealed
TM-3	560	Spring Canyon Member Star Point Sandstone	6900	Monthly See Monitoring Plan

Well TM-1: Well TM-1 was drilled outside the mine near the main manway portal. The hole was drilled to a total depth of 650 feet, beginning at a point 5.0 feet below the top of the Star Point Sandstone. At this location the Star Point was encountered to a depth of 350 feet, with a transition from the Star Point to the Mancos Shale existing from a depth of 350 feet to 500 feet. Below the 500-foot depth, the Mancos shale is present. The elevation of the ground surface at TM-1 is 7276.0 feet. On September 17, 1993 the static water level in TM-1 was at a depth of 17.4 feet below the surface; hence, the elevation of the potentiometric surface at TM-1 is 7258.6 feet. During routine monitoring on December 20, 1993 the bailer utilized to retrieve the quality samples became lodged in the casing at a depth of approximately forty feet. Several unsuccessful attempts were made to retrieve the bailer. Well TM-1 has been permanently abandoned using Division of Water Rights specifications. Monitoring potential impacts to the Star Point Sandstone at the mine facility was transferred to Well TM-1B on June 22, 1994.

Well TM-1B: Beaver Creek Coal developed a surface well located near the bathhouse (designated as well TM-1B on the enclosed Surface Facilities map 3-1) with the intended purpose of supplying water to the water treatment plant (see Volume 2 Appendix 7-7). During well development it was determined that the well production was insufficient to supply the water treatment plant (production was less than five gallons per minute) and the well was temporarily abandoned. Well TM-1B was drilled in October 1987 to a depth of 480 feet, which fully penetrated the Star Point Sandstone formation. Development included setting 480 feet of 6 inch steel casing, perforating the casing from 380-460, and setting a Grundfos 5-10 GPM pump at 420 feet with a 1 inch galvanized discharge line. Monitoring of well TM-1B was initiated in June 1994 with depth on a monthly basis and quality collected quarterly.

Well TM-2: Well TM-2 was an in-mine well drilled at crosscut 54 in the south mains. The hole was drilled to a total depth of 60 feet, beginning at the top of the Star Point. Only the Spring Canyon Member of the Star Point Sandstone was penetrated in this hole. The elevation of the mine floor and the top of the Star Point Sandstone at TM-2 is 7167.0 feet. On October 24, 1985 the static water level in TM-2 was at a depth of 16.5 feet below the mine floor. Hence, the elevation of the potentiometric surface at this location is 7150.5 feet.

Well TM-3: PacifiCorp drilled and developed well TM-3 on September 28, 1993 to satisfy a special condition request from the mid-term permit review. Results of an aquifer test conducted April 28, 1994 can be found in Appendix 7. Well TM-3 was drilled in Straight Canyon, approximately 11 miles northwest of Orangeville, Utah (SW1/4 NW1/4 of Section 3, Plate 7-2). Well TM-3 was drilled to a total depth of 560 feet. At this location, the Star Point was encountered to a depth of 455 feet, with a transition from the Star Point - Spring Canyon Member to the Mancos Shale existing from a depth of 555 feet to 560 feet. The elevation of the ground surface at TM-3 is 6750 feet. Water in the Star Point Sandstone is under artesian pressure, with the static pressure on June 22, 1994 of 65 psi. Hence, the elevation of the potentiometric surface at TM-3 was 6900.2 feet when the well was completed.

Results of complete chemical analyses from Well TM-1B are presented with other water monitoring data in the Annual Reports (pre-2015). Plate 7-1 also shows the elevation of the potentiometric surface in the greater Mine area. This data is taken from Lines (1985) and modified using data from Wells TM-1, TM-1B, TM-2 and TM-3. As noted, the potentiometric surface surmised by Lines should be shifted to the south in the vicinity of Cottonwood Creek. Plate 7-1 indicates that the flow of groundwater in the Star Point Sandstone in the vicinity of the Mine is to the south-southwest toward Straight Canyon.

Springs in the vicinity of the Trail Mountain Mine are used by cattle, deer, elk and other wildlife. Five of the springs (T-4, T-6, T-8, T-9, T-11, T-15) have been developed with watering troughs or ponds.

Data presented by Lines (1985) indicate that the total dissolved solids concentrations of water from springs in the North Horn Formation tend to increase in the direction of groundwater flow, i.e., in the south-southwest direction according to Lines, (1985). A review of TDS data collected from springs monitored by PacifiCorp substantiates this observation (review Annual Hydrologic Monitoring Reports (pre-2015), Springs T-8, T-15 and T-6). The pattern of increasing TDS in a southerly direction could possibly be due to increased leaching of the bedrock in the down gradient direction or contact with altered strata associated with natural burning along the southern outcrop. Insufficient springs were available to determine if such a trend exists within other formations in the vicinity of the mine; however, Lines (1985-Appendix 7-B) found that the pattern did not exist in the Blackhawk-Star Point aquifer.

The pH of water issuing from springs in the survey area showed no trends. Values varied from 7.3 to 8.5, generally falling in the range of 7.3 to 7.6; hence, spring water in the study area is slightly alkaline.

<ins>Groundwater Quality</ins> - Water quality samples have been collected from seepage within the Trail Mountain Mine (pre-2015) to determine the groundwater hydrologic conditions within the Blackhawk Formation in which the coal-bearing zone is located. Water quality samples have also been collected from springs to provide an index of groundwater hydrologic conditions within other overlying formations of the mine plan area.

All samples were collected and preserved as previously outlined. The results of the chemical analyses for samples taken from within the mine are presented in Table 7-1.

Wells and Users - As indicated previously, no wells are known to exist within or adjacent to the mine plan area except for the wells drilled to monitor potential impacts to the Star Point Sandstone aquifer. Principal groundwater use in the general area is restricted to use of wildlife and for stock watering from springs or seeps. Groundwater produced within the mine is used for dust suppression and equipment operation within the mine or discharged under an approved UPDES permit (see Appendix 7).

7.1.4 Groundwater Development and Mine Dewatering

This section of the report discusses the groundwater supply and usage in the mine plan and adjacent areas as well as the dewatering taking place in the Trail Mountain Mine.

7.1.4.1 Water Supply

Water required for underground mining operations is supplied from two sources:

1. Underground water from the mine is collected in a sump and recirculated for mining purposes; and

2. Supplemental mine water needs can also be supplied by pumping water from Cottonwood Creek.

Culinary water is supplied from underground sources pumped to a water treatment plant located near the main portal.

Water Rights - A search of water rights from the Utah Division of Water Rights within and adjacent to the mine plan area showed no claimed groundwater rights within two miles.

7.1.4.2 Mine Dewatering

Generally water encountered within the mine has been in the form of roof leakers through bolt holes and tension cracks positioned parallel to the working face of the mine. As mining progresses downdip, leakers further than 500 feet updip of the working face generally dry up. Only a limited amount of water is made within the mine. Water produced within the mine is used for dust suppression and fire protection within the mine and for the operation of in-mine machinery. Occasionally mine water production will exceed usage because of inactivity of the mine operation, short-lived surges of inflow, etc. As a result, a system has been constructed to allow for discharge of the mine water from the sump to Cottonwood Creek, with an option of routing the discharge through the sediment pond if necessary. This discharge point is approved under an UPDES Discharge Permit and is fitted with a flow meter for accurate quantity measurement. Intercepted groundwater will be monitored, quantified and reported annually in the Hydrologic Monitoring Report (pre-2015).

7.1.5 Effects of Mining on the Groundwater Hydrologic Balance

As has been noted, the occurrence and quality of water in any region is highly controlled by geology. A structural feature known as the Straight Canyon Syncline may influence the groundwater hydrology in the northwestern corner of the permit area. The axis of the syncline, plunging NE-SW at approximately 3.5°, passes just to the northwest of the permit boundary and is visible on outcrop at the Joes Valley dam. The syncline is a prominent feature and could provide a conduit from groundwater migration from NE-SW. The only data for this area has been obtained from exploration holes which have been drilled near the syncline axis. No unusual or persistent sources of groundwater at the coal seam horizon were noted in holes TMX-2, TMX-6, and TMX-7 (see Appendix 7). As with any syncline structure, increased amounts of intercepted groundwater could be expected as mining approaches the syncline axis. Rather than rapid inundation which can occur along fault zones, a gradual increase in the amount groundwater entering the mine should be anticipated as mining proceeds down dip below the potentiometric surface toward the syncline axis. Since excess water in the mine is stored in sumps, settled and pumped out into Cottonwood Canyon Creek, the net loss to the general hydrologic regime would be minor or zero. The entire permit area is within the Cottonwood drainage system. Interbasin transfer will not occur from the interception and discharging of groundwater.

Springs - As noted previously, springs within and surrounding the mine plan area were inventoried in June, 1981 and October 1985. Experience gained from the data collected at nearby mines and from the general area has provided vital information regarding the possible effect of mining on springs.

Plate 7-1 shows the location of all water sources found during the hydrologic inventory of the mine plan and adjacent area. As shown, only a limited number of springs/seeps were found on the east face of Trail Mountain. The springs located were mainly confined to the west slopes of the mountain.

Based on the data collected by PacifiCorp and the Bureau of Mines on the adjacent East Mountain property, mining induced impacts have not been identified. As discussed in Chapter 11, subsidence is expected to have no impact on bedrock-aquifer springs in the vicinity of the Mine.

Four run off fed ponds were also identified during the October 29, 1985 survey. Their locations are shown on Plate 7-1. These ponds, numbered 35-1P, 26-1P, 26-2P and 26-3P, were sampled for water quality during the 1981 survey and occur within the area of potential subsidence. The subsidence effects on the ponds may result in changes in retention capacity if subsidence fractures intercept them; however, water quality is not likely to be adversely affected. Inflows to the mine are projected to be insufficient to require other than occasional dewatering; hence, impacts due to dewatering are projected to be minimal. The water supply for use at the mine (culinary and domestic) is obtained from in-mine sources. Lines (1985) states that mining is not expected to adversely impact water quality in the vicinity of the Trail Mountain Mine.

7.1.6 Mitigation and Control Plans

As was previously discussed, no significant impacts to the groundwater system are expected from the mining operation. The groundwater monitoring plan (discussed in the following section) will provide a means to follow the possible effect of mining activities on the groundwater system.

Any roads, fences, stock ponds, earth dams, or water troughs which are materially damaged by subsidence will be repaired and regraded to restore them to their pre-subsidence usefulness. Should significant subsidence impacts occur, the applicant will restore to the extent technologically and economically feasible those surface lands that were reduced in reasonably foreseeable use as a result of such subsidence to a condition capable of supporting reasonable foreseeable uses that such lands were capable of supporting before subsidence.

7.1.6.1 Alternative Water Supply

In order to restore any land affected by Applicant's mining operations to a condition capable of supporting the current and post-mining land uses stated herein, the Applicant will replace water determined to have been lost or adversely affected as a result of Applicant's mining operations if such loss or adverse impact occurs prior to final bond release. The water will be replaced from an alternative source in sufficient quantity and quality to maintain the current and post-mining land uses as stated herein.

During the course of regular monitoring activities required by the permit, or as the Applicant otherwise acquires knowledge, the Applicant will advise the Division of the loss or adverse occurrence discussed above, within ten working days of having determined that it has occurred. Within ten days after the Division notifies Applicant in writing that it has determined that the water loss is the result of the Applicant's mining operation, the Applicant will meet with the Division to determine if a plan for replacement is necessary and, if so, establish a schedule for submittal of a plan to replace the affected water. Upon acceptance of the plan by the Division, the plan shall be implemented. Applicant reserves the right to appeal the Division's water loss determinations as well as the proposed plan and schedule for water replacement as provided by Utah Code Ann. 40-10-22(3)(a).

7.1.7 Groundwater Monitoring Plan

An inventory of the springs adjacent to the mine plan area was conducted during the spring of 1981 and the fall of 1985. Water quality and quantity data were collected at springs throughout the mine plan and adjacent area. After the quantity and quality data was assembled, representative springs were selected for the groundwater monitoring program. These springs are shown in Plate 7-2.

Groundwater monitoring for the permit area will also consist of collecting water quality and quantity from points of significant inflow to the underground workings. An inventory of the active portion of the mine will be conducted on a quarterly basis to identify the location and geologic occurrence of mine inflows that exceed three gallons per minute. Certain of these inflows, if they occur, will be selected, in consultation with DOGM, for continued monitoring. Samples from all monitoring stations will be collected and analyzed according to Appendix 7-1. Groundwater monitoring data collected during a calendar year will be summarized and submitted to DOGM in the Annual Report (pre-2015). Monitoring parameters will be in accordance with DOGM Guidelines for Groundwater Monitoring. Monitoring schedule and reporting will be in accordance with Appendix 7-1.

7.1.7.1 Baseline Monitoring

Baseline monitoring will be conducted on new sites for a two year period, after which monitoring will revert to the operational parameters list in the Division's guidelines. In addition, all sites, both groundwater and surface water, will be sampled and analyzed for baseline parameters every fifth year (see Appendix 7 for groundwater and surface water locations and frequencies).

7.1.7.2 Operational Monitoring

When two years of baseline data have been collected, the monitoring frequency will be adjusted according to DOGM's guidelines and as shown in Appendix 7-1 for Operational Phase Monitoring.

Mine water and sediment pond discharge will be monitored in accordance with the approved UPDES permit.

7.1.7.3 Post-Mining Monitoring

Post-mining monitoring of groundwater will continue on representative springs, which will be determined with the aid and approval of the UDOGM. Quantity and quality monitoring and analysis will be accomplished biannually for the time period associated with the reclamation bond or until post-mining data approaches preliminary standards. Parameters to be monitored will be selected following consultation with the State and Federal agencies.

7.2 SURFACE WATER HYDROLOGY

As was explained under Section 7.1, OSM and DOGM regulations require that water monitoring programs be established in areas of underground coal mining to monitor the effects of mining activities and protect the hydrologic balance of such area. This section outlines the surface water hydrologic investigation conducted on the permit area.

7.2.1 Scope

The scope of the surface water section of this report is to describe the existing hydrologic conditions of the mine plan and adjacent areas and to describe the methods that have been and will be used to predict, monitor and mitigate the impacts of mining. Sections within this section will cover the following major topics: methodology, existing surface water resources, surface water development, control and diversions, effects of mining on the surface water hydrologic balance, mitigation and control plans, and surface water monitoring plans.

7.2.2 Methodology

Information used in preparing the surface water hydrologic section of this report has been gathered by field investigations. Pertinent literature has been examined. Numerous water quality samples have been and will continue to be analyzed by a certified laboratory. Water rights have been determined by examining current records of the Utah Division of Water Rights.

The mean annual water yield from areas of Trail Mountain that could impact the Mine was calculated by two separate methods and compared with an estimate of the mean annual water yield given in Jeppson et al. (1968) to increase the level of confidence. The first method of calculation, referred to as "Grunsky's Rule," was originally developed by Grunsky (1908) and later adapted by Sellars (1965). In accordance with this method, the average annual water yield can be determined from:

$$Q = \propto P^2 \text{ [for } P \leq 1/(2)] \qquad (7\text{-}1)$$

or

$$Q = P - 1/4(\propto) \text{ [for } P \geq 1/(2)] \qquad (7\text{-}2)$$

Where "Q" is the mean annual water yield, in inches; "P" is the normal annual precipitation, in inches; and "∝"is the runoff coefficient, in inches $^{-1}$. Alpha (∝) was determined from guidelines set forth by Hawkins (1976). The second method of calculation is known as Ol'deKop's formula (Sellars, 1965). According to this method, the mean annual water yield is determined from:

$$Q = P - E_o \tanh\left(\frac{P}{E_o}\right)$$

where " Q" and "P" are as previously defined and "E_o" is the annual potential evapotranspiration, in inches.

Estimates of peak flow recurrence intervals for ephemeral streams in the mine plan area were determined from techniques presented by Fields (1975). According to Fields (1975), the 25 and 50 year recurrence interval flood discharge of Utah streams is related to channel geometry characteristics. In this USGS investigation Utah was subdivided into three areas, which were defined from information collected at 85 gaging stations. The locations of the sites used to develop the three appropriate equation sets were of similar streamflow characteristics. Thirty-three sites were studied at mountainous locations in east central Utah [see Figure 2, Fields (1975)] designated as Area 2. Analysis of the data provided reliable estimating equations for flood flows with 25 and 50 year recurrence intervals. Specifically, for the mine plan area, the following relationships were found to apply:

$$q_{25} = 3.7W^{1.57} \quad (7\text{-}4)$$

and

$$q_{50} = 3.9W^{1.58} \quad (7\text{-}5)$$

where "W" is the width of the channel bar cross-section in feet, and 25 and 50 are the 25 and 50-year recurrence interval flood discharges in cfs, respectively. The respective standard errors associated with Equations 7-4 and 7-5 are 28 and 33 percent.

The runoff volume resulting from a particular rainfall depth was determined using the runoff curve number technique, as defined by the US Soil Conservation Service (1972). According to the curve number methodology, the algebraic and hydrologic relationship between storm rainfall, soil moisture storage, and runoff can be expressed by the equations;

$$S = \frac{1000}{CN} - 10 \quad (7\text{-}6)$$

and

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad (7\text{-}7)$$

where "Q" is the direct runoff volume in inches, "P" is the storm rainfall depth in inches, "S" is a watershed storage factor in inches (defined as the maximum possible difference between "P" and "Q"), and "CN" is a dimensionless expression of "S" referred to as the curve number. Curve number values were chosen using information supplied by the U.S. Soil Conservation Service (1972), Hawkins (1973), and personal hydrologic judgment following field observations. Weighted curve numbers were used for heterogeneous areas. Kent (1973) gives CN values for the four different hydrologic soil groups and different land use descriptions. The mine site disturbed area has soil characteristics with average runoff potential, i.e., between groups B and C. Land use consists of 70% fair condition range land at CN avg. = 74, 25% industrial area at CN avg. - 89.5, and 5% dirt road at CN avg. = 84.5 (see Table 7-2). The disturbed area weighted CN was found to be 78.5 [from (0.70) (74) = (0.25) (89.5) = (0.05) (84.5)]. The side canyon has soil characteristics with moderately high runoff potential, group C, because of shallow soils and ledges. The area is 85% fair condition range land at CN=79 and 15% poor condition range land at CN=86. This yields a weighted CN for the side canyon of 80 [from (0.85 (79) + (0.15(86)]. This drainage area of North Cottonwood Canyon is moderately low runoff potential soil, group B, and 2/3 good woods and 1/3 good range which are characterized by CN's of 55 and 61 respectively. The weighted CN is 57 [from (0.67)(55) + (0.33) (61)]. Values of "P" were obtained for selected durations and return periods from Miller et. al. (1973). A 24-hour storm was used for design purposes.

The undisturbed area draining to the sediment pond is predominantly from the soil types classified as Rockland and Stony Sandy Loam, which contain the Grassland Shrub Community. Although these areas do have rock ledges, they are located nearer to the canyon bottom and have slightly flatter slopes and more vegetation between rock outcrops. Based on the soil types (Sandy Loam) and vegetation (Grassland-Shrub), the runoff curve number of 72 is selected based on range land in fair condition, hydrologic soil group between B&C and forest land, thin stand, poor cover, no mulch hydrologic soil group between B&C.

Equation 7-6 is based upon the assumption $I_a = 0.2S$, where I_a is the initial abstraction from storm rainfall, defined as the rainfall which must fall before runoff begins, (i.e., to satisfy interception, evaporation and soil-water storage; therefore, determination of runoff from Equation 7-6 is valid only when $P \geq I_a$ or $P \geq 0.2S$. No runoff can occur below this point.

Estimates of the peak discharge to be expected from various precipitation events were made using the unit hydrograph procedure developed by the US Soil Conservation Service 1972). Figure 7-2 shows a runoff hydrograph and the associated terminology.

A hyetograph of a single block of rainfall excess with duration D is shown in the upper portion of the figure. The lower portion of the figure contains the resultant runoff hydrograph. For runoff from excess rainfall, the area under the hydrograph curve and the area enclosed by the rainfall hyetograph represent the same volume of water (Q). The peak flow rate for the hydrograph is represented by "Q_p", while "t_p" represents the time to peak flow from the start of the hydrograph to "Q_p". The base time (t_b) is the duration of the hydrograph. The time from the center of mass of rainfall excess to the peak of the runoff hydrograph is the lag time (t_L).

The time of concentration (t_c), not shown on Figure 7-2, is defined as the time for flow from the hydraulically most remote point in a basin to reach the basin outlet.

Time to peak, t_p, is assumed to be a function of watershed lag (t_L) which is determined according to the equation:

$$t_L = \frac{(l^{0.8})(S+1)^{0.7}}{1900Y^{0.5}} \qquad (7\text{-}8)$$

where t_L is the watershed lagtime in hours, l is the hydraulic length or the length of the main stream to the farthest divide in feet, "S" is as previously defined, and "Y" is the average watershed slope in percent. Values of "Y" were obtained by using methods outlined by Craig and Rankl (1977). The hydraulic length, *l*, was taken from an appropriate topographic map while "S" was determined from

Equation 7-7 once the runoff curve number was estimated. According to the US Soil Conservation Service (1972), the watershed lag time is equal to $0.6t_C$ and the time of concentration (t_C) is equal to $1.5\ t_p$.

Combining these two expressions, it can be seen that:

$$t_p = 1.11\ t_L \qquad (7\text{-}9)$$

where both variables are as previously defined.

The peak discharge constant used in the dimensionless unit hydrograph method is determined according to the equation:

$$q_p = \frac{484AQ}{t_p} \qquad (7\text{-}10)$$

where "q_p" is the unit hydrograph peak flow rate in cubic feet per second, "A" is the drainage area in square miles, "Q" is the runoff volume in inches (as determined by Equation 7-6), "t_p" is as previously defined in hours, and 484 is a conversion factor. The rainfall distribution for the 24-hour storm duration was generated from the theoretical NOAA Type II storm distribution shown in Figure 7-3.

Dimensionless unit hydrographs are developed by simulating many natural unit hydrographs using the time to peak and the peak discharge constant. Haan (1970) proposed a dimensionless unit hydrograph based on the gamma function:

$$\frac{q(t)}{q_p} = \frac{rt \times e^{1-t/t_p} C_3 t_p}{t_p} \qquad (7\text{-}11)$$

where "q(t)" is the hydrograph ordinate at time "t", "q_p" and "t_p" are as previously defined, and "C_3" is a parameter defined by:

$$Q = q_p t_p \left[\frac{e}{C_3 t_p} \right] C_3 t_p \times T(C_3 t_p) \qquad (7\text{-}12)$$

where "Q" is the runoff volume (one inch for a unit hydrograph) and represents the gamma function.

Figure 7-4 shows how the shape of the hydrograph defined by equation 7-11 changes as "C_3t_p" changes. The higher the value of "C_3t_p", the sharper the peak of the hydrograph. The hydrograph for the disturbed area runoff of 0.75 inches was determined to have a shape with characteristics t_L = 0.08 hr., t_p = 0.09 hr., and q_p = 20.1 cfs. These results are associated with a "C_3 t_p" factor of 3.0 or a "C_3" of 43. Similar evaluations were made for the hydrograph of Cottonwood and Side Canyon runoffs and are given in Table 7-7.

The dimensionless unit hydrograph method involves the development of a runoff hydrograph from a complex rainstorm. The storm is divided into blocks of uniform intensity of duration D. Values of D must be less than or equal to t_p. Practically, the selection of D as a multiple of t_p will ensure that the peak will be encountered. Rainfall excess is generated from the rainfall depths of duration D and the rainfall-runoff relationship expressed in equation 7-6. The rainfall excess from each increment D is then multiplied by the unit hydrograph ordinates to produce a component hydrograph. Each of the component hydrographs are then lagged by a time increment D and are concurrently summed to produce the synthetic runoff hydrograph. A more complete discussion of the unit hydrograph method can be found in Chow (1964) or Haan and Barfield (1977).

Following the determination of a given peak discharge, design sizes for culverts used for runoff diversions and conveyance were determined using methods derived by the US Soil Conservation Service (1972) and illustrated in Figure 7-5.

Sedimentation storage requirements were determined using a disturbed acreage factor of 0.05 ac-ft. of sediment per acre disturbed.

This factor was determined from the Universal Soil Loss Equation as defined by the Agricultural Research Service (ARS) at Purdue University[1]. The equation for soil loss A in tons/acre-year is:

A = R K L S C P

where "R" is the rainfall erosivity factor, "K" is the soil erodibility factor, "L" and "S" are slope length and gradient factors given as one variable.

LS = $(X/72.6)^m$ $(430\ x^2 + 30x + 0.43)/6.57415$ with "X" being slope length, "m" a function of slope, and "x" the size of the slope angle, "C" is the cover factor, and "P" is the erosion-control practice factor.

Appropriate constants for each factor were obtained for the disturbed area from curves and tables given by the ARS. "R" for the Trail Mountain Mine region of Utah is 25. "K" for the loam to sandy loam soil texture class with > 4% organic matter content is 0.25. For a slope length of 250 feet, and average slope angle of 1.75° (since 17.5° = 0.3), and an "m" of 0.5 for gradients > 5%, "LS" is 13.6. The cover factor "C" is 1.0 for essentially no cover and practice factor is also 1.0 for no control measures presently. With these values "A" is 85 tons/acre-year. This soil type 1.0 ton per 0.95 yd^3 and converting to acre feet gives an annual soil loss factor of 0.050 acre feet per acre disturbed.

Open channel flow capacities were determined using the Manning equation. According to this method:

$$V = \frac{1.486 R^{0.67} S^{0.5}}{n} \qquad (7\text{-}13)$$

where "V" is the velocity in feet per second, "n" is the Manning roughness coefficient, "R" is the hydraulic radius in feet, (defined as the area divided by the wetted perimeter), and "S" is the hydraulic slope, in feet per feet. Estimates of the roughness coefficient were determined from tabular information presented by the US Department of Transportation (1979). The velocity obtained by equation 7-13 was converted to a flow rate using the continuity equation which states that:

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1 *Wanielista, Martin P., Stormwater Management Quantity and Quality, Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, pp. 305-318, 1979.*

q = AV (7-14)

where "q" is the discharge, in cubic feet per second; "A" is the cross-sectional area of flow in square feet; and "V" is velocity in feet per second. A maximum permissible velocity of 5 feet per second for unlined channels was assumed.

Those sections of diversion channels having velocities in excess of 5 feet per second were designed with rock riprap linings in accordance with methodologies presented by the US Department of Transportation (1975). In accordance with this methodology, the maximum permissible depth of flow for a channel lined with rock riprap is determined by:

$$d_{max} = \frac{63.5(D_{50})}{S_0} \quad (7\text{-}15)$$

where "d_{max}" is the maximum permissible depth of flow, in feet; "D_{50}" is the mean rock diameter (or the particle size gradation for which 50 percent of the mixture is finer by weight) in feet, 63.5 is the unit weight of water in pounds per cubic feet, and "S_o" is the channel slope, in feet per feet. The mean rock diameter (D_{50}) in each case was assumed from which the maximum permissible depth was determined. The channel configuration was then determined such that the maximum permissible depth at the design flow would not be exceeded.

7.2.3 Existing Surface Water Resources

This section of the report deals with the region in general and the Trail Mountain area more specifically. Watershed and stream characteristics are both described.

7.2.3.1 Regional Surface Water Hydrology

The Mine is located immediately adjacent to Cottonwood Canyon Creek, one of the major tributaries of the San Rafael River. Near Orangeville, Cottonwood Creek has had an annual flow of 70,700 acre-feet during the period of record that extends intermittently from 1909 through the present (US Geological Survey, 1984). Approximately 50 to 70 percent of stream flow in the mountain streams of the region occurs during May through July (Waddell et al., 1981). Stream flow during this late spring/early summer period is the result of snowmelt runoff.

Snowmelt is the primary source of water for the perennial streams in the San Rafael River Basin with summer precipitation usually producing little runoff (US Geological Survey, 1979). Ephemeral streams are also abundant in the San Rafael River Basin, existing primarily at lower elevations where evapotranspiration significantly exceeds precipitation.

Water use upstream from Castle Valley, the valley containing most of the agricultural land noted in Figure 7-6, is primarily for stockwatering and industrial purposes (coal mining and electrical power generation). Within Castle Valley agriculture and power production utilize nearly all of the inflowing water (Mundorff, 1972), with minimum flows in the gaged streams and rivers in the basin occasionally approaching zero. Storage reservoirs are common at higher elevations throughout the region. Transbasin diversions occur throughout the area.

The quality of water in Cottonwood Creek and other similar streams in the area varies significantly with distance downstream. Waddell et. al. (1981) found that concentrations of dissolved solids varied from 125 to 375 milligrams per liter in major streams in the region in reaches above major diversions to 1600 to 4025 milligrams per liter in reaches below major irrigation diversions and population centers. The major ions at the upper sites were calcium, magnesium, and bicarbonate, whereas sodium and sulfate were more dominant at the lower sites. They attributed the changes to (1) diversion of water containing low dissolved solids concentrations, (2) subsequent irrigation and return drainage from moderate to highly saline soils, (3) groundwater seepage, and (4) inflow of sewage and pollutants from population centers. Average annual sediment yields within the Cottonwood Creek drainage basin range from approximately 0.1 acre-feet per square mile in the headwaters area to about 3.0 acre-feet per square mile near the confluence with the San Rafael River (Waddell et al., 1981).

7.2.3.2 Mine Plan Area Watersheds and Streams, Stream Characteristics, and Watershed Characteristics

A portion of the Cottonwood Creek watershed receives drainage from within the mine plan area. Stream channels from the mine plan area flow to the east toward the Cottonwood Canyon Creek and to the south toward Straight Canyon Creek, a tributary of Cottonwood Creek. Cottonwood Creek is a perennial stream.

The Cottonwood Canyon Creek is a major drainage system where evidence of glaciation exists. From the headwaters to Section 24, Township 17 South, Range 6 East, the canyon is characterized by U-shaped valleys with associated lateral and terminal moraine deposits. Lateral moraine deposits most commonly occur at the intersection with side canyons. Terminal moraine deposits occur at the northwest corner of Section 24 and from this point to near the confluence with Straight Canyon the canyon can be characterized as a V-shaped valley with little evidence of glaciation.

Based on data collected by PacifiCorp, Cottonwood Canyon Creek is an ephemeral stream from its headwaters to Section 24, Township 17 South, Range 6 East, and intermittent from that point to its confluence with Cottonwood Creek at Straight Canyon. The stream becomes intermittent near the intersection of Roans Canyon just below the terminal moraine deposits discussed above. During drought conditions which have been experienced since 1985, flow in Cottonwood Canyon is limited to flow emanating from the Roans Canyon Spring located in Section 24 near the confluence with Roans Canyon. Prior to the drought, flow occurred along the entire reach of Cottonwood Canyon and had to be forded to access East Mountain at the Mill Canyon dugway located in Section 2.

Along with Roans Canyon Spring, another spring referred to as Cottonwood Spring (TM-23) is also associated with the alluvial (glacial) deposits. Cottonwood Spring is located in the canyon bottom within the area of terminal moraine deposits at an elevation higher than that of Roans Spring. With normal precipitation, especially in the form of winter snowpack, runoff would saturate the alluvial deposits and a portion of groundwater would discharge at the location of Cottonwood Spring. During the period of the drought recharge to the alluvial deposits has been limited and the level of groundwater has been reduced to a point below the elevation of the Cottonwood Spring. To verify the extent of the alluvial deposits and to define the hydrologic characteristics, PacifiCorp conducted a hydrologic research project in 1992 which included a series of resistivity lines and the drilling of three surface sites (see Deer Creek/Cottonwood/Des-Bee-Dove Permit, Volume 9 - Appendix F for complete details). At each of the surface sites two wells were completed (except for CCCW-2, see Plate 6-2 for well locations); one in the alluvial deposits and one in the Spring Canyon member of the Star Point Sandstone Formation. Wells completed in the alluvial deposits will be utilized to compare the well hydrographs to those of Cottonwood Canyon Creek and the Star Point Sandstone. Monitoring data will be included in future Annual Hydrologic Monitoring Reports (pre-2015).

Surface water-quality data collected from Cottonwood Canyon Creek by PacifiCorp indicate that the dominant ions are: calcium, magnesium, and bicarbonate. Water quality and quantity data collected during the year are presented in the Annual Report (pre-2015). Total dissolved solids concentrations in the stream vary from about 250 to 300 milligrams per liter in the mine area, with the lower concentrations normally occurring during the high-flow season. Slight variations have been noted between stations located upstream and downstream from the permit area (SW-1, SW-2 and SW-3).

As expected, total suspended solids concentrations in Cottonwood Canyon Creek tend to vary inversely with the flow rate. Concentrations have varied during the period of record from less than 1 milligram per liter to greater than 1000 milligrams per liter.

Topography in the area is very rugged, with elevation varying from 6800 to over 9000 feet above sea level. Slopes within the mine plan area vary from near vertical cliffs to less than 4 percent (2 degrees) on Trail Mountain. Major escarpments occur to the east and south of the mine plan area.

7.2.4 Surface Water Development, Control and Diversion

Because of the remoteness and the limited amount of surface water in and adjacent to the mine plan area, essentially no development of the surface water has occurred except from some possible stock watering. Cottonwood Creek water is used downstream for irrigation and for power generation. This section deals with the surface water supply in the area as well as the specific runoff and sedimentation control measures planned for the Mine.

7.2.4.1 Water Supply

Surface water in the mine plan and adjacent area is utilized primarily for stock watering purposes. A listing of surface water rights within the permit and adjacent areas is provided in Table 7-6. (Also see Appendix 7-8 Cottonwood Irrigation Shares.) A review of the files of the Utah Division of Water Rights indicated that additional rights have not been added to the area since that original submittal.

Flow Characteristics - According to Jeppson et al. (1968) the mean annual water yield for the mine plan area is approximately 1.5 inches. Other hydrologic methods (described in Section 7.2.1) were used to determine the mean annual water yield to increase the confidence level of the estimate. According to Grunsky's Rule the mean annual water yield from the mine plan area is 2.0 inches. This was determined using an alpha value of 0.008/in. Water yield studies have found values of 0.007 to 0.009 for un-gaged areas with medium elevations, medium summer rainfall, medium temperature, medium soil, moderate slopes and east exposure. Gaged areas such as Black Mesa and Holbrook Creek, Colorado, and Black Hills, South Dakota, which are similar to the Trail Mountain Mine site, have values ranging from 0.0068 to 0.0090.

According to Ol'deKop's formula (Sellars, 1965), the mean annual water yield from the mine plan area is 2.9 inches. The two methods utilize the information that mean annual precipitation and evapotranspiration over the mine plan area are 16 to 19 inches, respectively (Jeppson et al., 1968).; therefore, estimates of the mean annual water yield from both Ol'deKop's and Grunsky's formulas compare favorably with the estimate from the Hydrologic Atlas of Utah prepared by Jeppson et al. (1968).

Monthly flows from Cottonwood Canyon Creek were computed as a percentage of annual flow for the water year 1979 (October 1978 to September 1979) to determine the seasonal distribution of flows for streams within and adjacent to the mine plan area. The results are illustrated in Figure 7-7. Although actual monthly percentages will change, the distribution pattern of stream flow is characteristic of watersheds in the western highlands where the majority of annual water yield occurs in the spring and early summer as a result of snowmelt runoff.

Daily discharge measurements for the Cottonwood Canyon Creek were taken only during the three years 1979, 1980 and 1981. Within those years flow varied from 0 to 22 cfs with an average of 1.64 cfs. The average discharges for the respective three years of record were 0.87, 3.33 and 0.72 cfs. The USGS gauging station monitoring was discontinued in September 1981 (additional information on flow characteristics of Cottonwood Canyon Creek, review annual Hydrologic Reports (pre-2015)).

<u>Surface Water Quality</u> - Three surface water sites (referred to as SW-1, SW-2 and SW-3 in Plate 7-2) have been sampled since 1979. Table 7-3 contains a list of the water quality parameters analyzed along with the results of the chemical analyses of surface water samples collected at these three sites. As illustrated in Plate 7-2, SW-1 is located approximately one mile above the mine, SW-2 is located immediately below all mine surface facilities, and SW-3 is located approximately 2 miles below the mine near the confluence of Cottonwood Canyon Creek and Straight Canyon. Additional water quality data have been collected by the USGS at a gaging station on the Cottonwood Canyon Creek located in the SE1/4NE1/4, Section 36, T17S, R6E. This data is compiled and reported in Table 7-4. This station was discontinued in 1981; however, an additional monitoring station, SW-3, was added by the applicant to monitor Cottonwood Creek below the permit area. Results from all the monitoring stations are summarized in the Annual Report (pre-2015).

As depicted in Tables 7-3 and 7-4 surface waters of the mine plan area are of a mixed chemical type (Calcium-magnesium, bicarbonate) and seasonally vary from a stronger magnesium-bicarbonate to a stronger calcium-bicarbonate. A sample collected by the USGS in November 1978 was a calcium-bicarbonate type; whereas, those collected in July and September of 1979 were of a stronger magnesium-bicarbonate type.

Total dissolved solids concentrations varied from 226 to 976 milligrams per liter at stations SW-1, SW-2, USGS gaging station, and SW-3. Measurements were taken during all periods of the year, therefore, this range represents both high and low TDS values to be expected during low and high flow periods of the year. From April to June, when stream discharges are highest due to direct snowmelt, a diluting effect usually occurs in surface waters, resulting in a lower total dissolved solids concentrations. Later in the year as flow decreases and the majority of the flow is derived from groundwater, the dilution effect becomes less pronounced and total dissolved solids concentrations increase.

Suspended solids concentrations during the inventory period were found to vary from less than 0.5 milligrams per liter to 5024 milligrams per liter in Cottonwood Canyon Creek. It is known that suspended solids concentrations tend to vary somewhat proportionately with flow rate (Vaughn Hansen Associates, 1979); therefore, during the snowmelt runoff period, suspended solids concentrations are expected to be generally higher than values from low flow periods. The Utah Division Environmental Quality has classified Cottonwood Creek within the mine plan area as; 1C - protected for domestic purposes with prior treatment by standard complete treatment processes, 3A - protected for cold water species of game fish and other cold water aquatic life, and Class 4 - protected for agricultural uses including irrigation of crops and stock watering. Table 7-5 contains the numerical water quality standards applicable to the various classifications. Few samples collected by either Beaver Creek Coal Company or the USGS were noted to exceed the chemical standards. One sample collected at the USGS gaging station contained a lead concentration of 0.13 milligrams per liter in excess of the standard set in all three applicable state classifications for the waters of Cottonwood Creek.

<u>Water Rights</u> - Surface water rights within and adjacent to the mine plan area have been obtained from the Utah Division of Water Rights and are presented in Table 7-

6 and Plate 7-4. In conjunction with the location and permit number, other information included is owner, source of supply, quantity of right, purpose of use, and period of use. As indicated on Table 7-6, the majority of rights in the area are for stockwatering, with only a minor percentage allotted to irrigation.

7.2.4.2 Sedimentation Control Structures and Diversions

One sedimentation pond with corresponding runoff control facilities is constructed to provide sediment control for the Mine. The layout of the sedimentation control plan, including pond location, pond drainage area boundary, ditches and berms, are illustrated on Plate 7-5.

A sedimentation pond exists on site. Specific design details for the sedimentation pond and channels conveying runoff to the pond are described in this section. All conveyance facilities associated with the runoff control plan have been constructed.

Conveyance Facilities Design - The sedimentation pond is sized to contain runoff from the areas draining onto the mine site. As shown in Plate 7-5, no diversion ditches for undisturbed area runoff are proposed. Only runoff from the side canyon above the operation will be bypassed through a culvert. The side canyon culvert was designed to pass runoff from the 10-year, 24-hour storm (2.4 inches). As stated earlier, Miller et al. (1973) gives values for precipitation. Their Figure 27 indicates a 10-year, 24-hour storm precipitation isopluvial at the mine site of 2.4 inches.

A diversion culvert and curb and gutter system conveys runoff from the disturbed area to the sedimentation pond. The culvert and gutter system were designed to pass runoff from the 10-year, 24-hour storm [2.4 inches - from Miller et al. (1973), Figure 27 as above]. The diversion culverts for Cottonwood Creek were designed and sized by the U.S. Forest Service and the Division of Oil, Gas and Mining to pass runoff from the 50 year, 24-hour storm [3.2 inches - from Miller et al. (1973), Figure 39, page 41]. The culvert was extended 300 feet upstream in the fall of 1990.
(See Appendix 7-3 for Culvert Specifications.)
(See Appendix 7-13 for Culvert Extension Details.)

Diversion with riprap has a higher roughness coefficient. Peak flows and peak flow design related information for the diversion ditch and culverts are contained in Table 7-7.

The soil conservation service equation for calculation of watershed lag times (t_L) was used in this analysis:

$$t_L = \frac{(l^{0.8})(S+1)^{0.7}}{1900Y^{0.5}} \quad \text{and} \quad S = \frac{1000}{CN} - 10$$

Where *l* = the hydraulic length (ft)

Y = the average water shed slope (%)

S = the storage at saturation

CN = curve number

The drainage basin characteristics are given in Table 7-7 along with the resultant: T_L values: canyon = $(6375)^{0.8}$ $(2.5 + 1)^{0.7}$/1900 $(49.12)^{0.5}$ = 0.2.

Drainage areas for the side canyon 48-inch culvert and Cottonwood Canyon 66-inch culvert are shown on Plate 7-6. Drainage areas for the disturbed and undisturbed drainage to the sediment pond are shown on Plate 7-5. It should be noted that diversion culvert designs for Cottonwood Canyon were originally developed by the U.S. Forest Service and subsequently verified by Vaughn Hansen and Associates as shown in Appendix 7-3. As indicated, the culvert was originally designed with a capacity of 535 cfs, based on the USFS design flood of 450 cfs and the Vaughn Hansen and Associates design flood of 510 cfs. The culvert was extended in 1990, and the design was verified for the 510 cfs flow as shown in Appendix 7-13.

The design flood includes <u>all</u> of the Cottonwood Canyon runoff, down to and including the side drainage and the three culvert inlets from the opposite side of the highway, as shown on Plates 3-1, 7-5 and 7-6.

Design criteria and calculation results for sizes and flows in the diversion system at maximum discharge are presented in Table 7-8. Also contained in Table 7-8 is the required mean rock diameter (D_{50}) for cross sections (with velocities in excess of five feet per second) which would require a rock riprap lining; however, the maximum flow does not result in velocities significantly larger than 5 fps on the non-metal surfaces.

Two other minor inlets to the sediment pond exist at this time. The first inlet is from a small road and pad area at the top of the switchback above the pond. It drains into a vegetated ditch and enters the pond at the point where the dam meets the hillside. The second inlet is from a 24-inch culvert which picks up a small amount of road drainage below the gate. The culvert was installed in 1988 to catch runoff below the gate which may contain dust or mud carried onto the highway by the haul trucks. A third minor inlet was the 4" mine water discharge line. The 4" discharge line located in the 2nd portal south of ROM belt portal was optionally used to channel mine water discharge through the sediment pond in lieu of discharging directly to Cottonwood Canyon Creek. Due to increased volume of flow from the shift in mining from the east to west side of the mine, a replacement 8" line now discharges mine water to the 100,000 gallon storage tank. From the storage tank, water can be discharged to an existing 48" culvert as discussed in section 7.2.4.2. Inflows to the 8" line vary according to routing as well as volume of water to be discharged. The existing 4" line is disconnected within the mine but remains in place on the surface for emergency backup measures and can be easily reconnected if needed. All inlets are shown on Plates 3-1 and 7-5. Design criteria and sizing are shown in Table 7-8.

"BTCA" Areas - It should be noted that two small areas of disturbance do not drain to the pond. The first "BTCA" area consists of approximately 0.21 acres located just south of the sediment pond. The calculated runoff from this area is 0.013 acre feet, based on the 0.21 acres and a 10-year, 24-hour event. The area is vegetated, and all drainage from the site passes through straw bales, the approved sediment control measure. The realigned stream channel is entirely protected with large (approved size) riprap. Riprap will be maintained at this site until bond release or earlier release by the Division. The straw bales or other sediment control measures approved by the Division, will be maintained at the site until vegetation is determined adequate by the Division. Adequacy will be based on comparison of the site with the riparian reference area.

The second "BTCA" area consists of approximately 0.04 acres located on the northern extent of the parking lot. The area,_which drains to Cottonwood Canyon Creek, is an outslope of the parking lot and cannot be diverted to the pond. The BTCA is riprapped with rock to control erosion and vegetated which filters sediment. This area will be maintained until bond release (see Plate 7-11 for Typical Sediment Control Measures). Runoff from the area for a 10-year, 24-hour event is calculated to 0.004 acre feet.

The above described "BTCA" areas are shown on Plates 3-1 and 7-5. It should be noted that these areas are included in the total disturbed area for the site (10.39 acres) but are not included in the runoff calculations for disturbed area draining to the pond (Note: 0.16 acres of disturbed area on the new ventilation portal access road drain into the mine, not to the pond).

Sedimentation Pond Design - As mentioned previously, one sedimentation pond is constructed to provide sediment control for the surface facilities of the Mine. The sedimentation pond was designed to contain sediment storage volume from 0.05 acre-feet of sediment per acre to disturbed area. Sediment will be cleaned out at 60 percent of the sediment storage level.

Spillway capacity requirements for the sedimentation pond were based on runoff from the 25-year, 24-hour storm (2.9 inches). Table 7-9 contains the volume and spillway capacity requirements for the pond as well as additional design related information.

The sedimentation pond will be inspected quarterly, and a copy of the inspection report will be kept at the mine site. A certified annual inspection report will also be done yearly, with a copy kept at the mine site and one sent to the Division quarterly. The above inspections will be performed in accordance with requirements of R645-301-514.330 and R645-301-514.310, respectively.

The pond design details for the sedimentation pond are illustrated on Plates 7-7 and 7-8 with the stage-capacity curve for the pond given in Figure 7-9. The sedimentation pond consists of a sediment storage pool, a dead pool, and a runoff control pool equal to the inflow volume from a 10-year, 24-hour storm (2.4 inches). A dewatering device is placed in the pond to draw the pond level down to the bottom of the runoff control pool in anticipation of a future runoff event. The Utah Division of Environmental Quality requires that no dewatering device be placed within three feet of the top of the sediment cleanout level (60 percent); therefore, a dead storage pool has been created in order to meet the requirements of both agencies. The proposed principal and emergency spillway system consists of a corrugated metal riser and conduit with an anti-vortex device, trash rack, and anti-seep collars. Utilizing Equation 7-16, which defines orifice flow, the discharge capacity of the riser-conduit combination with a diameter of 48 inches was found adequate in passing the peak inflow resulting from the 25-year, 24-hour storm (see Figure 7-10).

Orifice flow occurs when the flow is restricted by the opening and can be determined as;

$$q = CA\,(2gH)^{1/2} \qquad (7\text{-}16)$$

where q is as previously defined; C is a coefficient dependent upon the orifice geometry (0.6 in this case); A is the cross sectional area of the opening, in square feet; g is the gravitational constant (32.2 feet per second squared); and H is the head above the orifice inlet, in feet. The orifices considered are the riser inlet and the inlet of the conduit leading from the riser through the pond embankment.

The total embankment height was obtained by adding the stage at full storage capacity, the head of water over the spillway under design flow conditions, the required freeboard height (1.0 feet), and a five percent settlement allowance. The embankment top width will not be less than (H + 35)/5 where H is the height of the embankment, in feet. Table 7-10 summarizes the design specifications for the sedimentation pond.

The sedimentation pond is constructed between the excavated slope of the old pond and a new embankment constructed over the 66-inch culvert. The excavated slope of the old pond was approximately equal to 1.06H:1V. To obtain the necessary pond storage capacity, the remaining inside slopes of the pond was designed at 2h:1V. The pond is lined with 18 inches of a 10:1 mixture of the embankment material and bentonite, respectively, to prevent seepage and piping.

The dewatering device consists of a 12-inch corrugated metal riser and an 8-inch conduit drainline, antivortex device, trash rack, and anti-seep collars. The anti-vortex also acts as a skimming device by not allowing water to be pulled directly from the surface of the pond. A water control gate valve is located at the end of the 8-inch diameter corrugated metal conduit within the 48-inch spillway within the pond embankment to allow efficient water release.

This was necessitated by the facts that:

1) The water control gate valve must be installed in the manhole/spillway to allow access to the valve;
2) The location of the riser does not allow access to the gate if placed at the extreme inlet;
3) Gates were apparently not available which could be attached between two culverts in a watertight manner; and
4) It was desirable to allow access to the control gate for maintenance purposes.

The control gate operator mechanism is located above the spillway cover. Access to the gate for maintenance can be made via a ladder or rebar rungs which have been welded to the spillway side. A walkway has been installed to allow access to the control gate for purposes of dewatering and inspection. Sufficient space must be available in the pond to completely detain the runoff resulting from the 10-year, 24-hour storm. At the same time, sufficient settling time must be allowed in order to meet applicable effluent standards in the discharged water. It is therefore suggested that water in the pond be released through the dewatering device after 14 days unless there is a good probability of occurrence of a runoff producing storm prior to that time, under which condition the water should be released before the storm occurrence. This would allow sufficient time for all but the fine clay and colloidal particles to settle (U.S. Environmental Protection Agency, 1976).

Anti-seep collars have been used based on methods outlined by the U.S. Environmental Protection Agency (1976). Figure 7-11 outlines details of the proposed anti-seep collars with spacing requirements shown Plate 7-7.

Riprap was placed in the inlet channels and below the outlet conduit of the pond to dissipate energy and reduce erosion potential. Riprap was placed on the inside slope of the pond embankment to a width of five feet on both sides of the spillway and dewatering device up the full height of the embankment to protect the embankment from erosion.

The outlet culvert from the pond discharges onto the riprap protection on the main channel as described in Appendix 7-3.

<u>Sediment Disposal Plans</u> - Federal and State regulations require that sediment, which has accumulated in the pond, be removed when 60 percent of the design sediment storage volume has been filled. The point at which cleanout becomes necessary is 11.2 feet below the top of the riser and can be measured directly with a tape. Sediment removed from the pond will be temporarily stored within the drainage basin to the pond. Removed sediment is disposed of at the Cottonwood Waste Rock Facility.

The procedure for sedimentation pond cleaning is as follows:

1. Decanting of the pond water:
   a. Discharge through the primary spillway, according to UPDES requirements, and/or;
   b. Pumping the water behind abandoned, sealed mine workings, and/or;
   c. Hauling to the Cottonwood Waste Rock Storage Facility's sedimentation pond.

2. Sediment disposal at the Cottonwood Waste Rock Facility.

3. Division's "Title V Coal Program Policy for Disposal of Sediment Pond Waste" guideline will be followed for sediment samples and testing.

4. Division will be contacted at the beginning of the sludge transport process.

Pond Reclamation - The disturbed area of the pond has been seeded with the interim (contemporaneous) seed mix. Permanent reclamation of the pond is discussed under Section 7.4.

7.2.5 Effect of Mining on the Surface Water Hydrologic Balance

As has been previously mentioned, the occurrence and quality of water in any region is highly controlled by geology. Section 7.1.3.1 Regional Groundwater Hydrology of this chapter describes in detail the influence geology has on the hydrologic regime. Major drainages conveying runoff away from the permit area are Cottonwood Canyon Creek and Straight Canyon. With the exception of the upper headwater regions of these drainage basins, mining and, therefore, subsidence will not occur beneath the major stream channels of these canyons. In the majority of cases, cracking due to subsidence is not anticipated to extend to the surface; therefore, surface runoff patterns will not be significantly affected. Data collected by PacifiCorp over a thirty-year period on the East Mountain permit area concerning subsidence and surface drainages has not detected any surface stream impacts. Consequently, subsidence should not cause significant impacts to the surface water system.

7.2.5.1 Quantity

As mentioned earlier in the report, the major drainage carrying runoff away from the mine facility area is Cottonwood Canyon Creek. All surface facilities are located adjacent to Cottonwood Canyon Creek, and surface runoff from disturbed areas is passed through the sedimentation pond prior to discharging in the creek.

Water intercepted within the mine is either: 1) used within the mine and therefore retained within the groundwater hydrologic system, or 2) is discharged into Cottonwood Canyon Creek. Discharge from the mine will vary depending on localized mining conditions. Underground sumps are installed for storage, settling and recirculation of water. When the sumps become full, water is pumped outside,

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either to the sediment pond for additional settling or directly to the creek if the quality meets effluent standards. Discharge quantity and quality will be reported in the Annual Hydrologic Reports (pre-2015).

The quality of flow from the headwaters of the San Rafael River Basin is excellent; however, the quality rapidly deteriorates downstream as streams cross shale formations and receive irrigation return flows from Mancos derived soils. The impact of mining on this system will be quite limited.

The existence of runoff and sediment control structures should minimize the potential for degradation of the quality of stream waters due to runoff from disturbed areas of the Trail Mountain Mine.

7.2.6 Mitigation and Control Plans

Runoff from all disturbed areas will be passed through sediment control facilities with the exception of two small "BTCA" areas as discussed in Section 7.2.4.2. Any discharge from facilities will be monitored in accordance with UPDES permit standards and State and Federal regulations. The effects of the mining operation on the surface water system will be analyzed through the surface water monitoring plan described in the next section. In the unlikely event that monitoring shows that the surface water system is being adversely affected by mining activities, additional steps will be taken to rectify the situation in consultation with State and Federal regulatory agencies.

7.2.7 Surface Water Monitoring Plan

An ongoing hydrologic monitoring program will be conducted at each of the stations shown in Plate 7-2 and as described in Appendix 7-1. Stations have been established to monitor water quality and quantity above and below the mine plan areas. Monitoring parameters will be in accordance with Table 7-2a in Appendix 7-1. Monitoring schedule and reporting will be in accordance with Appendix 7-1.

7.2.7.1 Baseline Monitoring

All surface water monitoring stations are presently on operational status. Baseline will be conducted every fifth year and compared to historical data.

7.2.7.2 Operational Monitoring

All surface water monitoring stations will be monitored quarterly for flow (when flowing) to delineate seasonal variation and correlate discharge with changes in water quality. The water quality parameters and sampling frequency will be as listed in Appendix 7-1. Surface monitoring stations will be monitored quarterly for water quality. Results of water quality data will be submitted quarterly.

7.2.7.3 Postmining Monitoring

Representative surface water stations will be monitored biannually during high and low flow conditions. The representative stations will be determined with the aid and approval of the Utah State Division of Oil, Gas and Mining. Duration of monitoring and parameter selection will be as per DOGM guidelines listed in Appendix 7-1.

7.3 ALLUVIAL VALLEY FLOOR DETERMINATION

Utah regulations (R645-302-320) require that the presence of alluvial valley floors in or adjacent to the mine permit area be identified. The regulations (R645-100-200) define an alluvial valley floor as "unconsolidated stream-laid deposits holding streams with water availability sufficient for sub-irrigation or flood irrigation agricultural activities but does not include upland areas which are generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion, deposits formed by un-concentrated runoff or slope wash together with talus, or other mass-movement accumulations, and windblown deposits". The existence of an alluvial valley floor is, therefore, determined to exist if:

1) Unconsolidated stream-laid deposits holding streams are present, and

2) There is sufficient water to support agricultural activities as evidenced by:
   a) The existence of flood irrigation in the area in question or its historical use;

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b) The capability of an area to be flood irrigated, based on stream-flow water yield, soils, water quality, topography, and regional practices; or

c) Sub-irrigation of the lands in question, derived from the groundwater system of the valley floor.

7.3.1 Scope

The purpose of this section is to examine the potential existence of alluvial valley floors in and adjacent to the areas to be affected by surface operations associated with the Trail Mountain Mine, an underground coal mine located ten miles northwest of Orangeville, Emery County, Utah.

This section is divided into three parts. First, a general description of the surface operations and site disturbances associated with the Mine is presented. Next, a discussion of geomorphic and irrigability characteristics and the water quality and availability of Cottonwood Canyon drainages as a possible alluvial valley floor are presented. Finally, the conclusions of the alluvial valley floor determination are summarized.

7.3.2 Site Description

Surface facilities associated with the Mine plan area consist of the portal area located in Cottonwood Canyon and an access road up Cottonwood Canyon.

The climate of the general area is semi-arid and continental. Mean monthly temperatures range from about 8° F to the mid-70's. Temperatures in the region tend to be inversely related to elevation. Average annual precipitation is approximately 16 inches. Seventy percent of the annual precipitation falls during the winter as snow with most of the remainder coming as summer thunderstorms.

7.3.3 Alluvial Valley Floor Characteristic

The various criteria for determining the existence of an alluvial valley floor are examined in relation to the Mine.

7.3.3.1 Geomorphic Criteria

Alluvial deposits in and adjacent to the mine permit area are shown on Plate 7-9. Plate 7-9 shows the extent of the alluvium as presented by Doelling (1972) and shows that the alluvium is found primarily along Lower Cottonwood Creek and at the mouth of the Cottonwood Canyon Creek. Only very narrow bands of alluvium are found along the Cottonwood Canyon Creek above the canyon mouths.

7.3.3.2 Water Quality and Availability

The potential for flood and subirrigation are now evaluated in conjunction with the alluvial valley floor determination.

Flood Irrigation - Flood irrigation near the mine plan area is currently, and has historically been, confined to the alluvial areas of Lower Cottonwood Creek. Water is diverted at the mouth of the Cottonwood Canyon Creek to irrigate fields on the alluvium.

No flood irrigation has historically been practiced on the narrow alluvium land upstream in the canyon opening to lower Cottonwood Creek. A reconnaissance survey of the surrounding region indicates that flood irrigation is also absent in other areas of similar hydrologic, geologic, and biotic characteristics. The historic lack of flood irrigation in these steep, narrow canyons suggests that such activities are not feasible in the region. In addition, the topography is very steep and consequently not conducive to agricultural activities.

Cottonwood Canyon Creek water quality is good. A detailed review of the surface water quality has been presented previously in this report.

Subirrigation - Some subirrigation of vegetation does occur on the alluvial valley floors shown in Plate 7-9. The subirrigated species, mainly cottonwoods and willows, are found along the channels of Cottonwood Creek suggesting that subirrigation is confined to the channel areas where the water table is near the surface.

7.3.4 Alluvial Valley Floor Identification

Based on the foregoing reconnaissance analysis, the canyon of Cottonwood Canyon Creek cannot be considered an alluvial valley floor due to the lack of area for supporting an agriculturally useful crop. The valley floor of Lower Cottonwood Creek, however, can be classified as an alluvial valley floor due to the presence of both flood irrigation and limited subirrigation on the alluvium. The flood or sub-irrigated alluvial areas are located over two miles from the mine permit area and are used for pasture and hay production.

7.3.5 Potential Impacts to the Alluvial Valley Floors

Plate 7-9 shows that the Mine permit area is over two miles from the alluvial valley floor at Cottonwood Creek. Little potential exists for the mine operation to impact the alluvial valley floor. Access to the mine is by existing county road across a minimal amount of alluvial area. All surface disturbances in the portal area will be protected by sediment control facilities and will be designed and constructed according to the Utah Coal Regulations in an environmentally sound manner.

The hydrologic monitoring program will help determine the actual impact of surface activities and aid in selecting mitigating measures, if necessary. However, it is the permittee's position that the Mine and associated activities will have no significant hydrologic impacts to the alluvial valley. Details concerning this monitoring program are outlined in a previous section of this report.

7.4 CLIMATOLOGICAL INFORMATION

PacifiCorp operates a network of weather stations, including two at low elevations (Hunter and Huntington power plants) and two at high elevations (Electric Lake and East Mountain).

7.4.1 Precipitation

The climate of the permit area has been described by the U.S. Geological Survey, which states that it is semi-arid to sub-humid and precipitation generally increases with altitude. The average annual precipitation ranges from about ten (10) inches in the lowest parts of the permit area (southeast) to more than twenty-five (25) inches in the highest parts (northwest). PacifiCorp's weather station, located in Section 26, Township 17 South, Range 7 East, has provided data which shows that the summer precipitation in the form of thundershowers averages about the same as the winter precipitation in the form of snowfall. Because much of the summer precipitation runs off without infiltration, the winter precipitation has the greatest impact on groundwater.

Precipitation amounts have been recorded at the Hunter and Huntington power plants, at Electric Lake Dam, and on East Mountain. Precipitation data can be found in the annual Hydrologic Monitoring Report (Table 7-12 for East Mountain data) (pre-2015)).

7.4.2 Temperatures

Air temperatures vary considerably both diurnally and annually throughout the region. Midsummer daytime temperatures in lower areas commonly exceed 100° F, and midwinter nighttime temperatures throughout the area commonly are well below 0° F. The summer temperatures are accompanied by large evaporation rates. Although not recorded, there probably also is significant sublimation of the winter snowpack, particularly in the higher plateaus which are unprotected from dry winds common to the region. Temperature information is collected at the UP&L weather stations at each power plant, at Electric Lake, and on East Mountain. These data will continue to be included in the annual Hydrologic Monitoring Report (pre-2015) (see Table 7-12 for East Mountain data).

7.4.3 Winds

The winds in the area are generally variable. The wind rose diagram presented in Figure 7-13 displays the variability for the Meetinghouse Ridge area for January to December 1978.

7.5 RECLAMATION HYDROLOGY

7.5.1 General

Reclamation hydrology will take place in two phases. Phase I reclamation will consist of removal of all diversions and the majority of the culverts, restoration of the main and side canyon channels, and redirection of the reclaimed area runoff to the sediment pond. Phase II reclamation will consist of the removal of the sediment pond and all remaining culverts after revegetation standards have been reached.

It is proposed to use a 2-Phase reclamation program with a sediment pond remaining through Phase I because of the close proximity of the site to an intermittent stream and the resulting difficulty in controlling both runoff and sediment by other means. Another advantage to this approach is that by leaving some culverts in place, access is provided for required maintenance by equipment.

The following sections will describe each of the major hydrologic items involved in reclamation, along with details on design, operation and final disposition.

7.5.2 Cottonwood Canyon Channel

During Phase I of the reclamation, the 66-inch culvert that presently carries the main canyon drainage beneath the site will be removed. The 96-inch to 66-inch transition and trash rack will be relocated to a point just above the sediment pond, as shown on Plate 3-5. The stream channel will be reconstructed through the property, down to the new culvert inlet near the pond.

It is expected that the reconstructed channel will be on bedrock and, for that reason, it was proposed that only the channel sides be protected by riprap. Since the bottom conditions are unknown, the permittee commits to place an appropriately sized riprap and filter blanket on the channel side and bottom, unless the bottom is found to be on bedrock.

Riprap, filter blanket and flow designs and calculations are detailed in Appendices 7-3 and 7-4. Design criteria are summarized in Table 7-11 in this Chapter. See Plate 3-5 for structure locations. The reclaimed main channel slope is projected to be a consistent 6% as shown in Table 7-11 and on Plates 3-5 and 3-5A.

The reclaimed area runoff will be prevented from reaching the restored channel by installation of an earthen berm on the reclamation side of the channel. The berm will direct disturbed runoff to the sedimentation pond. A typical section of the restored channel (and berm) is shown on Figure 7-12.

When the revegetation standards have been met, the second phase of reclamation will begin. It will consist of removal of the sedimentation pond and all remaining culvert sections. The remaining channel area will be restored as in Phase I, and all newly disturbed areas will be reseeded. Additional sediment and/or erosion controls, such as strawbales, silt fence, berms, etc., will be installed if necessary to protect the restored channel and stream.

During reconstruction of the main channel, it is proposed to divert the Cottonwood Creek flow around the mine site. This will be accomplished by installation of a small, temporary dam in the channel with a pump diverting the flow into a flexible culvert (or other conveyance structure), which will discharge either back into the culvert below or into the channel below the pond.

7.5.3 Side Canyon Channel

During Phase I of the reclamation, the 48-inch culvert will be removed from the side channel down to its confluence with the restored main channel. The side channel will also be restored and riprapped as described in Appendix 7-3. At the intersection of the side and main channels, 40 feet of 48-inch culvert will be left in place in the side channel. The inlet section and trash rack will also be installed at this location. The reclaimed area will be separated from the restored channels by installation of an earthen berm on the reclamation side of the channels, providing for reclaimed area drainage to the north of the side canyon to flow over the culverted area and to the sediment pond.

During Phase II, the remaining 48-inch culvert will be removed along with the sediment pond and remaining main channel culverts when revegetation standards have been met. The remaining disturbed area will then be reseeded in accordance with the plan.

Design parameters are summarized in Table 7-11 of this Chapter. Riprap, filter blanket and flow designs and calculations are detailed in Appendices 7-3 and 7-4. A typical section of the restored side channel is shown in Figure 7-12, and the overall plan and structure locations are shown on Plates 3-5 and 3-6.

7.5.4 Sedimentation Pond

The sedimentation pond will remain in place during Phase I of reclamation. There will be no change in pond size, operation or configuration. The reclaimed area runoff will be directed to the pond at the existing inlet location by earthen berms as described in the previous sections. Runoff area will be less than the operational design area by the amount of area involved in the channel restoration; therefore, the pond capacity is more than adequate to contain the reclaimed area runoff from a 10-year, 24 hour event.

The sedimentation pond will continue to be operated, maintained, and inspected, as required until such time as it can be removed.

When revegetation standards have been reached on the reclamation, the sedimentation pond and all remaining culverts will be removed. Any sediment removed from the pond will be hauled to the Cottonwood Waste Rock Facility for disposal. The main channel will be restored through the former pond area, and all remaining disturbed areas will be reseeded.

Pond design details can be found in Section 7.2.4.2 of this Chapter. Structure locations for Phases I and II of reclamation are shown in Plates 3-5 and 3-6.

7.5.5 Post-Mining Water Monitoring

Upon completion of Phase I of the reclamation, all water monitoring locations with the exception of the UPDES sampling point for the sediment pond discharge will enter reclamation status. Post-mining monitoring will take place at the locations and frequencies described in Appendix 7-1. The UPDES (pond discharge) point will continue to be monitored in accordance with requirements of the permit until such time as the permit is cancelled and/or the pond is removed.

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TABLE 7-1

Results of Groundwater Quality Analyses

	Belt Entry 26+00	Belt Entry 24+00	Station #134 23+00	Intake #4 29 & 33	Entry #4 31+00	Station #164 1st Right	Station #138 1st Left 32+40	Entry #1 South Section	Entry #2 32+00	Entry #2 1st Right 3+00	Entry #4 West Section 8+30	Belt Entry 34+00	Entry #3 West Section 11+70	Entry #3 West Section	#3 West Section 17+30	South Section 34+75
	6- -79	7- -79	9-6-79	10- -79	11-1-79	11-27-79	12-27-79	1-31-80	2-13-80	3-27-80	6- -80	7- -80	8- -80	9- -80	10-3-80	11-20-80
Conductivity, umhos/cm	700	3300	310	1000	630	1850	700	400	430	490	470	700	320	705	1300	490
pH, Units	7.62	7.22	7.60	7.60	7.73	6.20	*3.20*	7.83	8.00	8.60	7.80	7.62	7.80	8.00	*2.62*	7.60
Iron (Dissolved), mg/l	0.250	0.170	0.020	0.025	0.100	0.125	0.130	0.122	0.060	0.035	0.039	0.250	0.220	0.071	0.096	0.180
Iron (Total), mg/l	0.310	0.170	0.110	0.115	0.136	0.330	0.305	0.150	0.110	0.137	0.150	0.310	0.260	0.160	0.160	0.190
Manganese, mg/l	0.009	0.009	0.009	0.010	0.010	0.010	0.012	0.015	0.010	0.014	0.013	0.009	0.010	0.010	0.003	0.007
Oil & Grease, mg/l	<1.0	<1.0	1.2	1.0	1.6	<1.0	2.0	0.20	2.00	<1.00	3.40	<1.0	1.00	<0.01	1.00	3.00
Sulfate, mg/l	52.0	710	<3.0	330	410	540	370	26.0	21.0	<3.0	<3.0	52.0	6.0	4.5	<0.1	<3.0
Suspended Solids, mg/l	320	3.0	2.0	1.0	1.0	<0.1	1.3	1.5	3.5	5.0	3.0	320	5.0	9.0	6.0	7.0
Total Dissolved Solids, mg/l	500	2700	420	837	406	1100	560	336	200	310	310	500	364	520	840	350

Only one location in the mine was known to produce sufficient groundwater flow (approximately one gal. per day) to suggest sampling. This locations was identified as UG-1 on Figure 6-9. Over 30 samples from this site have been analyzed during the 1979-1983 period. The lowest pH was 6.8 and most are above 7.5. Alkalinities are also high, generally above 240 mg/l as $CaCO_3$ which indicates a large pH buffering capacity. (See Annual Reports for Water Monitoring Data) Other samples from misc. sites in the mine show similar results. *The low pH samples list in Table 7-1 are either erroneous or else samples of small stagnant pools, not representative of any significant water generated within the mine.

Note: UG-1 was rendered inaccessible in 1988. A new underground monitoring site, UG-2, has since been selected for monitoring.

TABLE 7-2

--Runoff curve numbers for hydrologic soil-cover complexes (Antecedent moisture conditon II, and $I_a = 0.2S$)

Land use	Cover Treatment or practice	Hydrologic condition	Hydrologic soil group A	B	C	D
Fallow	Straight row	-----	77	86	91	94
Row crops	"	Poor	72	81	88	91
	"	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	"	Good	65	75	82	86
	"and terraced	Poor	66	74	80	82
	"and terraced	Good	62	71	78	81
Small grain	Straight row	Poor	65	76	84	88
		Good	63	75	83	87
	Contoured	Poor	63	74	82	85
		Good	61	73	81	84
	"and terraced	Poor	61	72	79	82
		Good	59	70	78	81
Close-seeded legumes 1 or rotation meadow	Straight row	Poor	66	77	85	89
	" "	Good	58	72	81	85
	Contoured	Poor	64	75	83	85
	"	Good	55	69	78	83
	"and terraced	Poor	63	73	80	83
	"and teraced	Good	51	67	76	80
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
	Contoured	Poor	47	67	81	88
	"	Fair	25	59	75	83
	"	Good	6	35	70	79
Meadow		Good	30	58	71	78
Woods		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads		----	59	74	82	86
Roads (dirt) 2		----	72	82	87	89
(hard surface) 2		----	74	84	90	92
Industrial area		----	81	88	91	93

1 Close-drilled or broadcast.
2 Including right-of-way

TABLE 7-3

COTTONWOOD CANYON CREEK WATER QUALITY *

SW-1

93 SAMPLE DATES	ACIDITY	ALKALINITY BICARBONATE	CALCIUM	CARBONATE	CHLORIDE	CONDUCTIVITY (umhos/cm)	DISSOLVED OXYGEN	HARDNESS	IRON DISSOLVED	IRON TOTAL	MAGNESIUM	MANGANESE	OIL & GREASE	pH (units)	POTASSIUM	SODIUM	SULFATE	SOLIDS TDS	SOLIDS TSS	SOLIDS SETTLEABLE
-22	0.0	231	39.6		0.7	406	8.4	210	0.12	0.02	27.00	0.03	0.0	8.82	0.00	16.3	20	254	0.0	0.00
-23	2.0	401	64.9	0	25.2	843	9.5	413	0.19	0.25	61.00	0.00	0.0	8.07	3.20	35.4	100	610	4.0	0.00
-19	2.0	355	152.3	0	5.6	423	9.5	466	0.19	0.91	20.90	0.19	0.0	8.34	3.10	6.0	40	253	412.0	1.50
-10	0.0	288	61.7	9	19.8	713	11.2	348	<0.05	0.13	47.00	<0.03	0.0	8.45	2.00	29.5	90	489	0.0	<0.30
IN	0.0	231	39.6	0	0.7	406	8.4	210	0.05	0.02	20.90	0.00	0.0	8.07	0.00	6.0	20	253	0.0	0.00
X	2.0	401	152.3	9	25.2	843	11.2	466	0.19	0.91	61.00	0.19	0.0	8.82	3.20	35.4	100	610	412.0	1.50
AN	1.0	319	79.6	3	12.8	596	9.7	359	0.14	0.33	38.97	0.06	0.0	8.42	2.07	21.8	62	401	106.0	0.50
ISTORICAL 1977-1992																				
IN	1.0	275	15.1	1.0	1.5	559	0.0	260	0.05	0.05	2.40	0.01	0.5	7.10	1.00	11.0	20.1	226	0.5	0.10
AX	22.0	416	100.0	1.0	22.0	737	0.0	390	0.43	15.90	61.61	1.31	350.0	8.36	21.00	60.0	230.7	900	1290.0	0.30
EAN	4.0	334	65.5	1.0	12.3	648	0.0	313	0.12	1.07	37.17	0.08	12.1	7.81	3.45	21.0	70.8	362	78.1	0.13
. OF ANALYSES	35	53	52	11	53	14	0	20	8	51	53	47	35	48	52	52	53	53	52	8

* Quality parameters are reported as mg/l unless otherwise noted.

TABLE 7-3

COTTONWOOD CANYON CREEK WATER QUALITY *

SW-2

SAMPLE DATES	ACIDITY	ALKALINITY BICARBONATE	CALCIUM	CARBONATE	CHLORIDE	CONDUCTIVITY (umhos/cm)	DISSOLVED OXYGEN	HARDNESS	---- IRON ---- DISSOLVED	TOTAL	MAGNESIUM	MANGANESE	OIL & GREASE	pH (units)	POTASSIUM	SODIUM	SULFATE	------ SOLIDS --- TDS	TSS	SETTLEABLE
-23	0.0	320	94.8	0.0	33.8	786	8.6	488	1.25	2.44	61.00	0.12	0.3	8.41	1.70	38.0	200	563	253.0	0.0
-19	2.0	408	136.9	0.0	7.1	456	9.0	461	0.25	3.11	28.90	0.22	0.1	8.90	0.00	8.0	80	300	482.0	1.5
-10	0.0	452	66.8	0.9	24.6	838	9.1	443	0.06	0.30	67.00	<0.03	1.0	8.80	4.00	39.7	150	584	18.0	<0.5
MIN	0.0	320	66.8	0.0	7.1	456	8.6	443	0.06	0.30	28.90	0.03	0.1	8.41	0.00	8.0	80	300	18.0	0.0
MAX	2.0	452	136.9	0.9	33.8	838	9.1	488	1.25	3.11	67.00	0.22	1.0	8.90	4.00	39.7	200	584	482.0	1.5
MEAN	0.6	393	99.5	0.3	21.8	693	8.9	464	0.52	1.95	52.30	0.12	0.5	8.70	1.90	28.6	143	482	317.6	0.7
HISTORICAL 1977-1992																				
MIN	0.1	261	11.1	1.0	1.5	570	0.0	250	0.05	0.05	2.40	0.01	0.5	7.00	1.00	11.88	19.5	267	1.0	0.1
MAX	22.0	458	123.2	1.0	32.0	915	0.0	469	0.34	16.20	69.25	1.37	9.0	8.39	25.60	53.10	246.9	780	1004.0	0.1
MEAN	3.9	324	64.7	1.0	13.4	715	0.0	315	0.09	1.23	37.78	0.10	2.0	7.86	4.77	24.01	84.8	376	68.0	0.1
NO. OF ANALYSES	34	51	51	11	51	12	0	18	8	50	51	47	39	46	51	50	51	51	50	8

* Quality parameters are reported as mg/l unless otherwise noted.

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TABLE 7-3

COTTONWOOD CANYON CREEK WATER QUALITY *

SW-3

1993 SAMPLE DATES	ACIDITY	ALKALINITY BICARBONATE	CALCIUM	CARBONATE	CHLORIDE	CONDUCTIVITY (umhos/cm)	DISSOLVED OXYGEN	HARDNESS	---- IRON ---- DISSOLVED	TOTAL	MAGNESIUM	MANGANESE	OIL & GREASE	pH (units)	POTASSIUM	SODIUM	SULFATE	------ SOLIDS --- TSS	TDS	SETTLEABLE
3-23	0.0	300	80.6	0.0	57.6	1320	7.9	486	0.20	0.27	69.00	0.00	0.7	8.06	2.50	84.7	340.0	987	17.0	0.0
6-10	2.0	481	150.0	<1.0	12.8	536	7.4	572	0.27	1.11	42.00	0.28	0.2	8.50	3.70	20.5	130.0	378	688.0	1.5
9-10	0.0	297	82.0	14.0	40.2	1210	6.4	436	<0.05	0.47	56.00	0.03	<1.0	8.00	3.00	80.8	300.0	900	15.0	<0.5
12-13	<1.0	340	91.0	<1.0	60.0	1100	10.1	540	<0.20	<0.20	70.00	<0.10	<5.0	8.31	5.00	70.0	270.0	964	0.0	<0.5
MIN	0.0	297	80.6	0.0	12.8	536	6.4	436	0.05	0.20	42.60	0.00	0.2	8.06	2.50	20.5	130.0	372	0.0	0.0
MAX	10.0	481	150.0	14.0	57.6	1320	10.1	572	0.27	1.11	78.00	0.28	5.0	8.60	5.00	80.8	340.0	987	688.0	1.5
MEAN	3.0	372	103.2	4.0	42.2	1057	7.9	510	0.18	0.61	61.40	0.00	1.7	8.41	3.58	60.0	267.5	760	165.6	0.6
HISTORICAL 1977-1992																				
MIN	0.1	253	14.3	0.1	1.7	600	8.7	245	0.05	19.00	2.40	0.01	0.2	7.30	1.62	3.00	22.0	40	1.0	0.1
MAX	10.6	430	150.8	14.0	60.2	1330	8.7	614	0.43	0.04	96.37	2.40	114	8.80	30.00	87.00	300	976	8004.0	0.1
MEAN	3.3	330	72.4	7.5	21.0	1000	8.7	410	0.10	1.46	43.42	0.15	4.6	7.92	4.06	33.44	180.0	440	176.4	0.1
NO. OF ANALYSES	34	63	62	12	62	14	1	30	8	60	63	43	46	46	61	62	63	63	60	7

* Quality parameters are reported as mg/l unless otherwise noted.

TABLE 7-4

USGS Water Quality Data at USGS Gaging Station on Cottonwood Creek above Straight Canyon, near Orangeville, Utah.

Date	Oct 21 1978	Nov 19 1978	Jun 13 1979	Jul 16 1979	Aug 05 1979	Sep 15 1979
Time	1130	1030	1430	1830	1630	1615
Stream Flow, cfs	.33	.57	3.3	.94	.54	.32
Specific Conductance, umhos/cm	530	570	470	540	560	560
pH	8.7	8.9	7.8	8.8	8.7	8.6
Temperature, C°	8.5	.0	17.0	17.0	19.5	13.5
Oxygen (Dissolved), mg/l	9.1	11.2	---	7.4	7.0	8.2
Coliform (Fecal), cols. 100 ml	---	K13	---	---	24	---
Streptococci (Fecal), cols. 100 ml	---	81	---	---	2000	---
Hardness as CaCO3, mg/l	300	300	---	250	280	270
Hardness as CaCO3 (Noncarbonate), mg/l	30	16	---	17	50.	40
Calcium (Dissolved), mg/l	54	55	---	39	60	42
Magnesium as Mg (Dissolved), mg/l	39	39	---	38	44	41
Sodium (Dissolved), mg/l	14	13	---	18	20	16
Sodium (Percent)	9	9	---	13	13	24
Sodium Absorption Ratio	.4	.3	---	.5	.5	.4
Sodium Potassium as Na (Dissolved), mg/l	---	---	---	20	26	18
Potassium as K (Dissolved), mg/l	2.9	1.9	---	2.1	6.1	2.3
Bicarbonate as HCO3, mg/l	280	310	---	260	260	260
Carbonate as CO3, mg/l	24	18	---	14	10	10
Alkalinity as CaCO3, mg/l	270	284	---	240	230	230
Carbon Dioxide as CO2 (Dissolved), mg/l	1.0	.7	---	.7	.9	1.1
Sulfate as SO4 (Dissolved), mg/l	69	44	---	56	61	60
Chloride as Cl (Dissolved), mg/l	10	9.0	---	8.9	11	9.1
Fluoride as F (Dissolved), mg/l	---	.1	---	---	.2	---
Silica as SIO2 (Dissolved), mg/l	6.9	6.9	---	6.5	6.7	6.8
Solids (Dissolved), tons per ac/ft	.46	.47	---	.42	.45	.43
Nitrate as N (Dissolved), mg/l	---	.31	---	---	.08	---
Nitrite as NO2 (Dissolved), mg/l	---	.00	---	---	.00	---
Nitrogen NO2 + NO3 as N (Dissolved), mg/l	---	.31	---	---	.08	---
Ammonia as N (Dissolved), mg/l	---	.02	---	---	.01	---
Organic Nitrogen as N (Dissolved), mg/l	---	.22	---	---	.13	---
Organic Ammonia as N (Total), mg/l	---	.22	---	---	.18	---
Organic Nitrogen NH4 (Total Suspended), mg/l	---	.00	---	---	.04	---
Ammonia + Organic Nitrogen (Dissolved), mg/l	---	.24	---	---	.14	---
Phosphorus as P (Total), mg/l	---	.010	---	---	.010	---
Phosphorus Ortho as P (Dissolved), mg/l	---	.00	---	---	.00	---
Phosphate Ortho as PO4 (Dissolved), mg/l	---	.00	---	---	.00	---
Boron as B (Dissolved), ug/l	---	30	---	---	60	---
Organic Carbon as C (Dissolved), mg/l	---	1.5	---	---	2.0	---
Organic Carbon as C (Total Suspended), mg/l	---	---	---	---	.1	---
Phenols, ug/l	---	3	---	---	0	---
Oil & Grease (Total), mg/l	---	0	---	---	0	---
Arsenic as As (Dissolved), ug/l	---	1	---	---	1	---
Chromium as Cr (Dissolved), ug/l	---	0	---	---	0	---
Iron as Fe (Dissolved), ug/l	---	10	---	---	0	---
Lead as Pb (Dissolved), ug/l	---	130	---	---	0	---
Lithium as Li (Dissolved), ug/l	---	10	---	---	20	---
Manganese as Mn (Dissolved), ug/l	---	2	---	---	1	---
Selenium as Se (Dissolved), ug/l	---	1	---	---	1	---
Strontrium as Sr (Dissolved), ug/l	---	320	---	---	370	---
Zinc as Zn (Dissolved), ug/l	---	3	---	---	3	---
Solids Sum of Constituents (Dissolved),mg/l	338	342	---	311	328	315
Solids (Dissolved), tons/day	.30	.53	---	.79	.68	.27

Utah Division of Health numerical standards for water in the state.

TABLE 7-5

Constituent	CLASSES: Domestic Source 1A	1B	1C	Recreation & Aesthetics 2A	2B	Aquatic Wildlife 3A	3B	3C	3D	Agri-culture 4	Indus-try 5	Special 6
Bacteriological (No./100 ml)								STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS (SEE APPENDIX B)			STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS	STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS
(30-day Geometric Mean) Maximum Total Coliforms	1	50	5,000	1,000	5,000	•	•		•	•		
Maximum Fecal Coliforms	•	•	2,000	200	2,000	•	•		•	•		
Physical												
Total Dissolved Gasses	•	•	•	•	•	(b)	(b)		•	•		
Minimum DO (mg/1) (a)	•	•	5.5	5.5	5.5	6.0	5.5		5.5	•		
Maximum Temperature	•	•	•	•	•	20ºC	27ºC		•	•		
Maximum Temp. Change	•	•	•	•	•	2ºC	4ºC		•	•		
pH	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0		6.5-9.0	6.5-9.0		
Turbidity increase (c)	•	•	•	10 NTU	10 NTU	10 NTU	10 NTU		15 NTU	•		
Chemical (Maximum mg/1)												
Arsenic, dissolved	.05	.05	.05	•	•	•	•		•	.1		
Barium, dissolved	1	1	1	•	•	•	•		•	•		
Cadmium, dissolved	.010	.010	.010	•	•	.0004(d)	.004(d)		•	.01		
Chromium, dissolved	.05	.05	.05	•	•	.10	.10		.10	.10		
Copper, dissolved	•	•	•	•	•	.01	.01		•	.2		
Cyanide	•	•	•	•	•	.005	.005		•	•		
Iron, dissolved	•	•	•	•	•	1.0	1.0		1.0	•		
Lead, dissolved	.05	.05	.05	•	•	.05	.05		•	.1		
Mercury, total	.002	.002	.002	•	•	.00005	.00005		.00005	•		
Phenol	•	•	•	•	•	.01	.01		•	•		
Selenium, dissolved	.01	.01	.01	•	•	.05	.05		•	.05		
Silver, dissolved	.05	.05	.05	•	•	.01	.01		•	•		
Zinc, dissolved	•	•	•	•	•	.05	.05		•	•		
NH_3 as N (un-ionized)	•	•	•	•	•	.02	.02		•	•		
Chlorine	•	•	•	•	•	.002	.01		•	•		
Fluoride, dissolved (e)	1.4-2.4	1.4-2.4	1.4-2.4	•	•	•	•		•	•		
NO_3 as N	10	10	10									
Boron, dissolved	•	•	•	•	•	•	•		•	.75		
H_2S	•	•	•	•	•	.002	.002		•	•		
TDS (f)	•	•	•	•	•	•	•		•	1200		
Radiological (Maximum pCi/1)												
Gross Alpha	15	15	15	•	•	15(g)	15(g)		15(g)	15(g)		
Radium 226, 228 combined	5	5	5	•	•	•	•		•	•		
Strontium 90	8	8	8	•	•	•	•		•	•		
Tritium	20,000	20,000	20,000	•	•	•	•		•	•		
Pesticides (Maximum ug/1)												
Endrin	.2	.2	.2	•	•	.004	.004		.004	•		
Lindane	4	4	4	•	•	.01	.01		.01	•		
Methoxychlor	100	100	100	•	•	.03	.03		.03	•		
Toxaphene	5	5	5	•	•	.005	.005		.005	•		
2, 4-D	100	100	100	•	•	•	•		•	•		
2, 4, 5-TP	10	10	10	•	•	•	•		•	•		
Pollution Indicators (g)												
Gross Beta (pCi/1)	50	50	50	•	•	50	50		50	50		
BOD (mg/1)	•	•	5	5	5	5	5		5	5		
NO_3 as N (mg/1)				4	4	4	4		•	•		
PO_4 as P (mg/1)(h)	•	•	•	.05	.05	.05	.05		•	•		

• Insufficient evidence to warrant the establishment of numerical standard. Limits assigned on case-by-case basis.

(a) These limits are not applicable to lower water levels in deep impoundments.

(b) Not to exceed 110% of saturation.

(c) For Classes 2A, 2B, 3A, and 3B at background levels of 100 NTUs or greater, a 10% increase limit will be used instead of the numeric values listed. For Class 3D at background levels of 150 NTUs or greater, a 10% increase limit will be used instead of the numeric value listed. Short term variances may be considered on a case-by-case basis.

(d) Limit shall be increased threefold if $CaCO_3$ hardness in water exceeds 150 mg/1.

(e) Maximum concentration varies according to the daily maximum mean air temperature.

Temp. ºC	mg/1
12.0 and below	2.4
12.1 to 14.6	2.2
14.7 to 17.6	2.0
17.7 to 21.4	1.8
21.5 to 26.2	1.6
26.3 to 32.5	1.4

(f) Total dissolved solids (TDS) limit may be adjusted on a case-by-case basis.

(g) Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

(h) PO_4 as P(mg/1) limit for lakes and reservoirs shall be

TABLE 7-6 SURFACE WATER RIGHTS IN THE VICINITY OF THE TRAIL MOUNTAIN MINE.

SOURCE	CLAIM NO.	OWNER	USE	PERIOD	
Straight Canyon	93-702	U.S.A Forest Service	Stockwatering	June 1-Oct.15	
Straight Canyon	93-703	Hunter Investment Co.	Stockwatering	June 21-Sept.20	
Straight Canyon	93-704	U.S.A. Forest Service	Stockwatering	June 1-Oct.15	
Cottonwood Creek	93-708	U.S.A. Forest Service	Stockwatering	June 1-Oct.15	
Cottonwood Creek	93-709	Trail Mnt. Coal LDT	Mining,Industry	Jan 1-Dec.31(See appen	
Cottonwood Creek	93-710	Div. of State Lands	Stockwatering	June 6-Sept.30	
Cottonwood Creek	93-711	B.L.M.	Stockwatering	Jan 1-Dec.31	
Cottonwood Creek	93-715	U.S.A. Forest Service	Stockwatering	June 1-Oct.15	
Trail Mountain	93-718	U.S.A. Forest Service	Stockwatering	June 1-Oct.15	
Roans Canyon	93-719	U.S.A. Forest Service	Stockwatering	June 1-Oct.15	
Roans Canyon	93-720	U.S.A. Forest Service	Stockwatering	June 1-Oct.15	
--------	93-721	U.S.A. Forest Service	Stockwatering	June 1-Oct.15	
Straight Canyon	93-800	B.L.M.	Stockwatering	Jan 1-Dec.31	
Straight Canyon	93-802	Jessie James Peacock	Stockwatering	Jan 1-Dec.31	
Straight Canyon	93-803	Jessie James Peacock	Stockwatering	Jan 1-Dec.31	
Cottonwood Creek	93-1087	Jessie James Peacock	Stockwatering	Jan 1-Dec.31	
Cottonwood Creek	93-1088	Jessie James Peacock	Irrigation	Apr 1-Oct.31	0.5 c
Cottonwood Creek	93-1088	Jessie James Peacock	Stockwatering	Jan 1-Dec.31	0.25

TABLE 7-7 Peak flows and peak flow design related information for diversion ditches and culverts.

Structure	Disturbed Area ac	Undisturbed Area ac	Total Area mi^2	Weighted Cn	Design Storm in	S in	Runoff (Q) in	Hydraulic Length ft	Average Watershed Slope %	Watershed Lag hr	t_p hr	ΔD hr	$\frac{484AQ}{t_p}$	$C_s t_p$	Peak Flow (q) cfs
Cottonwood Canyon Culvert	—	11,969	18.7	57	3.2	7.54	0.31	40,000	36.5	1.74	2.09	1.0	1341.3	3.70	380.0
Side Canyon Culver	—	366	0.57	80	2.4	2.5	0.82	6,375	49.12	0.199	0.22	0.04	1032	.83	80.1
* Sediment Pond Diversion 1	9.27	22.82	0.05	78.5	2.4	2.74	0.75	2,200	8.0	0.22					22.36

* SCS - TR55 Method

DESIGN CRITERIA
SEDIMENT POND INLETS

Location	Curb/Gutter (Upper Section)	Curb/Gutter (near Pond) (Lower Section)	Switchback	Culvert from Road	Mine Waterline
Disturbed	9.55	8.800	0.18	0.287	-
Undisturbed Drainage Area (ac.)	26.61	14.700	3.79	-	-
Precipitation -10/24 (in.)	2.4	2.4	2.4	2.4	-
Flow (cfs)	22.56	22.56	4.65	0.45	0.20
Slope (%)	0.075	0.200	0.400	0.020	-
Bottom Width (ft.)	0.01	0.01	0.01	-	-
Side Slope (h:v)	4:1	5:1	2:1	-	-
Manning's N	0.015	0.015	0.035	0.024	-
Velocity (fps)	12.82	14.82	9.79	2.50	-
Flow Depth (ft.)	0.66	0.40	0.48	0.42	-
Runoff CN	78.5	78.5	78.5	90.0	-
Area Req'd (Sq. Ft.)	1.77	1.52	0.48	0.18	-
Min. Structure Area (Sq. Ft.)	2.00	1.77	1.00	3.14	-

TABLE 7-8

(CONT.)

Channel Flow Calculation

For: CURB GUTTER (UPPER SECTION)

Bed Slope =	.075	
Manning's N =	.015	
Bottom Width =	.01	feet
Channel Side Slope =	.25	
Flow Depth =	.6620242	feet
Cross Sectional Area =	1.759724	square feet
Wetted Perimeter =	5.469192	feet
Hydraulic Radius =	.3217522	feet
Discharge =	22.56	cubic feet/sec
Velocity =	12.82019	feet/sec

TABLE 7-8

(CONT.)

Channel Flow Calculation

For: CURB/GUTTER (LOWER SECTION NEAR POND

Bed Slope =	.2	
Manning's N =	.015	
Bottom Width =	.01	feet
Channel Side Slope =	.1	
Flow Depth =	.3896175	feet
Cross Sectional Area =	1.521914	square feet
Wetted Perimeter =	7.841215	feet
Hydraulic Radius =	.1940917	feet
Discharge =	22.56	cubic feet/sec
Velocity =	14.82344	feet/sec

TABLE 7-8

(CONT.)

Channel Flow Calculation
For: SWITCHBACK DIVERSION

Bed Slope =	.4	
Manning's N =	.035	
Bottom Width =	.01	feet
Channel Side Slope =	.5	
Flow Depth =	.4849017	feet
Cross Sectional Area =	.4751083	square feet
Wetted Perimeter =	2.178546	feet
Hydraulic Radius =	.218085	feet
Discharge =	4.65	cubic feet/sec
Velocity =	9.787243	feet/sec

TABLE 7-8

(CONT.)

Channel Flow Calculation

For: CULVERT FROM ROAD

Bed Slope =	.02	
Manning's N =	.024	
Bottom Width =	.01	feet
Channel Side Slope =	1	
Flow Depth =	.4196697	feet
Cross Sectional Area =	.1803193	square feet
Wetted Perimeter =	1.197005	feet
Hydraulic Radius =	.1506421	feet
Discharge =	.45	cubic feet/sec
Velocity =	2.495573	feet/sec

TABLE 7.9

Sedimentation pond storage and spillway capacity requirements.

VARIABLE	
Disturbed Area, in acres	9.55
Undisturbed Area, in acres	26.61
Total Area (A) in Mi^2	0.56
Weighted Curve Number (Disturbed Area)	78.5
Weighted Curve Number (Undisturbed Area)	72.0
S, in inches	2.74
25-year, 24-hour Precip. (P) in inches	2.9
25-year, 24-hour Runoff (Q) in inches (Disturbed)	1.22
25-year, 24-hour Runoff (Q) in inches (Undisturbed)	0.75
Hydraulic Length (), in feet	2200
Average Watershed Slope (Y), in percent	8.0%
Time of Concentration (T_c), in hours	0.37
25-year, 24-hour Peak inflow, in cfs	36.46
10-year, 24-hour Precip., in inches	2.4
10-year, 24-hour runoff, in inches (Disturbed)	0.75
10-year, 24-hour Runoff, in inches (Undisturbed)	0.48
10-year, 24-hour Runoff, in ac-ft	1.67
Sediment Storage Requirement, in ac-ft	0.47
Pond Storage Requirement, in ac-ft.	2.14

TABLE 7.10

Design values of the sedimentation pond

Sediment Storage Volume (ac-ft.)	0.47
Runoff Storage Volume (ac-ft)	1.67
Total Storage Volume (ac-ft) (Design Volume)	2.14
Embankment height at Design Volume*(ft)	14.50
Spillway Capacity (cfs)	36.5
Spillway Diameter (inches)	48.00
Head Above Spillway Crest as Design Discharge (ft)	0.80
Required Freeboard (ft)	1.00
Required Total Embankment Height * (ft)	16.00
Actual Embankment Height of Existing Ponds (ft)	17.00
Total Width (ft)	11-13

TABLE 7-11

DESIGN CRITERIA
RECLAMATION HYDROLOGY

Location	Main Channel	Side Canyon	Sediment Pond Inlet
Undisturbed Drainage Area (ac.)	11,969.0	366.0	14.7
Disturbed Drainage Area (ac.)	-	-	2.4
Precip. - 10/24 (in.)	-	-	8.8
Precip - 100/24 (in.)	3.8	3.8	-
Flow (cfs)	710.0	160.0	20.1
Slope (%)	0.060	0.080	0.065
Bottom Width (ft.)	7.0	2.0	0.01
Side Slope (h:v)	2:1	2:1	2:1
Mannings N	0.040	0.040	0.040
Velocity (fps)	15.02	11.67	6.24
Flow Depth (ft.)	3.42	2.16	1.27
Area Req'd (Sq. Ft.)	47.28	13.71	3.22
Min. Structure Area (Sq. Ft.)	72.00	24.00	4.00
Rip-Rap Req'd (Y/N)	Y	Y	N

TABLE 7-11
(CONT.)

Channel Flow Calculation

For: Main Channel

Bed Slope =	.06	
Manning's N =	.04	
Bottom Width =	7	feet
Channel Side Slope =	.5	
Flow Depth =	3.417295	feet
Cross Sectional Area =	47.27688	square feet
Wetted Perimeter =	22.28261	feet
Hydraulic Radius =	2.121694	feet
Discharge =	710	cubic feet/sec
Velocity =	15.01791	feet/sec

TABLE 7-11
(CONT.)

Channel Flow Calculation

For: Side Canyon

Bed Slope =	.08	
Manning's N =	.04	
Bottom Width =	2	feet
Channel Side Slope =	.5	
Flow Depth =	2.165701	feet
Cross Sectional Area =	13.71192	square feet
Wetted Perimeter =	11.68531	feet
Hydraulic Radius =	1.173432	feet
Discharge =	160	cubic feet/sec
Velocity =	11.66868	feet/sec

TABLE 7-11
(CONT.)

Channel Flow Calculation

For: Sed. Pond Inlet

Bed Slope =	.06	
Manning's N =	.04	
Bottom Width =	.01	feet
Channel Side Slope =	.5	
Flow Depth =	1.266117	feet
Cross Sectional Area =	3.218768	square feet
Wetted Perimeter =	5.67225	feet
Hydraulic Radius =	.5674588	feet
Discharge =	20.1	cubic feet/sec
Velocity =	6.244627	feet/sec

TABLE 7-12

EAST MOUNTAIN TEMPERATURES - HISTORICAL SUMMARY

OCTOBER SUMMARY

	HIGH	LOW
AVG.	47.1	28.6
MAX.	71.5	54.0
MIN.	11.6	4.3

FEBRUARY SUMMARY

	HIGH	LOW
AVG.	32.2	15.6
MAX.	55.5	32.2
MIN.	-2.3	-14.7

JUNE SUMMARY

	HIGH	LOW
AVG.	68.0	43.3
MAX.	88.7	70.1
MIN.	37.7	23.1

NOVEMBER SUMMARY

	HIGH	LOW
AVG.	34.5	21.2
MAX.	54.3	40.9
MIN.	13.0	6.2

MARCH SUMMARY

	HIGH	LOW
AVG.	38.6	20.9
MAX.	60.7	40.0
MIN.	7.4	-6.0

JULY SUMMARY

	HIGH	LOW
AVG.	82.0	58.4
MAX.	88.0	68.1
MIN.	48.5	38.4

DECEMBER SUMMARY

	HIGH	LOW
AVG.	28.0	12.9
MAX.	58.6	40.0
MIN.	-2.6	-17.6

APRIL SUMMARY

	HIGH	LOW
AVG.	45.6	28.3
MAX.	68.4	51.9
MIN.	12.7	-0.3

AUGUST SUMMARY

	HIGH	LOW
AVG.	78.0	58.3
MAX.	88.3	68.6
MIN.	47.4	32.0

JANUARY SUMMARY

	HIGH	LOW
AVG.	28.9	13.0
MAX.	50.7	34.9
MIN.	2.0	-15.2

MAY SUMMARY

	HIGH	LOW
AVG.	58.1	38.2
MAX.	78.4	58.4
MIN.	15.0	2.4

SEPTEMBER SUMMARY

	HIGH	LOW
AVG.	68.3	43.9
MAX.	85.4	58.4
MIN.	31.6	28.0

HISTORICAL SUMMARY

PARAMETER	DATE	TEMP
AVERAGE HIGH		47.9
MAXIMUM HIGH	[illegible]-Jun-[illegible]	88.3
AVG. MAX. HIGH		88.0
MINIMUM HIGH	[illegible]-Dec-[illegible]	-2.6
AVG. MIN. HIGH		6.1
AVERAGE LOW		28.3
MAXIMUM LOW	[illegible]-Jun-[illegible]	[illegible]
AVG. MAX. LOW		62.4
MINIMUM LOW	[illegible]-Dec-[illegible]	-17.6
AVG. MIN. LOW		-6.7

ENERGY WEST MINING COMPANY
EAST MOUNTAIN PRECIPITATION
HISTORICAL COMPARISON

MONTH	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	MIN	MEAN	MAX	ST DEV
OCT	1.30	1.00	0.35	0.70	1.07	1.15	1.57	2.77	0.61	0.30	0.40	0.40	1.07	0.30	1.27	2.77	0.64
NOV	0.30	0.35	2.00	2.40	0.07	2.20	0.30	1.51	0.40	0.30	0.35	1.07	0.57	0.35	1.12	2.50	0.68
DEC	0.65	0.07	1.30	2.40	1.07	0.07	0.16	1.30	1.05	0.16	0.05	0.07	1.50	0.00	0.80	2.42	0.72
JAN	0.30	1.22	1.30	0.37	0.40	0.30	1.37	1.42	1.00	0.74	0.34	0.61	4.30	0.07	1.10	4.30	1.00
FEB	0.52	0.14	1.81	0.00	0.50	2.10	1.37	0.00	0.00	2.00	0.30	1.70	2.30	0.00	1.11	2.34	0.73
MAR	2.77	1.07	1.50	1.32	1.77	1.45	1.65	0.50	1.00	1.75	2.34	2.30	2.60	0.50	1.77	2.77	0.55
APR	0.64	0.00	0.02	0.50	1.35	1.65	1.16	2.00	0.35	1.00	0.50	0.55	0.30	0.00	0.61	2.00	0.50
MAY	0.07	0.45	0.71	0.32	1.70	0.30	1.77	1.00	0.47	0.35	1.00	2.30	0.32	0.32	0.97	2.30	0.67
JUN	0.11	0.00	0.61	1.30	0.20	0.50	0.50	0.61	0.40	0.67	0.21	0.55	0.30	0.00	0.51	1.30	0.32
JUL	0.57	1.00	1.37	1.50	2.47	0.57	2.40	0.45	1.30	0.00	1.61	0.65	0.04	0.04	1.22	2.40	0.67
AUG	0.65	1.30	4.00	2.30	0.12	2.30	1.16	0.50	2.44	1.00	1.40	0.40	0.62	0.12	1.00	4.00	1.00
SEP	2.05	2.01	1.02	0.04	2.31	1.00	0.65	0.51	0.40	1.02	3.11	0.35	0.14	0.00	1.30	3.11	0.93
TOTAL	10.00	14.57	16.71	14.55	17.02	14.02	13.73	14.02	10.90	10.90	12.00	11.74	14.57	10.90	13.00	16.71	2.00

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Project Title = trail mtn area la

Table 7-13

WATERSHED HYDROGRAPH

Inflow into structure # 1

Structure type: Null

Watershed data for watershed # 1

Curve number	=	95.0
Area	=	0.2 acres
Hydraulic length	=	320.00 Feet
Elevation change	=	8.0 feet.
Concentration time	=	0.03 hours
Concentration time type	=	SCS Upland Curves
Unit hydrograph type	=	Disturbed
Total Area	=	0.2 acres

qvc

Storm data

Total precipitaion	=	2.2 inches
Storm type	=	SCS 6 hour design storm
Peak Discharge	=	0.15 cfs
Discharge volume	=	0.02 acre ft

time	rainfall	hydrograph	time	rainfall	hydrograph
(hr.)	(in.)	(cfs)	(hr.)	(in.)	(cfs)
0.00	0.000	0.000 *	0.20	0.028	0.000
0.40	0.028	0.000 *	0.60	0.035	0.000
0.80	0.042	0.001 *	1.00	0.042	0.003
1.20	0.047	0.006 *	1.40	0.047	0.009
1.60	0.065	0.015 *	1.80	0.084	0.023
2.00	0.084	0.028 *	2.20	0.327	0.115
2.40	0.327	0.145 *	2.60	0.208	0.106
2.80	0.088	0.051 *	3.00	0.088	0.043
3.20	0.070	0.036 *	3.40	0.070	0.035
3.60	0.059	0.030 *	3.80	0.048	0.025
4.00	0.048	0.024 *	4.20	0.043	0.022
4.40	0.043	0.022 *	4.60	0.039	0.020
4.80	0.035	0.018 *	5.00	0.035	0.018
5.20	0.032	0.016 *	5.40	0.032	0.016
5.60	0.033	0.017 *	5.80	0.035	0.018
6.00	0.035	0.018 *	6.20	0.000	0.003
6.40	0.000	0.000 *			

X qvc

Project Title = trail mtn area 1 b

Table 7-13

WATERSHED HYDROGRAPH

Inflow into structure # 1

Structure type: Null

9/6/C

Watershed data for watershed # 1

Curve number	=	98.0
Area	=	0.2 acres
Hydraulic length	=	140.00 Feet
Elevation change	=	1.0 feet.
Concentration time	=	0.02 hours
Concentration time type	=	SCS Upland Curves
Unit hydrograph type	=	Disturbed
Total Area	=	0.2 acres

Storm data

Total precipitaion	=	2.2 inches
Storm type	=	SCS 6 hour design storm
Peak Discharge	=	0.20 cfs
Discharge volume	=	0.03 acre ft

9/6/C

time	rainfall	hydrograph	time	rainfall	hydrograph
(hr.)	(in.)	(cfs)	(hr.)	(in.)	(cfs)
0.00	0.000	0.000 *	0.20	0.028	0.000
0.40	0.028	0.001 *	0.60	0.035	0.005
0.80	0.042	0.011 *	1.00	0.042	0.015
1.20	0.047	0.020 *	1.40	0.047	0.022
1.60	0.065	0.032 *	1.80	0.084	0.044
2.00	0.084	0.048 *	2.20	0.327	0.176
2.40	0.327	0.204 *	2.60	0.208	0.143
2.80	0.088	0.067 *	3.00	0.088	0.056
3.20	0.070	0.047 *	3.40	0.070	0.045
3.60	0.059	0.039 *	3.80	0.048	0.032
4.00	0.048	0.031 *	4.20	0.043	0.028
4.40	0.043	0.028 *	4.60	0.039	0.026
4.80	0.035	0.023 *	5.00	0.035	0.023
5.20	0.032	0.021 *	5.40	0.032	0.020
5.60	0.033	0.021 *	5.80	0.035	0.022
6.00	0.035	0.023 *	6.20	0.000	0.003
6.40	0.000	0.000 *			

Project Title = trail mtn area I c

Table 7-13

WATERSHED HYDROGRAPH

Inflow into structure # 1

Structure type: Null

Watershed data for watershed # 1

Curve number	=	77.0
Area	=	1.6 acres
Hydraulic length	=	513.00 Feet
Elevation change	=	52.0 feet.
Concentration time	=	0.06 hours
Concentration time type	=	SCS Upland Curves
Unit hydrograph type	=	Forested
Total Area	=	1.6 acres

Storm data

Total precipitation	=	2.2 inches
Storm type	=	SCS 6 hour design storm
Peak Discharge	=	0.31 cfs
Discharge volume	=	0.07 acre ft

time	rainfall	hydrograph	time	rainfall	hydrograph
(hr.)	(in.)	(cfs)	(hr.)	(in.)	(cfs)
0.00	0.000	0.000 *	0.20	0.028	0.000
0.40	0.028	0.000 *	0.60	0.035	0.000
0.80	0.042	0.000 *	1.00	0.042	0.000
1.20	0.047	0.000 *	1.40	0.047	0.000
1.60	0.065	0.000 *	1.80	0.084	0.000
2.00	0.084	0.000 *	2.20	0.327	0.047
2.40	0.327	0.226 *	2.60	0.208	0.313
2.80	0.088	0.255 *	3.00	0.088	0.244
3.20	0.070	0.242 *	3.40	0.070	0.247
3.60	0.059	0.241 *	3.80	0.048	0.225
4.00	0.048	0.217 *	4.20	0.043	0.204
4.40	0.043	0.194 *	4.60	0.039	0.180
4.80	0.035	0.165 *	5.00	0.035	0.158
5.20	0.032	0.149 *	5.40	0.032	0.143
5.60	0.033	0.143 *	5.80	0.035	0.146
6.00	0.035	0.147 *	6.20	0.000	0.091
6.40	0.000	0.060 *	6.60	0.000	0.048

time	rainfall	hydrograph	time	rainfall	hydrograph
(hr.)	(in.)	(cfs)	(hr.)	(in.)	(cfs)
6.80	0.000	0.037 *	7.00	0.000	0.028
7.20	0.000	0.020 *	7.40	0.000	0.014
7.60	0.000	0.009 *	7.80	0.000	0.004
8.00	0.000	0.002 *	8.20	0.000	0.000
8.40	0.000	0.000 *			

Project Title = trail mtn area 4

Table 7-13

WATERSHED HYDROGRAPH

Inflow into structure # 1

Structure type: Null

Watershed data for watershed # 1

Curve number	=	95.0
Area	=	0.1 acres
Hydraulic length	=	109.00 Feet
Elevation change	=	52.0 feet.
Concentration time	=	3.5 hours
Concentration time type	=	SCS Upland Curves
Unit hydrograph type	=	Disturbed
Total Area	=	0.1 acres

Storm data

Total precipitaion	=	2.2 inches
Storm type	=	SCS 6 hour design storm
Peak Discharge	=	0.07 cfs
Discharge volume	=	0.02 acre ft

time	rainfall	hydrograph	time	rainfall	hydrograph
(hr.)	(in.)	(cfs)	(hr.)	(in.)	(cfs)
0.00	0.000	0.000 *	0.20	0.028	0.000
0.40	0.028	0.000 *	0.60	0.035	0.000
0.80	0.042	0.000 *	1.00	0.042	0.002
1.20	0.047	0.003 *	1.40	0.047	0.004
1.60	0.065	0.007 *	1.80	0.084	0.011
2.00	0.084	0.013 *	2.20	0.327	0.056
2.40	0.327	0.071 *	2.60	0.208	0.051
2.80	0.088	0.024 *	3.00	0.088	0.021
3.20	0.070	0.017 *	3.40	0.070	0.017
3.60	0.059	0.015 *	3.80	0.048	0.012
4.00	0.048	0.012 *	4.20	0.043	0.011
4.40	0.043	0.010 *	4.60	0.039	0.010
4.80	0.035	0.009 *	5.00	0.035	0.009
5.20	0.032	0.008 *	5.40	0.032	0.008
5.60	0.033	0.008 *	5.80	0.035	0.009
6.00	0.035	0.009 *	6.20	0.000	0.001
6.40	0.000	0.000 *			

Table 7-14

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Trail Mtn. pipe #1

Comment: Trail Mtn. culvert # 1 (inflows la,b,c)

Solve For Actual Depth

Given Input Data:

Diameter	1.00 ft
Slope.	0.0600 ft/ft
Manning's n	0.025
Discharge.	0.66 cfs

Computed Results:

Depth	0.26 ft
Velocity	4.12 fps
Flow Area.	0.16sf
Critical Depth. . .	0.34 ft
Critical Slope. . .	0.0208 ft/ft
Percent Full	25.77%
Full Capacity. . .	4.54 cfs
QMAX @.94D. .	4.88 cfs

EFFECTIVE:
1996

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EFFECTIVE:
JUL 15 1996

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Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, CT 06708

Table 7-14

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Trail Mtn. pipe #4

Comment: Trail Mtn. CMP #4. inflows (la.b.c & 4)

Solve For Actual Depth

Given Input Data:

Diameter	1.00 ft
Slope.	0.0670 ft/ft
Manning's n	0.025
Discharge.	0.73 fcs

Computed Results:

Depth	0.26 ft
Velocity	4.41 fps
Flow Area.	0.17sf
Critical Depth. . .	0.36 ft
Critical Slope. . .	0.0209 ft/ft
Percent Full	26.37%
Full Capacity. . .	4.80 cfs
QMAX @.94D. .	5.16 cfs

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Table 7-14

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name:	Trail Mtn. pipe #5
Comment:	Trail Mtn. Temp. pipe #5

Solve For Actual Depth

Given Input Data:

Diameter.	0.50 ft
Slope.	0.0580 ft/ft
Manning's n.	0.016
Discharge.	0.41 cfs

Computed Results:

Depth	0.21 ft
Velocity	5.19 fps
Flow Area.	0.08 sf
Critical Depth. . .	0.33 ft
Critical Slope. . .	0.0140 ft/ft
Percent Full	42.33%
Full Capacity. . .	1.10 cfs
QMAX @.94D. .	1.18 cfs

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1996
96C

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, CT 06708

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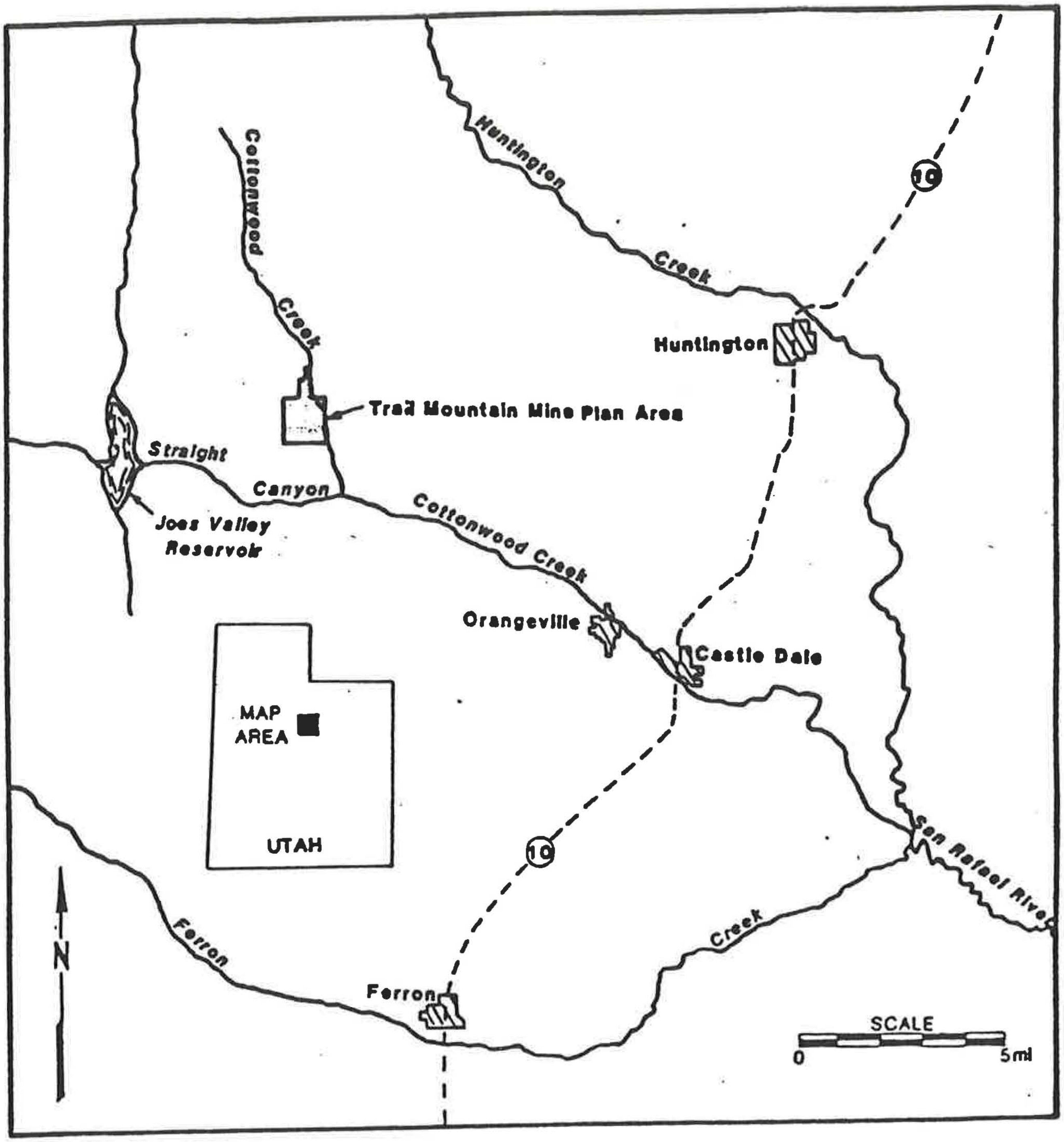


Figure 7-1. Location of the Trail Mountain Mine Plan Area.

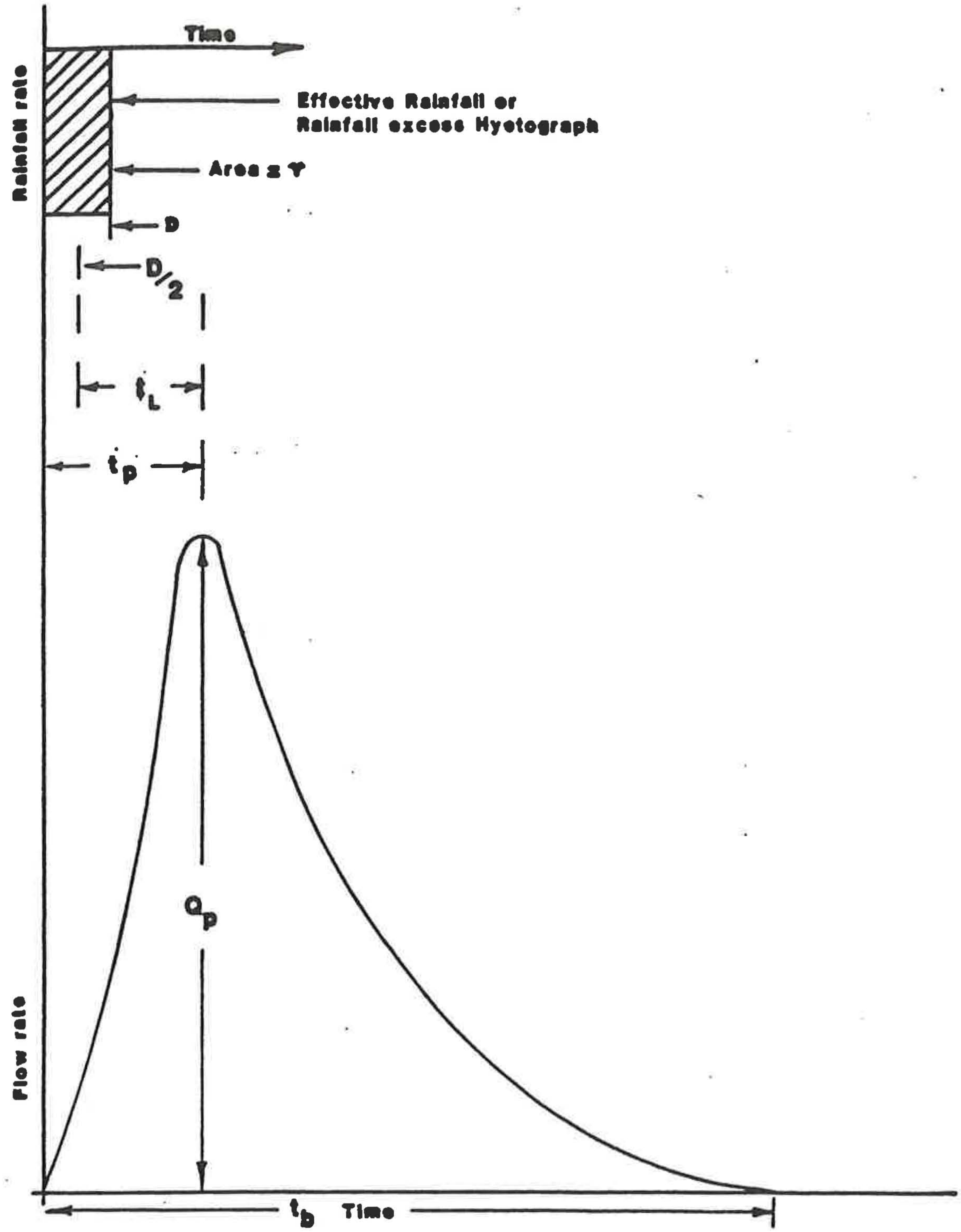


FIGURE 7-2 Hydrograph Terminology

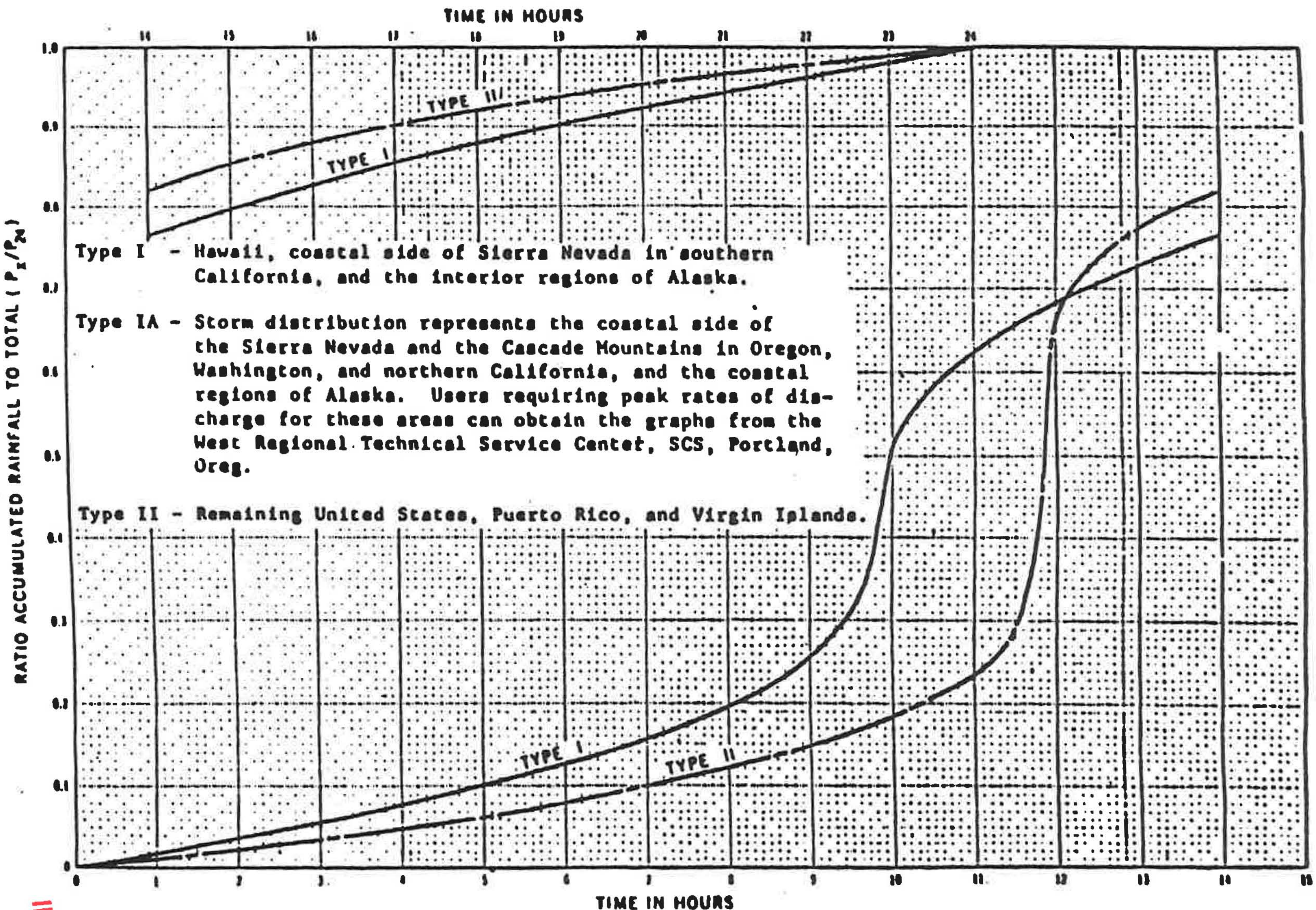


FIGURE 7-3 Twenty-four-hour rainfall distributions (from Kent, 1973).

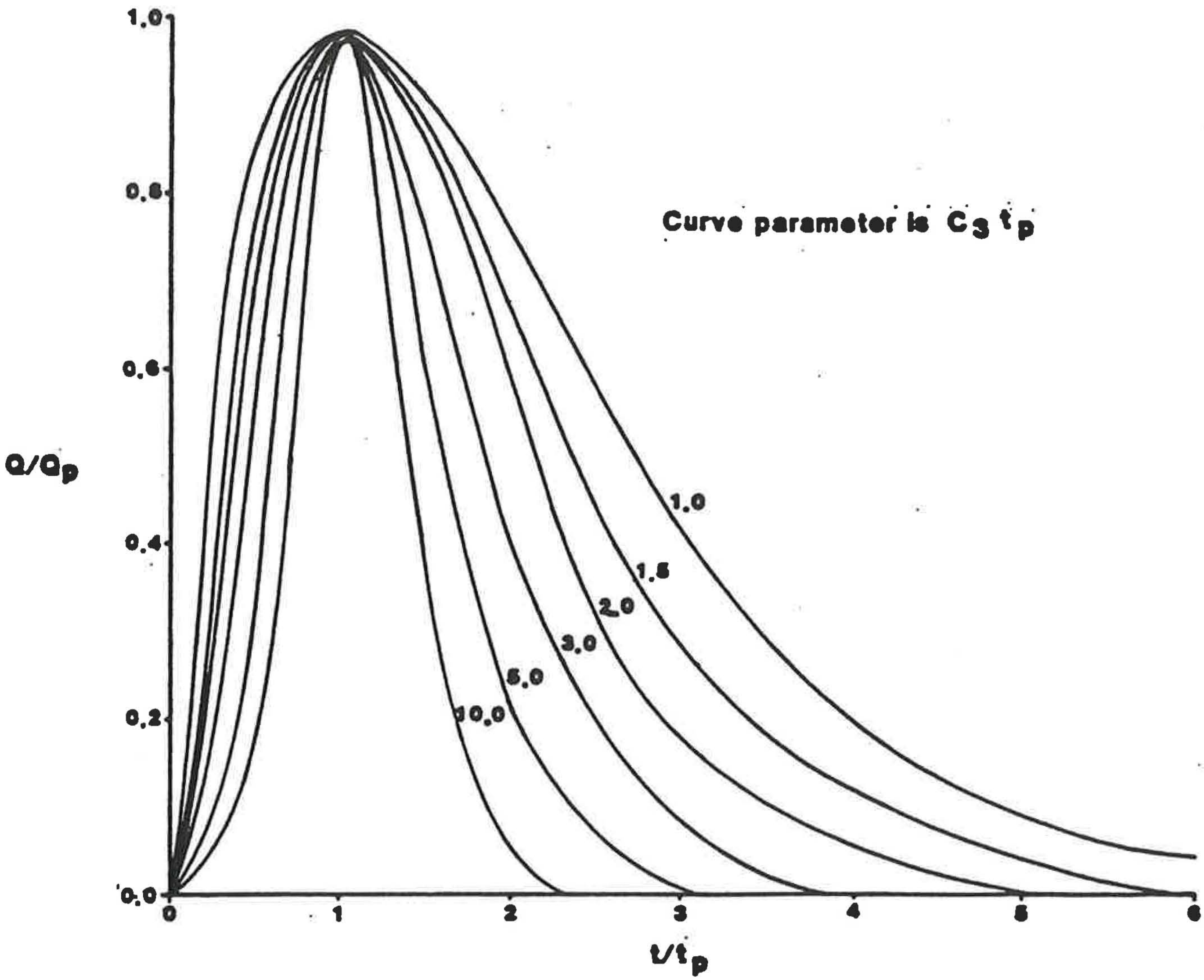


FIGURE 7-4 Variation of hydrograph shape with $C_3\ t_p$

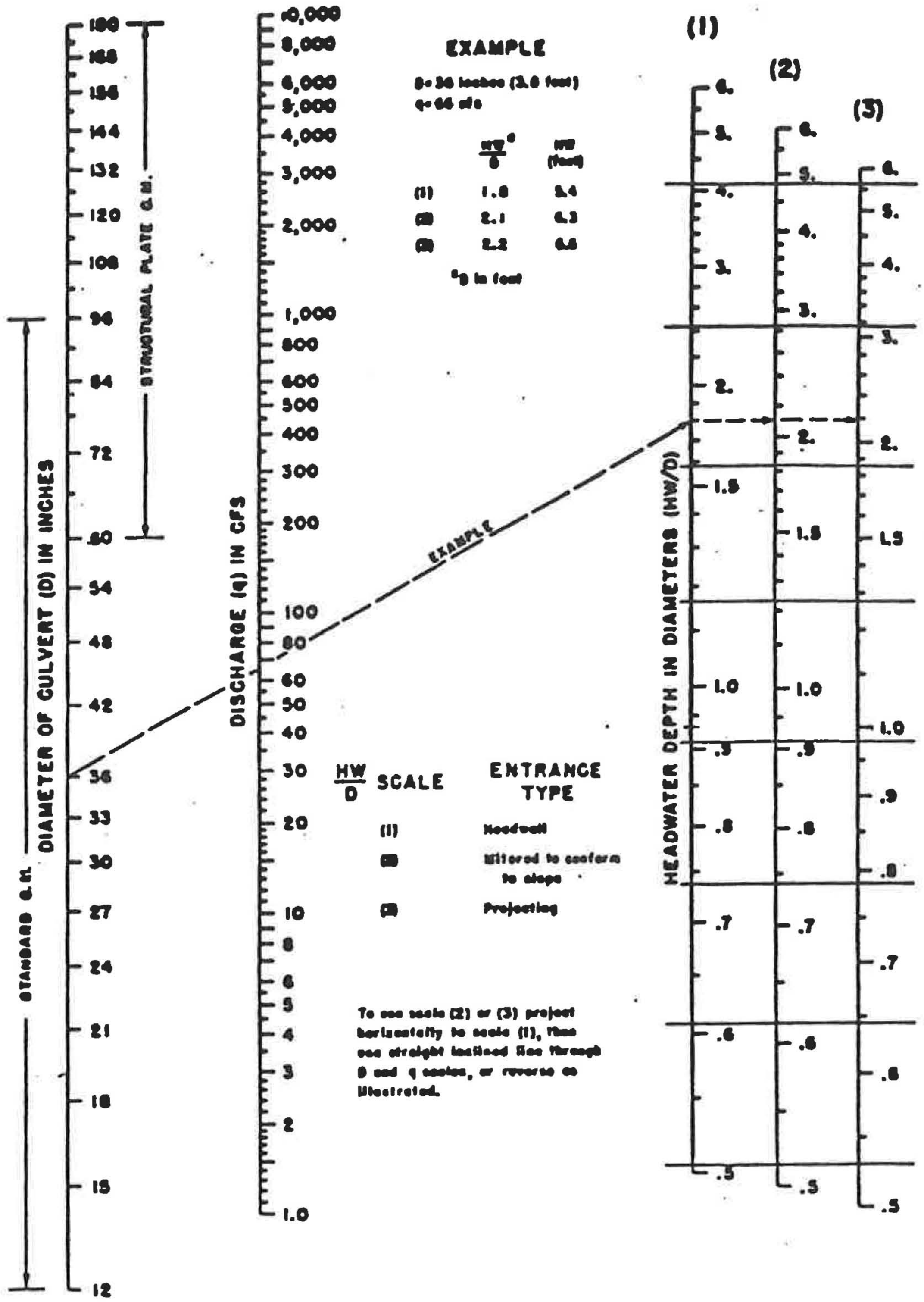


FIGURE 7-5 Headwater depth for corrugated metal pipe culverts with inlet control (U.S. Soil Conservation Service, 1972).

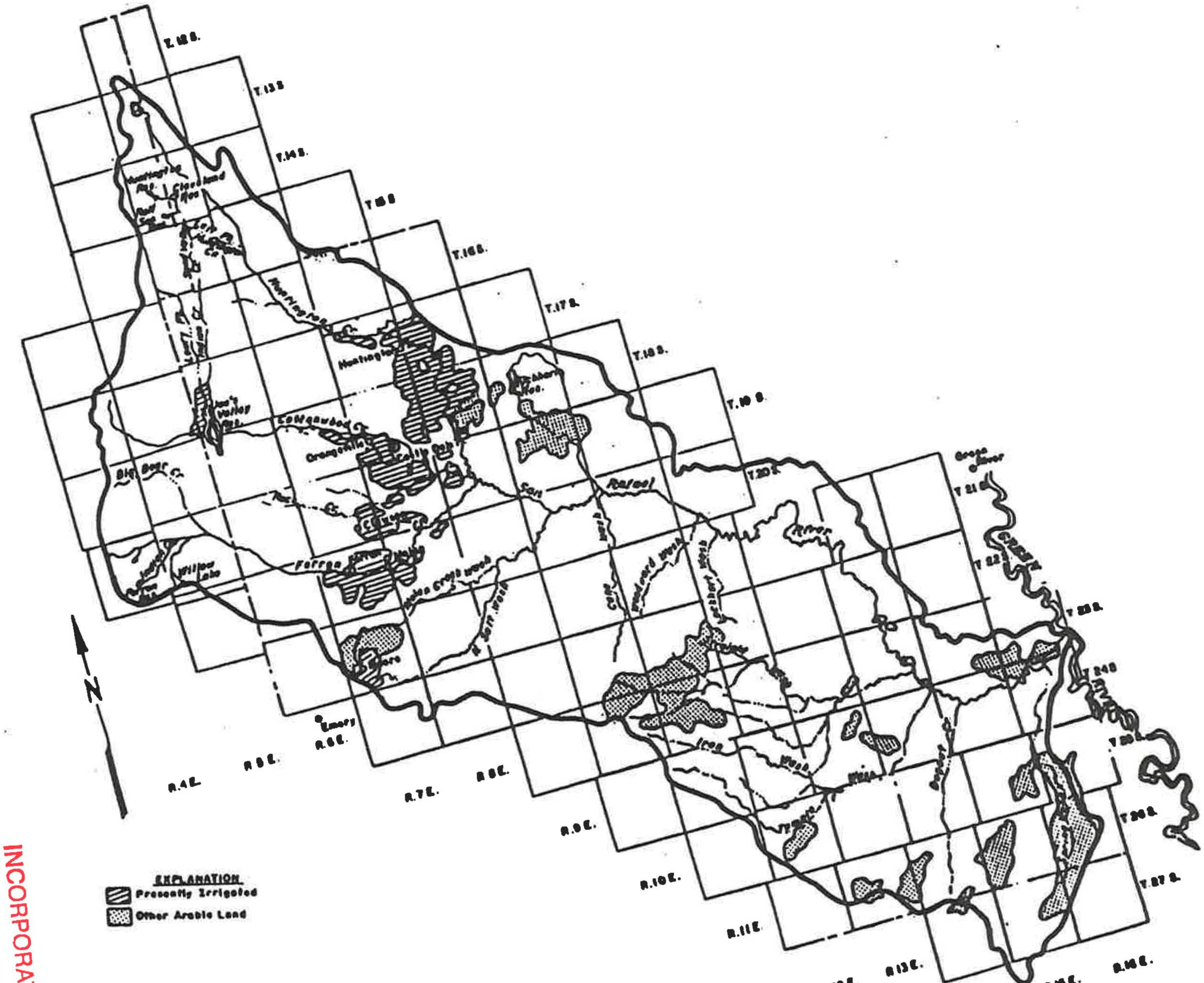


FIGURE 7-6 San Rafael River Basin (taken from Utah Division of Water Resources, 1976)

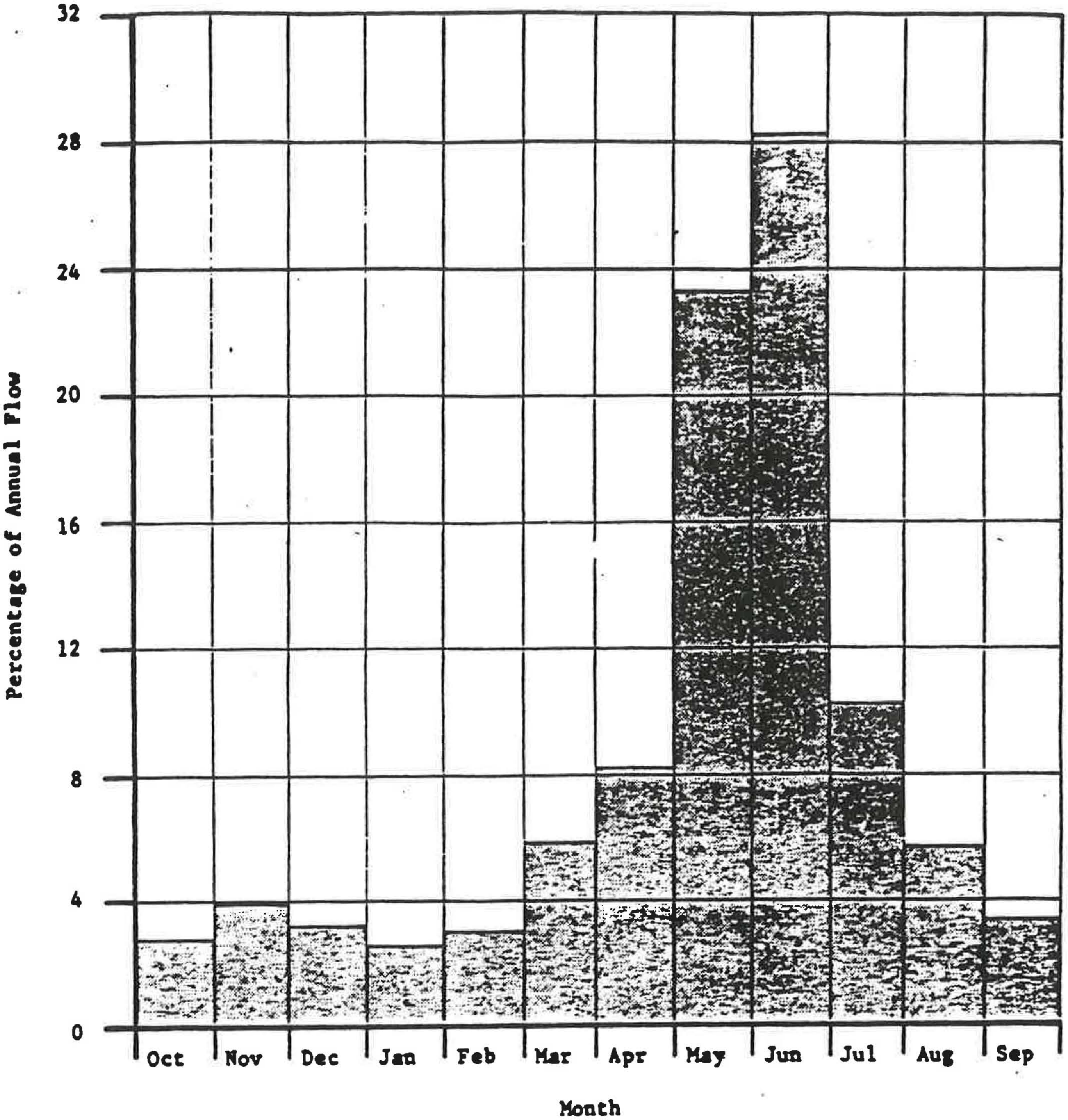
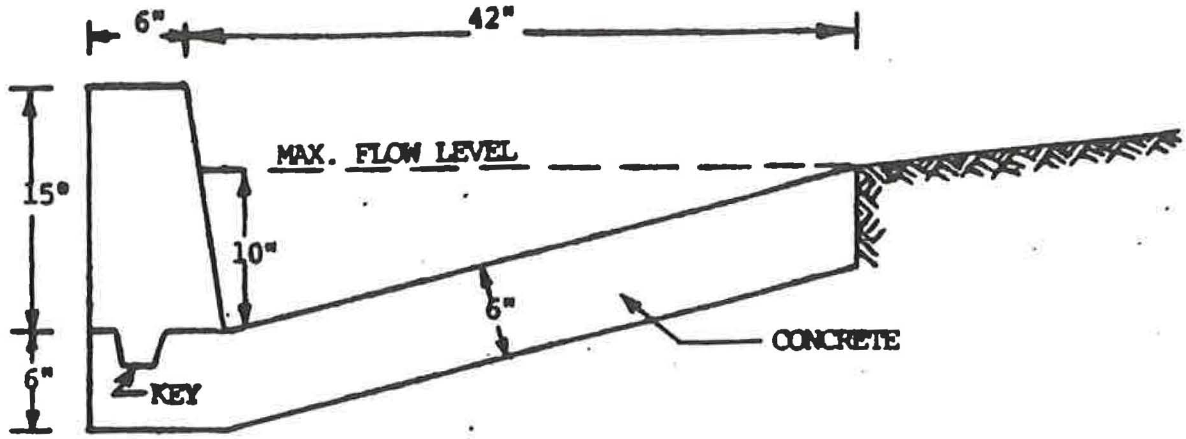


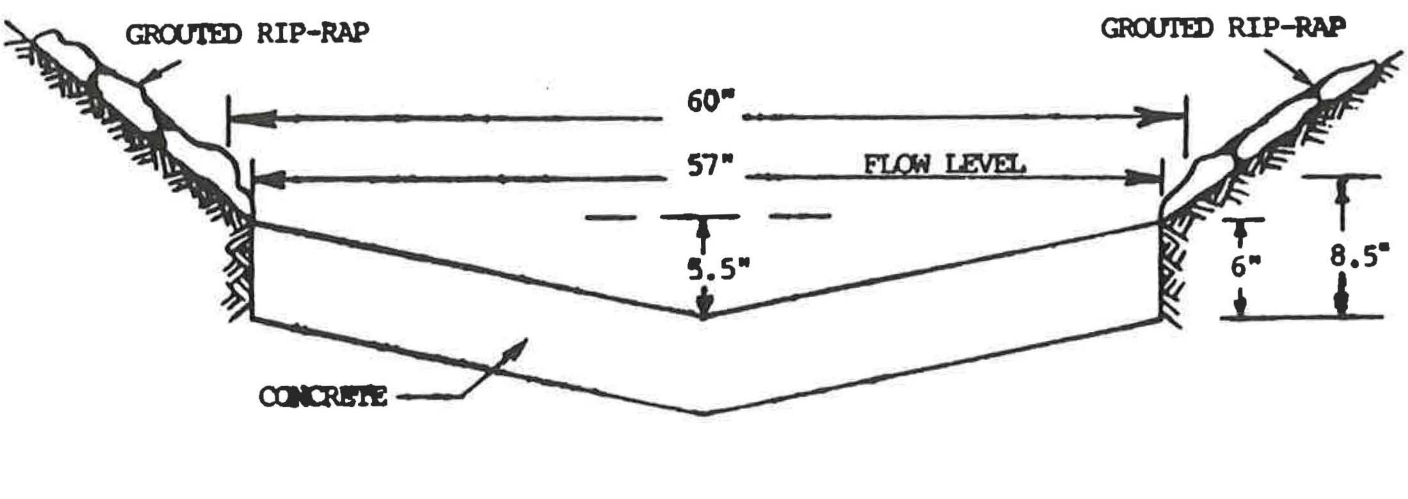
FIGURE 7-7 Monthly distribution of flows for Cottonwood Creek above Straight Canyon for the water year 1979 (Oct. 1978 to Sept. 1979). (from Water Resources Data for Utah. Part 1: Surface Water Records, 1979 USGS gauging Station 09324200)

FIGURE 7-8

TYPICAL SECTIONS OF CURB/GUTTER DIVERSION
TRAIL MOUNTAIN MINE



CURB/GUTTER
(UPPER SECTION)
1" = 1'



CURB/GUTTER
(LOWER SECTION-NEAR POND)
1" = 1'

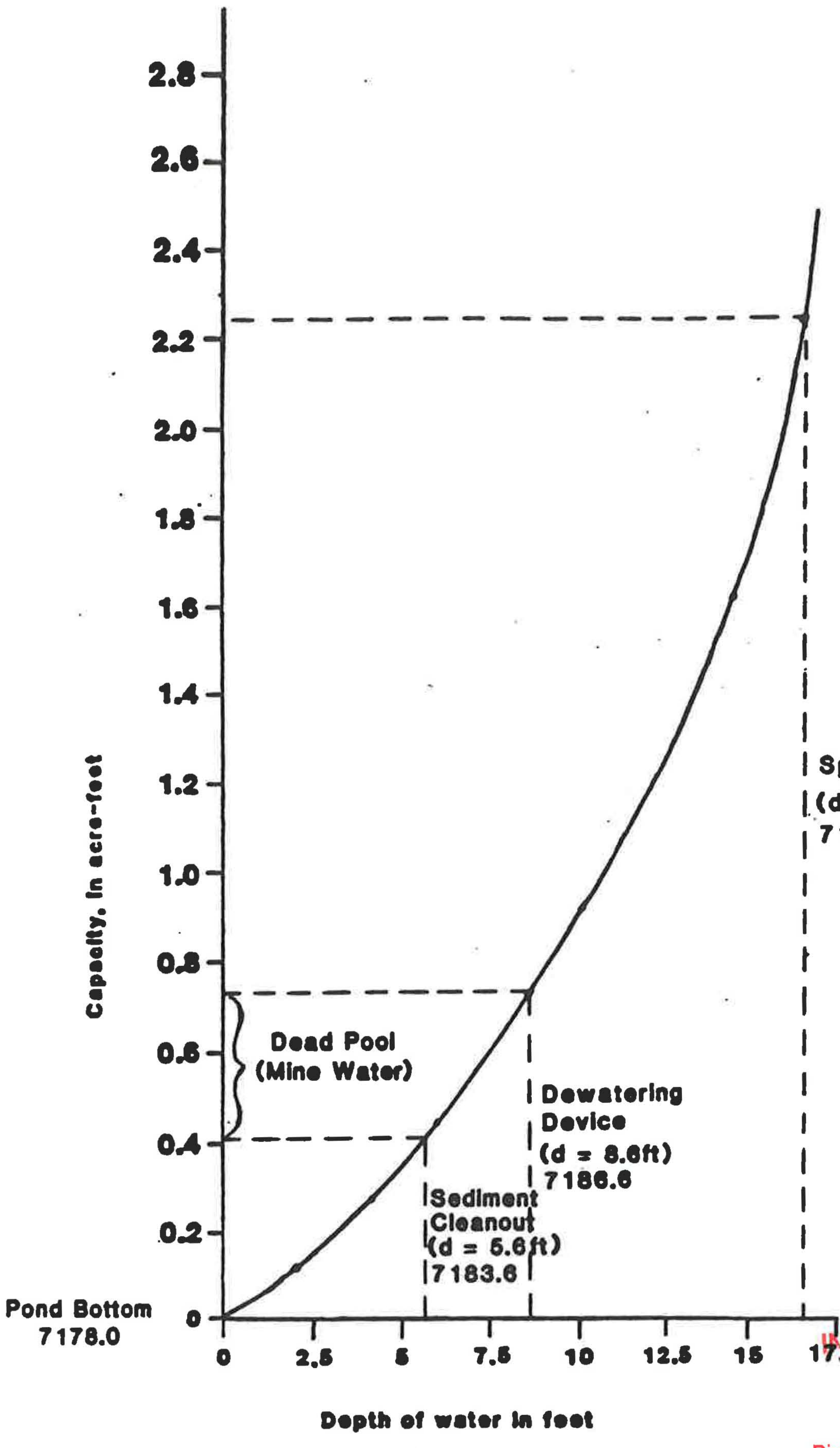


FIGURE 7-9 Stage-capacity curve for Sedimentation Pond.

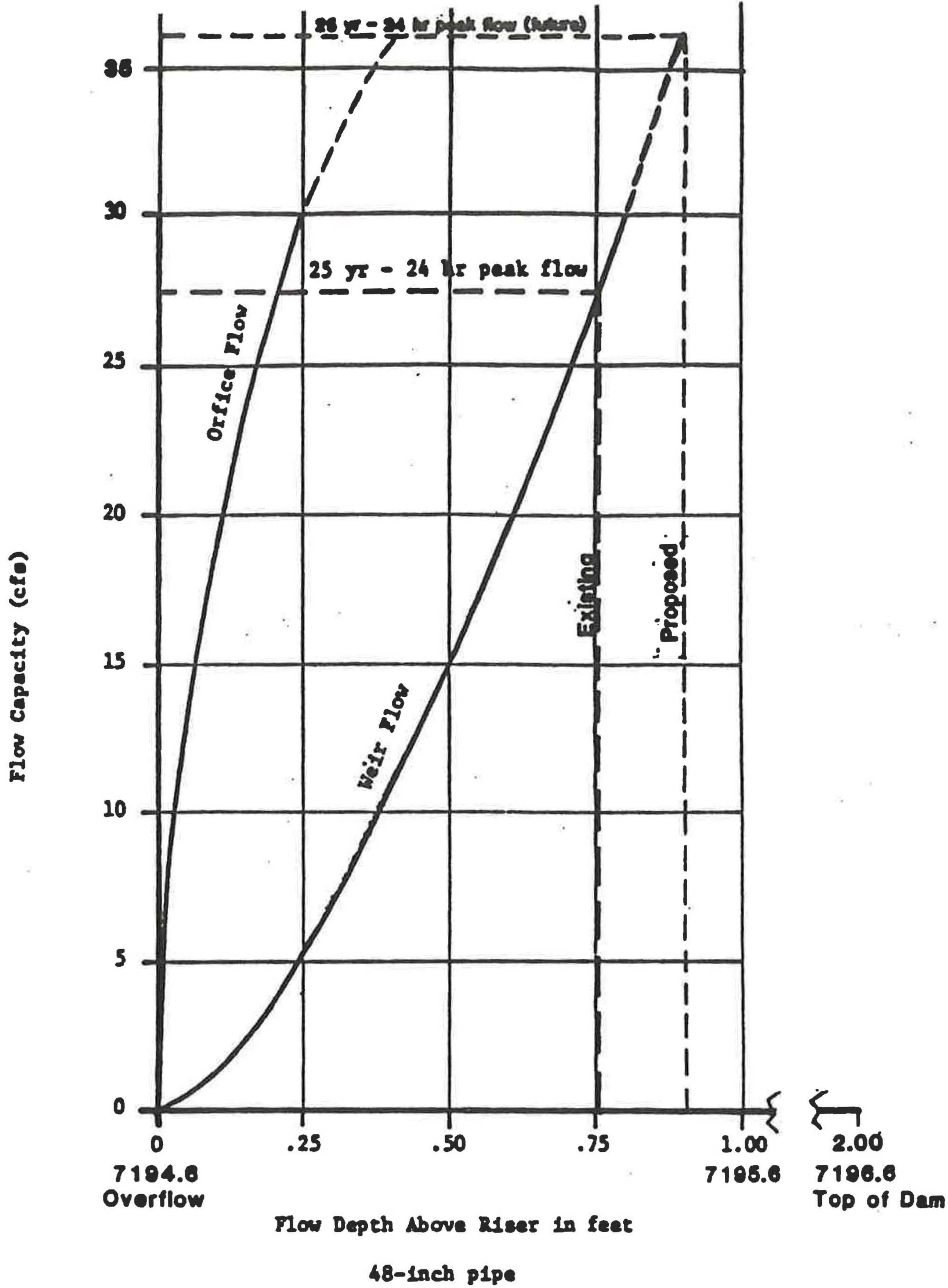
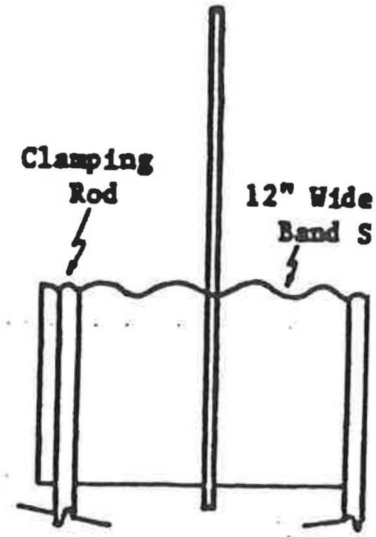


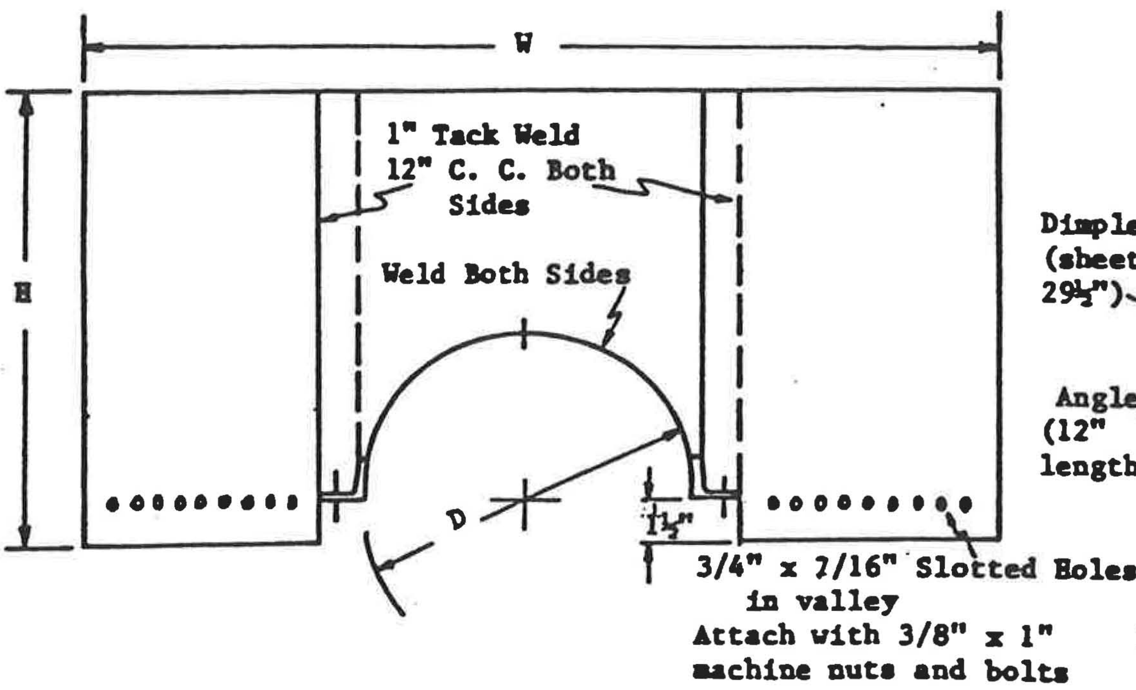
FIGURE 7-10 Stage-discharge curves for the 48-inch spillway riser and conduit.

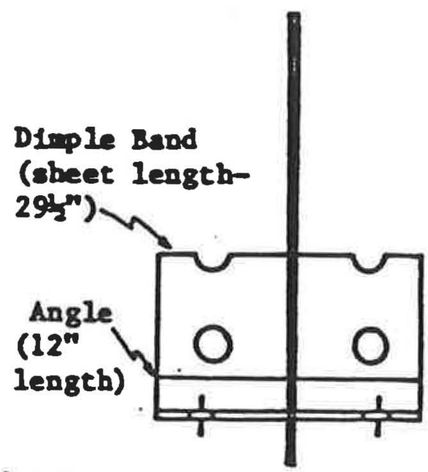
Size of Anti-Seep Collars

	Spillway	Dewatering Device
Metal Gauge	14	14
Width, inches	72	36
Height, inches	38	20



END VIEW
FOR ANNULAR PIPE

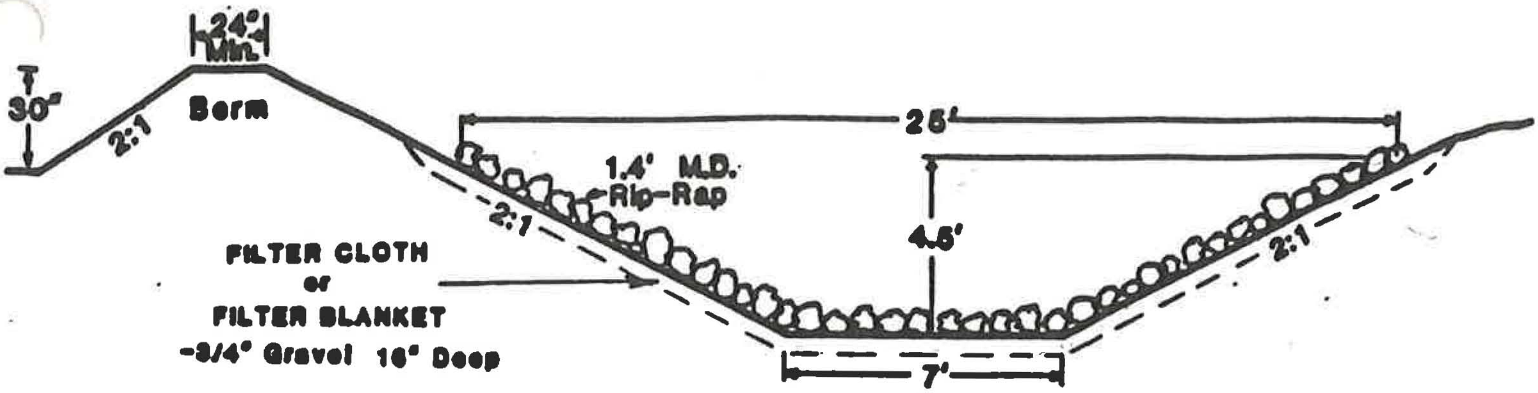




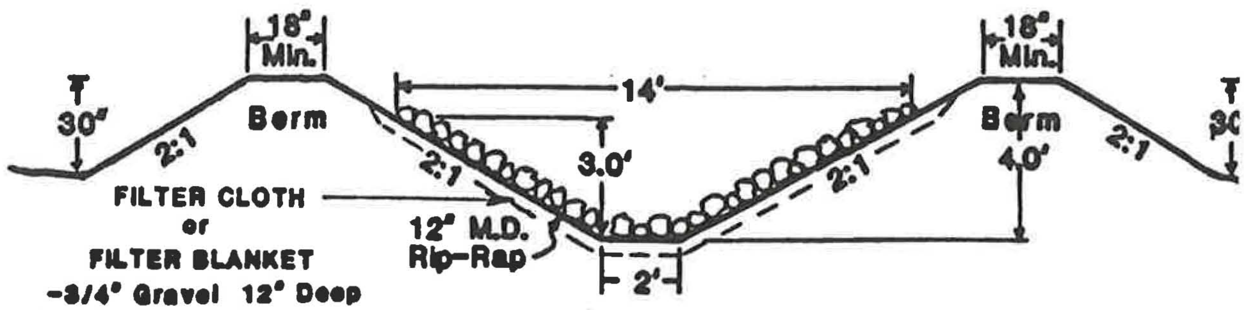
END VIEW
FOR HEL-COR PIPE

ONE HALF SHOWN - OTHER HALF IDENTICAL

FIGURE 7-11 Armco Corrugated Metal Anti-Seep Collar.



Main Channel - Typical Reclaimed Section



Side Channel - Typical Reclaimed Section

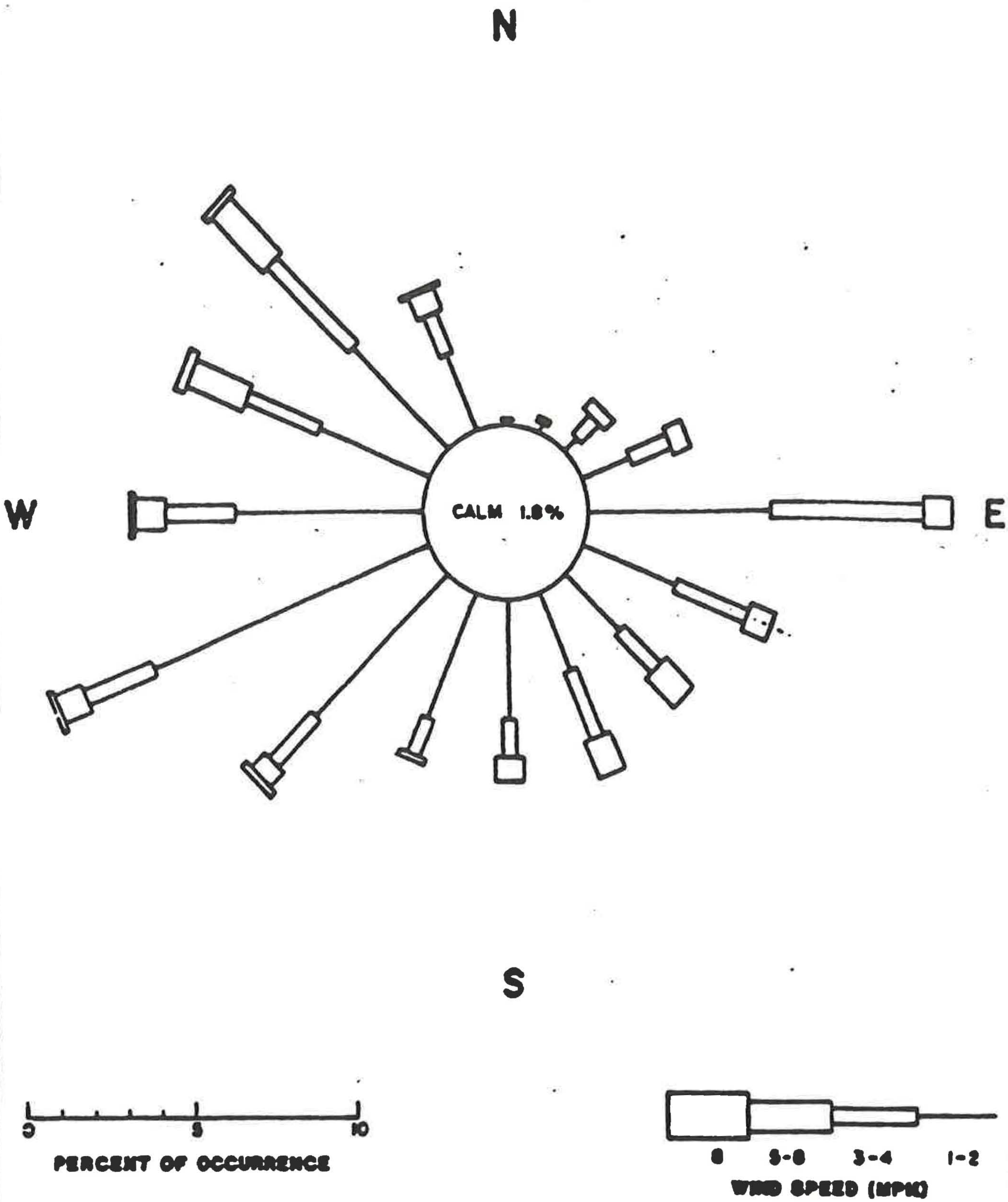
FIGURE 7-12

ENERGY WEST MINING CO.

Typical Reclaimed Channels

Prepared: D.W. Guy	Scale: 1" = 5'
Department: ENG.	Date:12/21/90
Drawn by: K.S.F.	Figure 7-20

FIGURE 7-13



MEETINGHOUSE RIDGE JAN.-DEC. 1978

ALL TIMES

CHAPTER 8
SOIL RESOURCES

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SOIL RESOURCES

8.1 SCOPE

The Mine is a previously disturbed site, having been in operation since l948. As such, no pre-mining conservation or reclamation measures were taken and little stockpiling of soil from areas to be disturbed were done. Likewise, no pre-mining studies were conducted in the disturbed area. Accordingly, future reclamation plans will have to rely on existing soil to provide a suitable medium in which to establish new vegetation. The existing disturbed site has been compacted by heavy equipment and automobiles. Some sections have also been subjected to years of oil, gasoline, and diesel fuel spillage. Moreover, coal piles have existed at the site, causing crushed coal and coal dust to be mixed and compacted into the existing soil. Revegetation test plots will be set up to determine whether the existing soil can result in a successful revegetation program or a supplemental soil will be required.

As supplemental soil may be required for future reclamation, and because the mining property to be reclaimed was already disturbed, it was necessary to characterize the soil from adjacent reference areas. These were chosen in two locations; as near as possible to the disturbed area and in areas determined, as well as could be done, to correspond in both soil type and vegetative community type to that of the disturbed area. Future supplemental soils would likely have to equal or exceed the quality of these two reference soils.

8.2 METHODOLOGY

Revegetation test plots have been set up to determine the suitability of the existing disturbed soil as a growth medium. (See Vegetation Test Plots, Appendix 9-l).Soil sample data is also included in Appendices 9-1 and 9-2, along with the vegetation test plot data.

In the event that the soils on site cannot be used for revegetation, supplemental soil will be required. The supplemental soils would likely have to equal or exceed the quality of the existing soil prior to disturbance. An estimate of this quality can be obtained from soil samples taken from two soil pits dug in soil types which have been disturbed previously by the Trail Mountain operations. The soil pits were sampled at each recognizable horizon down to sixty inches or to bedrock, whichever came first. Each horizon was described in the field according to thickness, color and soil structure.

These soil pits were located in the Riparian (streamside) and Grassland-Shrub plant communities. Only soil types similar to those already disturbed or expected to be disturbed were sampled to serve as a basis for the reclamation plan to be developed.

After collection, the soil samples were air dried and passed through a two millimeter screen (Tyler #l0 mesh). Rock percentages were obtained by weighing separately the total soil sample and the rocks separated out by the 2 mm screen.

Soil textural analysis was performed in the lab using the Boyoucos hydrometer method with 50 gram samples. A sample of each soil horizon was sent to the Utah State University's Soil and Water Testing Laboratory in Logan, Utah for selected chemical analyses. These analyses included a standard fertility test (pH, salinity by probe, phosphorus, potassium, texture, and lime); exchangeable cation percentage (CEC, Na, K, Ca, and Mg, extractable ion, saturation percent, and the water soluble ions listed above); and sodium absorption ratios (SAR) where the salinity was found to be high.

8.3 SOIL RESOURCE INFORMATION

8.3.1 Soils Identification and Descriptions.

Four main soil types occur in the mine plan area, plus various thin soils among rocky outcrops and on talus slopes, which are designated as rockland (map symbols RoG and RY, see Plate 8-1). Two of the four developed soil types are dry stony soils of steep mountain slopes. These are designated by the map symbols AbG (Very stony sandy loam complex) and CoG (Stony sandy loam complex). A third soil type, designated SN (shaly colluvial land), is located on the top of Trail Mountain in areas that will not be disturbed by mining activities and therefore will not be considered further. The fourth soil type, here designated by the map symbol R (for Riparian), is the principal soil type found in the disturbed area. In the soil pit located north of the Mine disturbed area, it would be classified as an azonal soil or entisol, and probably an arent (from ar, L., to plow, meaning mixed horizons). However, the soil is also located within a mapping unit called the Kenilworth Series, which is also defined as a Xerollic Calciorthid Ardidisol.

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This is the soil of the canyon bottom along the stream. It is characterized by numerous gravelly, silty, and sandy layers; but in the Reference Area it does not exhibit any soil profile development. It is in alluvial soil that has developed from gravelly outwash brought down by the canyon stream during infrequent floods plus collected finer fractions deposited by wind and talus erosion. It is a deep soil, exceeding 5 feet and often attaining l0 or more feet, as may be seen at some eroded banks along Cottonwood Creek. The soil pit dug in the Riparian Community reference area showed eight horizons (but no classic soil profile) including what appeared to be a buried soil profile from an earlier time.

The streamside, or canyon-bottom soils were referred to as the Kenilworth Series in a prior classification (USDA, USDI, and UAES, l970), specifically to the KeE2 mapping unit. This was called the Kenilworth very stony sandy loam of 0 to 20 percent slopes. This soil is stony, well-drained, and moderately coarse textured. In its broader distribution, this soil type occupies high benches on old dissected outwash plains below very steep mountains. It forms in thick deposits of strongly calcareous (high lime) stony alluvium and supports a vegetative cover mostly of juniper and pinion. The land use is mainly for wildlife, recreation, and limited grazing.

In Cottonwood Canyon, at the site of the Mine plan area, the presence of the canyon stream has led to a well-developed streamside plant community of narrow leaf cottonwood trees and a lush understory of grasses and forbs. This community is narrowly distributed along the stream course. Higher up, it transitions into the Pinion-Juniper Community of the east-facing steep slopes of Trail Mountain. Probably 25% or less of the Mine disturbed area is located on soils of this canyon-bottom type within the Riparian Plant Community and its transition zone away from the stream, but still in the canyon bottom.

Three of the above four soils that were found in the approved Mine Plan were also found on the Tract 2 Mine Plan Area. They were RoG (rocklands), CoG (stony sandy loam complex), and AbG (very stony sandy loam complex).

In addition, five other soil types were found within the boundaries of the Tract 2 Mine Plan Area (data taken from the Soil Conservation Service and U.S. Forest Service, Price, Utah). The map symbols and soil types are: ACl (Argic Pachic Cryoborolls), TU (Typic Ustorthents), TC (Typic Cryorthents), AC3 (Argic Pachic Cryoborolls), and AC2 (Argic Pachic Cryoborolls). Refer to Soils

Map 8-I for locations of these soil types. These soils are also located in areas that will be undisturbed by mining, and therefore will not be considered further.

8.3.2 Present and Potential Productivity of Existing Soils

The soils in the disturbed area support a streamside plant community of dominant narrow leaf cottonwood trees plus lesser numbers of Rocky Mountain Juniper, Chokecherry, Elderberry, and numerous understory species of shrubs, grasses, and forbs. The transition zone on the same soil, but away from the stream and not yet on the steep Pinion-Juniper covered canyon slopes, has more juniper and pinion pine and is more open. The understory is mostly grasses and sagebrush.

The area is useful mainly for wildlife, recreation, limited grazing and mining. No cultivation could be established because of the steepness of the canyon.

8.4 PRIME FARMLAND

No farmland exists in the area. The capability unit category in the canyon bottom is VIIs-SX (non-irrigated), which is soil near steep mountains on recently formed flood plains of streams. These soils are suited for range.

8.5 SOILS: PHYSICAL AND CHEMICAL PROPERTIES

Two soil pits were dug. The results of textural analysis from the Riparian Reference Area soil pit are shown in Table 8 I. Chemical tests are shown in Table 8 2.

This is the soil of mapping unit RI. The top layer, which is not necessarily an A horizon, is 9 to I0 inches thick and is mainly a sandy clay loam texture having only about 5% rock over 2 mm diameter and 95% fine soil particles. The finer soil fraction is 48% sand, 30% silt, and 22% clay. Deeper layers show increasing percentages of rock (mainly gravel) down to layer 5, which suddenly reverts to less than one percent rock. This layer is also thick (7 inches) suggesting an older soil A horizon buried by the present developing soil surface.

Table 8-2 shows pH values ranging from 8.0 to 8.4 and slight salinity at the surface, increasing with depth. It is highly calcareous soil, with an average phosphorus content of p = 2.0 ppm and a potassium content of K = 2l7 ppm by the standard soil fertility test.

The second soil pit was located in the Grassland Shrub Community on a steep northeast facing slope uphill from the coal loading piles of the disturbed area. This is the mapping unit CoG or RoG. It is a soil type that has been disturbed by the Mine operations, but only slightly. Some of the lower steep hillside has been cut away to provide clean mine entrances and room for a coal pile. Probably only about 75% or more of the disturbed area is represented by this soil type.

The results of textural analysis are shown in Table 8-3 and of chemical analysis in Table 8-4. The Grassland Shrub soil was relatively shallow, bedrock being encountered at only l9 inches. The A horizon was 5 inches deep and consisted of 71.5% fine soil and 28% larger rock fragments by weight. The fine soil fraction was a loam soil of 40% sand, 35% silt, and 25% clay. Deeper layers increased rapidly in rocky material, silt, and clay fractions. The pH ranged from 8.2 to 8.7 and the salinity from .3 to 4 mmho/cm2. Phosphorus and potassium levels were much lower than the streamside soil of the canyon bottom.

8.6 USE OF SELECTED OVERBURDEN

Since the site is a previously disturbed site since l948, and no further disturbance is proposed, no overburden will be handled.

8.7 PLANS FOR REMOVAL, STORAGE AND PROTECTION OF SOILS

Since the site has was previously disturbed no soils were removed, stored, or protected prior to l982. Compliance work in l982 - l983, involved the use of an on site borrow area and resulting topsoil storage pile. Please refer to Appendix 8-l for details on the borrow area. For any future disturbances, any soils encountered will be removed, stored, and protected.

8.8 PLANS FOR REDISTRIBUTION OF SOILS

In the event that the existing soil cannot be revegetated, supplemental soil will have to be hauled in for regrading of the disturbed site. Such soil should be tested for similarity to the existing soils and should equal or exceed the quality of the Riparian soil of Tables 8-l and 8-2. This is the soil type of 25% or less of the disturbed area.

Once the buildings, mine equipment, coal piles and other structures and disturbances are removed, the existing disturbed area must be graded to the final configuration. If the existing soil is unsuitable for revegetation and supplemental soil must be brought in, a depth of not less than six inches should then be applied and graded in preparation for seeding. Existing soil should prove adequate for plant growth.

8.9 NUTRIENTS AND SOIL AMENDMENTS

Existing soil or soils hauled in for the restoration of the disturbed soils will have to be supplemented with commercial fertilizers containing nitrogen, phosphorus, and potassium. The exact mixture will have to be determined following tests on the actual soil used, but a broadcast rate of about 50 pounds of phosphorus, 80 pounds nitrogen and 80 pounds of potassium per acre can be expected. Stabilization will be obtained by the use of an erosion control mat.

8.l0 EFFECTS OF MINING OPERATIONS ON SOILS

The existing disturbed site has been compacted by heavy equipment and automobiles. Some sections have been subjected to oil, gasoline, and diesel fuel spillage. Crushed coal and coal dust from the coal piles have been mixed and compacted in the existing soil.

8.11 MITIGATION AND CONTROL PLANS

As a previously disturbed site, no soils had originally been saved for protection of the resource. A small amount of topsoil was salvaged during the hydrologic reconstruction on site, and has been stored and protected as shown on Figure 3-1. Should any future disturbance of undisturbed soils of good potential occur, the soils will be removed, stored, and protected.

8.l2 BIBLIOGRAPHY

United States Department of Agriculture, U.S. Department of the Interior, and Utah Agricultural Experiment Station, l970, Soil Survey, Carbon-Emery Area, Utah.

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TABLE 8-1

RIPARIAN SOIL TEXTURAL ANALYSES

	Horizons							
	1	2	3	4	5	6	7	8
Thickness (cm)	24	9	5	8	18	26	12	50
Color	light gray-brown	light brown	bluish-black	light brown	blue-black	grayish-yellow-ish-brown	light yellow-ish-brown	grayish-brown
Structure	blocky-platy	none	blocky	none	blocky	platy	none	blocky
Weight Percents of Bulk Soil								
% Rock > 2 mm*	4.8%	36.0%	20.5%	50.1%	0.8%	2.0%	55.0%	13.0%
% Soil < 2 mm	95.2%	64.0%	79.5%	49.9%	99.2%	98.0%	45.0%	87.0%
Weight Percents of Soil Fractions < 2 mm								
"Old Method" (2nd Hydrometer Reading at 1 Hour)								
% Sand	47.8%	68.6%	51.4%	77.0%	43.4%	38.8%	65.2%	49.4%
% Silt	29.8%	16.8%	28.5%	11.8%	33.8%	36.4%	17.2%	27.2%
% Clay	22.4%	14.6%	20.1%	11.2%	22.8%	24.8%	17.6%	23.4%
Texture Class	sandy clay loam	sandy loam	sandy clay loam	sandy loam	loam	loam	sandy loam	sandy clay loam
"New Method" (2nd Hydrometer Reading at 2 Hours)								
% Sand	47.8%	68.6%	51.4%	77.0%	43.4%	38.8%	65.2%	49.4%
% Silt	33.6%	18.6%	32.0%	13.0%	38.4%	38.2%	19.8%	30.2%
% Clay	18.6%	12.8%	16.6%	10.0%	18.2%	23.0%	15.0%	20.4%
Texture Class	loam	sandy loam	loam	sandy loam	loam	loam	sandy loam	loam

* Tyler Screen, #10 mesh = 1.981 mm openings

TABLE 8-2

SOIL CHEMISTRY: Riparian Reference Area

Horizon	Depth (cm)	Soil Texture Class	Acidity (pH)	Salinity (mmho/cm²)	Soil Fertility P(ppm)	K(ppm)	Lime*	CEC† (meq./100g)
1	0-24	sandy clay loam	8.0	.6	2.3	372	++	13.3
2	24-33	sandy loam	8.3	.6	1.0	280	++	8.3
3	33-38	sandy clay loam	8.2	.6	2.4	340	++	10.0
4	38-46	sandy loam	8.4	.5	1.0	152	++	6.6
5	46-64	loam	8.2	.6	2.5	293	++	22.8
6	64-90	loam	8.2	.4	2.5	196	++	18.5
7	90-102	sandy loam	8.0	2.0	1.2	38	++	8.2
8	102-152	sandy clay loam	8.0	3.2	3.2	65	++	10.8

Horizon	Ammonium Acetate Extractable Ions (meq./100g) Na	K	Ca	Mg	Saturation Percentage	Water Soluble Ions (meq./100g) Na	K	Ca	Mg	meq/L in Sat. Ext. Chloride	Bi carbonate	SAR†
1	.33	.89	37.8	2.6	36.3	.02	.09	0.1	.03	.3	<.5	.08
2	.44	.64	36.9	2.1	27.0	.02	.07	<0.1	.02	.2	3.9	---
3	.44	.89	38.6	3.6	42.6	.06	.09	0.1	.05	.2	4.3	.22
4	.33	.38	28.9	2.1	25.7	.03	.04	<0.1	.03	.2	3.6	---
5	.44	.70	44.7	5.1	48.7	.07	.04	0.1	.07	<.1	5.0	.24
6	.44	.51	41.1	4.4	48.8	.05	.04	0.1	.06	<.1	3.4	.18
7	1.42	.19	34.2	3.1	28.8	.09	.01	0.3	.19	5.3	2.6	.18
8	.54	.19	37.3	4.9	39.1	.21	.02	0.6	.48	11.7	2.5	.29

* Lime is indicated relatively. Here, ++ means lime is high.

† CEC = Cation Exchange Capacity, SAR = Sodium Adsorption Ratio

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TABLE 8-3
GRASSLAND-SHRUB SOIL TEXTURAL ANALYSIS

	Horizons				
	1	2	3	4	5
Thickness (cm)	13	15	5	4	11
Color	reddish-brown	yellowish-gray	gray	yellowish-gray	gray
Structure	none	gravelly	caked hard-pan	clay	clay
Weight Percents of Bulk Soil					
% Rock > 2 mm*	28.5%	46.4%	49.7%	40.3%	66.3%
% Soil < 2 mm	71.5%	53.6%	50.3%	59.7%	33.4%
Weight Percents of Soil Fractions < 2 mm					
"Old Method" (2nd Hydrometer Reading at 1 Hour)					
% Sand	40.2%	17.0%	10.8%	12.0%	14.2%
% Silt	35.2%	47.2%	46.0%	50.0%	52.0%
% Clay	24.6%	25.8%	43.2%	38.0%	33.8%
Texture Class	loam	silty clay loam	silty clay	silty clay loam	silty clay loam
"New Method" (2nd Hydrometer Reading at 2 Hours)					
% Sand	40.2%	17.0%	10.8%	12.0%	14.2%
% Silt	38.8%	61.4%	51.8%	57.6%	56.8%
% Clay	21.0%	21.6%	37.4%	30.4%	29.0%
Texture Class	loam	silt loam	silty clay loam	silty clay loam	silty clay loam

*Tyler Screen, #10 mesh = 1.981 mm openings

TABLE 8-4

SOIL CHEMISTRY: Grassland-Shrub Reference Area

Horizon	Depth (cm)	Soil Texture Class	Acidity (pH)	Salinity (mmho/cm^2)	Soil Fertility P(ppm)	Soil Fertility K(ppm)	Soil Fertility Lime*	CEC† (meq./100g)
1	0-13	loam	8.2	.4	.9	95	++	9.0
2	13-28	silty clay loam	8.3	.4	.9	63	++	8.2
3	28-33	silty clay	8.5	.3	.6	80	++	7.6
4	33-39	silty clay loam	8.7	.3	.4	53	++	4.5
5	39-50	silty clay loam	8.7	.4	.6	75	++	6.3

Horizon	Ammonium Acetate Extractable Ions (meq./100g) Na	K	Ca	Mg	Saturation Percentage	Water Soluble Ions (meq./100g Na	K	Ca	Mg	meq/L in Sat. Ext. Chloride	Bi car-bonate	SAR†
1	.33	.26	36.6	2.3	32.4	.02	.01	.1	.03	.3	3.2	.08
2	.44	.32	34.7	3.6	38.6	.02	.01	.1	.06	<.1	3.5	.07
3	.33	.26	36.1	5.7	42.7	.03	.01	<.1	.07	.2	2.5	---
4	.33	.19	36.7	4.9	48.0	.02	.01	<.1	.07	<.1	2.5	---
5	.33	.26	37.0	6.4	49.4	.03	.01	<.1	.10	.6	2.9	---

* Lime is indicated relatively. Here, ++ means lime is high.

† CEC = Cation Exchange Capacity, SAR = Sodium Adsorption Ratio

CHAPTER 9

VEGETATION RESOURCES

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VEGETATION RESOURCES

9.1 SCOPE

A preliminary survey of the mine plan area indicated that four plant community types were in the boundaries of the area which had been disturbed or might be disturbed by any further expansion of the mine. Sites for concentrated sampling were chosen. The following methods were utilized.

9.2 METHODOLOGY

9.2.1 Trees

The point-quarter method was used to determine tree density and frequency. Ten points along a 500 foot transect were used. The four nearest trees to each point (one in each of four quadrants) were measured for diameter and distance from the point. Four saplings were also measured for distance but not diameter at each point. Thus 40 trees and 40 saplings were measured in each of the four plant communities. Pinion and juniper trees were measured at one foot height for diameter, and all other trees were measured at breast height (diameter-breast-height = DBH). These tree measurements yielded tree and sapling density and frequency. Tree dominance in terms of basal area was obtained from DBH. Sapling data provided estimates of tree reproduction. Tree (canopy) cover was estimated by the line-intersect method along a 500-foot transect with in-out measurements having a 6-inch resolution.

9.2.2 Understory Vegetation

Cover, density, and frequency of understory plants plus non-living cover of litter, rock, and soil were measured by the quadrate method. The one-meter-square quadratus were spaced every ten feet along the selected transects. The Riparian and Conifer Communities were sampled with 30 quadratus each, the Grassland-Shrub Community was sampled with 50 quadratus, and the Pinion-Juniper Community was sampled with 50 quadratus, and the Pinion-Juniper Community was sampled with 5l quadratus. Living plants were determined to species and their percent of total area in each quadrate (cover) was estimated. The number of separate plants was also counted (density). These data were grouped by growth form into trees; shrubs and vines; grasses, sedges, and rushes; forbs; and cryptograms.

9.2.3 Reference Areas

Two reference areas are designated to be permanently marked and protected. One is in the Riparian Community, and one is in the Grassland Shrub Community. Their locations are marked on the vegetation map, Map A, Appendix 9-1.

9.2.4 Vegetation Map

A vegetation map was compiled with the aid of aerial photographs printed in a scale of approximately 528 feet-to-the-inch (1:6, 3346), assisted by ground-truthing surveys.* The most recent available aerial survey (l977) was used. The final map was later transferred to a contour map at the same scale. Area measurements were made for each community type by cutting up one of the maps and weighing the various pieces according to the community type. This gave percentages for each community type in the mine plan area and permitted calculating the acreages involved.

9.2.5 Sampling Adequacy

The date summarized for each sampled plant community was subjected to precision analysis using the statistic:

$$N = \left(\frac{ts}{px} \right)^2 \qquad (9\text{-}1)$$

in which:

N = number of points, trees, quadratus, etc. which are necessary to sample within certain prescribed precision and confidence limits.

t = student's t-value for two-tailed tests and N-1 degrees of freedom. Various confidence limits were tested, but the minimum acceptable level was 80%.

s = standard deviation

$\bar{x}$ = the mean or average of a group of values

p = sampling precision, entered as a decimal but representing the percent variability around the true population mean.

In this test, N, the number of samples required to adequately sample the population at 80% confidence, and p = ±20% was calculated for each parameter (DBH, tree distance (density), sapling density, total plant cover, non-living cover, etc.). Precision was also calculated for these data using the actual number of samples used. This was done for 95%, 90%, and 80% confidence limits.

The interpretation of these precision tests is given in the following example. If N is calculated using the results of 30 samples, the 30 measurements are summed to obtain the mean (x) and standard deviation (s). The proper value of t is obtained from a t-table for N-l = 29 degrees of freedom under the desired confidence limit column (95%, 90%, 80%, etc.). The value of p is also selected; assume p = .20 (which means the true population is to be estimated within ±20% precision). Assuming the example yielded an answer of N = 26, we could say that the 30 actual measurements constituted an adequate sample since only 26 were required to meet the criteria of ±20% with 80% confidence level. If we then said that x was the mean for the population, we would be within ±20% of the true mean in 80 out of l00 times that we sampled the population in the same way.

The true precision for our 30 samples could also be calculated by using

$$p = \frac{ts}{Nx} \qquad (9\text{-}2)$$

In the above example it would be less than .20 (±20% precision) because only 26 samples were needed to obtain p = ± .20; in fact, it would be p = ± .l8 and the true precision is ±l8% with 80% confidence.

Vegetation sampling is done within various confidence limits to suit different requirements. Higher values require more samples and increase costs. The value of 80% is accepted by the U.S.Bureau of Land Management for estimating vegetation, productivity, etc. Likewise, p = (±20% precision) is normally accepted in vegetation sampling work.

9.3 EXISTING RESOURCES

9.3.1 General Site Description

The following discussion treats four of the five plant communities mapped within the Mine plan area boundaries. (See Plate 9-1). The fifth, consisting of aspen communities located on top of Trail Mountain, will not come under direct disturbance by coal mining activities unless subsidence occurs when the mine is finally closed. Although this might alter drainages, it is very unlikely because of the

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extent of relief above the coal seam.

Grassland-Shrub and Conifer communities on top of Trail Mountain are quite similar to those sampled below and are not expected to undergo perturbation from mining activities. The four sampled communities will be discussed in order of elevational scale; i.e. Riparian (streamside) in the bottom of the canyon, Pinion-Juniper above the Riparian, Grassland-Shrub above the mine mouth, and the Conifer Community directly west of the mine mouth and contiguous with the Grassland-Shrub Community. Discussions of these community types will be followed by a short treatment of the results of mapping, threatened and endangered species, and sampling adequacy.

9.3.2 Riparian (Streamside) Plant Community

9.3.2.1 General Description

The Riparian Community was sampled just north of the Mine offices in Cottonwood Canyon beginning about 200 feet upstream from the office building. A 500 foot transect was run from that point along the west side of the stream to avoid the disturbances caused by the canyon road on the east side of the stream. Steep banks on each side of the stream are I0 to 30 feet high with slopes ranging from 40% to 90% where the stream has cut through old stream bed material. Vegetation is comparatively dense with a heavy understory of grasses, forbs, and scattered shrubs. Some 86 plant species were encountered in a survey of the stand. These are listed in Table 9-1 by life form (trees, shrubs, grasses, forbs) with scientific and common names. The greatest species diversity occurred among the forbs, which have 48 species. Shrubs and vines were represented by I9 species, grasses and sedges by I0, and trees by 9. Narrow leaf cottonwood (Populous angustifolia) dominates the canopy layer and is reproducing vigorously with many seedlings and saplings appearing also in the understory. The total canopy cover measured on the line intercept was 40%, leaving 60% open space in this area next to the stream.

9.3.2.2 Riparian Tree Data

Table 9-2 summarizes the data taken by the point quarter method for I0 points along a 500 foot transect. A total of 40 trees and 40 additional saplings were measured. Three tree species came into the sample plus one large chokecherry (Prunus viginiana) reached tree size (DBH of 4 inches or more) in this case in the fourth quadrant of point l0. Tree density estimated from the sample was 87.8 trees per acre with 97.5% of these being narrowleaf cottonwood. Narrowleaf cottonwood dominated in all parameters of density, basal area, cover, and frequency with an importance value (IV) of 397.7 out of a possible 400 IV points for trees. Basal area and percent cover was not measured for seedlings and saplings, but narrowleaf cottonwood dominated the understory also with an importance value of l78.3 out of a possible 200 points for 89.2% of relative IV. The C x F index (cover x frequency), another measure of relative importance, also shows similar traits for the trees. Saplings of three species occurred in this community at a density of 892 per acre. Since fully grown trees occur at 88 per acre, it appears there is a natural mortality rate of about 90% among established tree seedlings in this community.

9.3.2.3 Riparian Understory Data

Table 9-3 summarizes the streamside species sampled in the understory with 30 one meter square quadratus. Forbs proved to be the most important life form followed by grasses, as may be seen by the importance values and the C x F index at the right of Table 9-3. Out of a possible 300 IV points, forbs had l42.3 (47.4%) to lll.8 (37.3%) for grasses; and of a possible total of 10,000 C x F index points, forbs had 606.6 compared to 26l for grasses. Counts of the stems for each species show that grasses have higher density counts with about twice the number of stems as forbs (66.7% density for grasses and 3l.5% for forbs). The most important species can be picked out by the IV values listed in Table 9-3. Poa pratensis (Kentucky bluegrass) had the highest individual IV value (80). This was followed by 47 for (Aster chilensis) 43.4 for scouring rush (Equisetum ervense), 3l8 for orchard grass (Doctylis glomerata), l6.4 for narrow leaf cottonwood seedlings, l5.2 for dandelion (Taraxacun afficionale)(, and ll.7 for western virgin's bower (Clematis ligusticifolia). The C x F index, however, shows that (Aster Chilensis) (CxF = 3l2.4 and scouring rush (C x F = 266.4) are very important compared to C x F = l76.8 for Kentucky bluegrass. This is based mainly on the high cover values measured for (Aster) and for scouring rush, as well as a high frequency of occurrence in the quadratus.

The overall average living understory cover was measured at 35.5% of total cover, and it ranged from 0.6% to 67% with litter contributing about 5l% of non-living cover. Rock and exposed soil were of rather minor importance (2.6% and 8.6% of total cover respectively.

9.3.3 Pinion-Juniper Plant Community

9.3.3.1 General Description.

This stand is located just north of the Mine office on steep south- and east-facing slopes above the Riparian Community reference area. The measured transect was 500 feet long, running in a south-north direction along a l68° bearing line (magnetic). The slope in the sampling area is about 42% with an exposure of 78± EEN. Large boulders are scattered among the trees, which causes a variety of relief and abrupt changes in percent slope. There are 62 plant species in this community, as listed in Table 9-4. The dominant tree is pinion pine (Pinus edulis). Significant percentages of Rocky Mountain juniper (Juniperus acopulorum), limber pine (Pinus flexilis), and Douglas fir (Pseudotsuga menziesii) also occur. The greatest species diversity occurs among the forbs (36 species) followed by shrubs (l3 species), grasses (7 species), and trees (6 species).

9.3.3.2 Pinion-Juniper Tree Data

Table 9-5 summarizes the data for four species of trees occurring in the point quarter and line intercept sampling data. Density of trees was estimated from tree distance at 99.2 trees per acre. Seedlings and saplings are present at l33.9 trees per acre. The combined total for both trees and young trees is 233.l trees per acre. Since full size trees represent about 43% of the combined total, a natural mortality rate of about 57% is suggested for tree seedlings in this community. Pinion pine showed the greatest values for density, basal area (dominance), cover, and frequency. The importance value (IV) of 239.6 for pinion pine far exceeds the other trees, as does the C x F value of 2,380.5. Rocky Mountain juniper is the next most important tree species with an IV of 70.8 and C x F index of 447. These dominant species are followed by Douglas fir with an IV score of 59.3 and a C x F value of 240.

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Tree reproduction indicates that seedlings and saplings of pinion juniper still

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dominate at an IV of 85.6 out of a possible 200; but Douglas fir, with an IV of 56.l, is more important than juniper at 43.8. Perhaps Douglas fir is increasing in this community. When both trees and reproduction are considered together, the density values show that Douglas fir is slightly more important than juniper and may indicate trends in successional directions, as do the importance values cited above.

9.3.3.3 Pinion-Juniper Understory Data

The data on understory vegetation for the Pinion-Juniper Community are summarized in Table 9-6. Grass species dominate the understory vegetation with a life form total importance value of l57.4 or 52.5% importance. Slender wheatgrass (Agropyron trachycaulum) was the most important species in the understory, with an importance value of l32.4 or 44.1% importance in comparison to the other understory species. On the basis of cover and frequency, this translates to a C x F index of l067.7 and a total C x F index of l067.7 and a total C x F index for grasses of ll04.6.

Lichens are the next most abundant life form in terms of cover and frequency (but not biomass or forage value), with an importance value of 30.4. This is followed by Utah serviceberry (A, e, amejoer utahensis) at 24.5. Hood's (Phlox hoodii) at l7.5, and Sandberg's bluegrass (Poa secunda) at l5.3.

Generally, the understory vegetation is rather sparse in density except for patches of slender wheatgrass. The average cover value for living plants was 23.4%, and ranged from 7.5% where mostly rock was exposed in the quadrate to 85% under bushes of Utah serviceberry. This leaves non-living cover averaging approximately 75% and consisting of rock (27.3% cover), litter (26%), and soil (22.6%).

9.3.4 Grassland-Shrub Community Data

9.3.4.1 General Description

This stand is located immediately above the Mine mouth and loading areas on the steep, generally east-facing mountain slope. The stand runs around the brow of the hill and has exposures ranging from north-northeast to east. The soils are rather heavy, being silty clay to loamy silty clay soils dotted with many boulders and rocks caused by talus from the rocky cliffs above. The slopes range from 43% to about 48%, measured by clinometer.

The vegetation forms are mainly grasses with scattered shrubs and an occasional tree here and there, especially at the west end of the sampled stand.

Table 9-7 lists plant species observed in this plant community. A total of 37 species are recorded, consisting of 3 trees, II shrubs, 6 grass and sedge species, and I7 forb species. Of the forbs, only one annual was observed (Lappula aredowskii). No extensive tree canopy exists except for the isolated trees, so no tree data was taken in this community.

9.3.4.2 Grassland-Shrub Understory Data

The summary data listed in Table 9-8 provide estimates from the vegetative sampling of cover, frequency, and density for two sites. Grasses and sedges were the most abundant as is indicated by the importance value (IV) and the C x F index on the right side of Table 9-8. The IV value is obtained by adding up the relative percentages of cover, frequency and density. The C x F index is obtained by multiplying the cover and frequency together. Thus, it is possible to obtain a total C x F value of 10,000. The higher the IV or the C x F index is, the more abundant and, consequently, the more important is the plant species or life form listed.

Based on these indices, grasses had an IV of about I46 out of a possible 300, or 53% importance. Slender sheatgrass, like the pinion-juniper stand discussed above, had the highest IP value (IP = I3I plus C x F = I383.3). Slender wheatgrass was followed in importance by a forb called shrubby bedstraw (Galium multiflorum) at an IV of about 32, and the shrub called shadscale (Atriplex confertifolia) at an IV of about 20. Other species of somewhat less importance were sticky rabbitbrush (Chrysothamnus visidiflarus), snakeweed (Gutierrezia sarathrae), Sandberg's bluegrass (Poa secunda), Hood's phlox (phlos hoodii), and buckwheat (Eriogonum carymboxum).

Total cover (54.4%) was rather high due to the heavy grass cover (33.4%). Because of this high cover, there was less soil and rock exposed without living cover or litter above it.

9.3.5 Conifer Plant Community

9.3.5.1 General Description

This plant community is located west of the mine mouth on north-facing slopes of a rather large draw trending east and west up Trail Mountain's east slopes. The slopes range from 50 to 60% with an exposure to the north. The sampling transect extended along a line bearing 260° west. The forest-covered steep slopes are at the base of steep cliffs which have contributed talus to the forest soil below. The soil is very rocky as with the contiguous Grassland-Shrub Community further east already described. The understory vegetation is sparse. A species list with a total of 43 species was compiled and appears in Table 9-9. Six trees, 9 shrubs, 6 grasses and sedges, and 22 forbs were found in the stand, of which some 26 species came into the sample transect.

9.3.5.2 Conifer Tree Data

Table 9-10 summarizes the tree data for the conifer stand. It shows White fir and Douglas fir to be co-dominant, with an IV value of 169 for white and 162 for Douglas fir. These accounted for almost 83% of the tree dominance and almost all of the total C x F index, as can be seen on the right side of Table 9-10. Douglas fir had the greatest amount of basal area, but white fir contributed the greater amount of canopy cover and was 10% more frequent.

Total density of trees was about 74 per acre, and Douglas fir and White fir were even although Douglas fir had almost twice as many seedlings and saplings. Both trees are reproducing themselves so this stand can be considered a climax community for this exposure, elevation and other static factors of soil, etc. Mountain red juniper showed good reproduction, but there were few tree-size individuals in the samples.

9.3.5.3 Conifer Understory

As in the Grasslands-Shrub Community immediately east of this stand, grass was the most important species in the understory (see Table 9-II). Forbs were next in importance. Here again slender wheatgrass proved to be most ubiquitous, with an IV value of l06 and a C x F index of 446. The most important forbs were shrubby bedstraw (Galium multiflorum) and Hood's phlox at scores of 28 and 27 on the IV index respectively. The two shrubs of most importance were creeping barberry (Mahonia repens) and Utah serviceberry at IV scores of l5 and l4 respectively. The grass blue wildrye (Elymus glauca) and the sedge (Carex geyeri) were also of minor importance at IV 23l and IV l5, in that order. Density count was the factor that provided much of the dominance for the grasses, however, with 833 stems counted in 30 quadratus.

As was mentioned earlier, the understory cover was described as rather sparse. This observation is supported by the measured low total cover value of about 23%. Litter was abundant at 23%, but soil had about 34% of absolute cover exposure under the trees. With a tree canopy of 60.4% it is understandable that understory cover is meager. This, coupled with comparatively low precipitation in this area, influences the lower understory values.

9.3.6 Vegetative Productivity

Productivity data from the two plant communities adjacent to the disturbed area are shown in Tables 9-l2 (Riparian) and 9-l3 (Grassland-Shrub). These two communities have been disturbed in the past operations of the Mine and are the only ones likely to receive any future disturbance. The data are shown for freshly cut or green weights and for air dry weights too. The following discussion concerns only the air dry weights. The Riparian community produced a total of 1,516 pounds per acre (air dry), while the Grassland-Shrub Community produced 9l0 lb/acre. Moisture in these productivity measurements accounted for 64 and 49 percents of the totals in the two communities so that the corresponding fresh weights were 4,236 and 1,774 lb/acre of total plant productivity. Since only understory plants were measured, tree data is for seedlings and saplings only. Even so, the Riparian Community out produced the Grassland-Shrub Community by a factor of about two. The most abundant life form in both communities was grass with 36% of total productivity in the Riparian and 79% in the Grassland-Shrub Community. Forbs and shrubs were about equal in the Riparian Community at 30 and 3l% (455 and 464 lb/acre) respectively. In the Grassland-Shrub Community, shrubs were the second most productive life form at 9% of the air dry total while forbs represented only about l%.

In the present study several methods were used to obtain estimates of vegetation growth in the vicinity of the Mine. These methods involved sampling and using the results to estimate the population values. Adequate sampling ensures that the population parameter will be estimated with acceptable precision. Any degree of precision can be obtained by increasing the sample size. Perfection can be achieved by measuring every member of the population. This is, of course, impractical and a compromise is always struck between the level of precision and the expense and time required to attain it.

9.3.7 Sampling Adequacy

The sampling adequacy and actual precision obtained for the various data obtained in the present study are summarized in Table 9-l4. The minimum criterion for adequate sampling in these date is ±20% precision at the 80% statistical confidence level. This means that the true population mean has been estimated to within ±20% or better, and that if we say this is true we would be wrong only twenty times in a hundred from random causes alone.

Table 9-l4 shows that in many cases the actual precision obtained in this study is much better than ±20%. These values are shown in Part B of the table where 29 of the 36 precision tests meet or exceed the ±20% precision standard. Three of the seven inadequate samples are very close to the acceptance level and the remaining four involve two density estimates of understory grasses and two estimates of tree canopy (% cover). The difficulty of counting grass stems is obvious and accounts for the one problem. The tree canopy estimates, which could benefit from additional sampling, are poorest in the two plant communities least likely to be disturbed by mining activities, the Conifer and Pinion-Juniper Communities. We believe no essential conclusions or recommendations advance in this vegetation report would be changed by additional sampling in these areas.

9.3.8 Reference Area Supporting Data

Two vegetation communities were assigned reference areas. These have been permanently marked, and are shown on Map A, Appendix 9-1. The riparian reference area represents the pre-disturbance condition of the parking area, coal loading facilities, and mine buildings area. (See Vegetation Map A, Appendix 9-1.) The grassland-shrub reference area represents the pre-mining grassland-shrub community--part of which still exists above the mine mouth. Both reference areas were sampled quantitatively. Data are included in Vegetation Resources, Chapter Nine.

9.4 THREATENED AND ENDANGERED SPECIES

No threatened or endangered species are observed in the mine lease area. However, Hedysarum ocidentale var Canone is known to occur in areas to the south and east of the mine plan area in the Miller Canyon vicinity. Heydysarum Ocidentale var Canone does not occur on the mine plan area (Bob Thompson, USFS l987). Several other species have been proposed to be listed in the past that occur in areas to the south and east in the Mancos Shale and Morrison Formation derived soils, and one species of grass (Festuca dasyclada) is found in Joe's Valley to the west; but are not known to occur in or contiguous to the mine plan area. Many of the species reported by Welsh, et al (l975) have since been delisted or dropped from the possibly threatened or endangered list by Welsh (l978).

9.5 EFFECTS OF MINING OPERATIONS ON VEGETATION

The mine has been in existence since l948 and has undergone expansion in the last few years, which has removed vegetation and redistributed soil to its present location as fill for the parking lot and coal loading areas. This has had the effect of removing the Riparian and part of a stand of a Grassland-Shrub Community.

9.6 MITIGATION AND MANAGEMENT PLANS

The mine site was disturbed during development activities from l948-l967. As such, no vegetative protection activities are planned for the disturbed areas. Any future disturbance will require the verification that threatened and endangered species do not exist on the site. If any threatened and endangered species are found, the appropriate authorities will be contacted.

To mitigate the loss of approximately 2,000 feet of riparian community that was damaged when a portion of the North Fork of the Cottonwood Creek adjacent to the disturbed area of the Mine was culverted, Trail Mountain (During April, l986) cut and collected approximately 3,500 l2-l8 inch long willow stems from local stock and cold storage them. During the latter of part of May, l986 these

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willow stems were planted at intervals of approximately six feet apart on both sides of the North Fork of the Cottonwood Creek for a distance of two miles below the disturbed area of the mine site. This willow shoot enhancement project was conducted by Trail Mountain with the technical supervision of Mr. Larry Dalton of the Division of Wildlife Resources (I986).

9.7 REVEGETATION METHODS AND JUSTIFICATIONS

After cessation of coal mining activities at the Mine, disturbed areas will be revegetated. The revegetation plan contains one option; to use the existing soils with amendments. The plan assumes that the existing buildings will be removed, the mine entrances sealed, and the site regraded to the final surface configuration.

Seeding for the Riparian area will follow the rates and species listed in Table 3, Appendix 9-I and seeding for the Grassland-Shrub area is listed in Table 2A, Appendix 9-I. (See Reclamation Plan Seedbed Preparation: Grassland and Riparian Appendix 9-I.)

9.8 REVEGETATION MONITORING

The vegetation composition of the reseeded areas will be compared to that in the reference areas. Ninety percent stocking rate is acceptable under the present regulations. Subsequent reseeding for each year will be done until cover and productivity are within 90% of the approved reference areas.

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TABLE 9-1

SPECIES PRESENCE LIST: RIPARIAN PLANT COMMUNITY

Species* (Total = 86)	Common Name
TREES (9)	
Abies concolor (Gord. & Glend.) Lindl.	White Fir
Acer glabrum Torr.	Rocky Mountain Maple, Smooth Maple
Acer grandidentatum Nutt.	Bigtooth Maple
Betula occidentalis Hook.	Water Birch
Juniperus scopulorum Sarg.	Rocky Mountain Juniper
Picea pungens Engelm.	Blue Spruce
Pinus edulis Engelm.	Pinyon Pine
Populus angustifolia James	Narrowleaf Cottonwood
Pseudotsuga menziesii (Mirb.) Franco	Douglas Fir
SHRUBS AND VINES (19)	
Amelanchier alnifolia (Nutt.) Nutt.	Saskatoon Serviceberry
Amelanchier utahensis Koehne	Utah Serviceberry
Artemisia tridentata Nutt.	Big Sage
Cercocarpus ledifolius Nutt.	Curlleaf Mountain Mahogany
Chrysothamnus nauseosus (Pall.) Britton	Rubber Rabbitbrush
Chrysothamnus viscidiflorus (Hook.) Nutt.	Douglas or Yellowbrush Rabbitbrush
Clematis columbiana (Nutt.) Torr. & Gray	Columbian Clematis, Virgin's Bower
Clematis ligusticifolia Nutt.	Western Virgin's Bower
Cornus stolonifera Michx.	Redosier Dogwood
Gutierrezia sarothrae (Pursh) Britton	Broom Snakeweed
Holodiscus dumosus (Hook.) Heller	Bush Oceanspray
Mahonia repens G. Don	Oregon Grape, Creeping Barberry
Prunus virginiana L.	Chokecherry
Ribes cereum Dougl.	Wax Currant
Rosa woodsii Lindl.	Wild Rose
Salix bebbiana Sarg.	Bebb Willow
Salix exigua Nutt.	Coyote Willow
Sambucus caerulea Raf.	Elderberry
Symphoricarpos oreophilus A. Gray	Mountain Snowberry
GRASSES, SEDGES, AND RUSHES (10)	
Agropyron spicatum (Pursh) Scribn. & Smith	Bluebunch Wheatgrass
Agropyron trachycaulum (Link) Malte	Slender Wheatgrass
(a) *Bromus tectorum* L.	Cheatgrass
Carex sp. L.	Sedge
Dactylis glomerata L.	Orchard Grass
Elymus cinereus Scribn. & Smith	Wildrye
Juncus balticus L.	Artic Rush
Oryzopsis hymenoides (Roem. & Schult.) Ricker	Indian Ricegrass
Poa pratensis L.	Kentucky Bluegrass
Typha latifolia L.	Common Cattail

(a) annual

*Taxonomy according to Holmgren and Reveal, 1966; Welsh and Moore, 1973; and Arnow and Wyckoff, 1977.

TABLE 9-1 CONTINUED

	Species	Common Name
		FORBS (48)
	Achillea millefolium L.	Yarrow
	Aquilegia flavescens S. Wats.	Yellow Columbine
	Arabis holboellii Hornem.	Rock Cress
	Artemisia ludoviciana Nutt.	Louisiana Sage, Wormwood
	Aster chilensis Nees	Aster
	Astragalus sp.	an unidentified white-flowered species
	Astragalus convallarius Greene	Timber Poisonweed
	Astragalus lentiginosus Dougl. var. *araneosus* (Sheld.) Barneby	Specklepod Locoweed
	Astragalus tenellus Pursh	Looseflower Milkvetch
	Castilleja applegatei Fern.	Indian Paintbrush
	Castilleja linariaefolia Benth.	Wyoming Painted Cup
	Chaenactis douglasii (Hook.) Hook. & Arn.	Chaenactis
	Cirsium undulatum (Nutt.) Spreng.	Wavyleaf Thistle
	Cirsium vulgare (Savi) Tenore	Thistle
	Coryphantha vivipara Britton & Brown	Mammillaria
	Cryptantha humilis (Greene) Payson	Cryptantha, Dwarf Catseye
	Descurainia richardsonii (Sweet) O.E. Schulz	Tansymustard
	Dodecatheon pulchellum (Raf.) Merrill	Shooting Star
	Equisetum arvense L.	Field Horsetail, Scouring Rush
	Erysimum asperum (Nutt.) DC	Western Wallflower
	Fragaria vesca L.	Strawberry
	Galium aparine L.	Catchweed Bedstraw
	Galium multiflorum Kellogg	Shrubby Bedstraw
	Geranium fremontii Torr.	Fremont Geranium
	Glycyrrhiza lepidota Pursh	American Licorice
	Habenaria hyperborea (L.) R. Br.	Northern Green Bog Orchid
	Hedysarum boreale Nutt.	Northern Sweetvetch
	Ipomopsis aggregata V. Grant	Skyrocket Gilia, Scarlet Gilia
(a)	*Lappula redowskii* (Hornem.) Green	Stickseed
	Lathyrus lanszwertii Kellogg	Thickleaf Sweetpea
	Lepidium montanum Nutt.	Mountain Pepperweed
	Lesquerella intermedia (S. Wats.) Heller	Bladderpod
(a)	*Lithospermum arvense* L.	Stoneseed
(a)	*Malcolmia africana* (L.) R. Br.	African Mustard
	Opuntia polyacantha Haw.	Plains Prickly Pear
	Penstemon eatoni A. Gray	Eaton's Penstemon
	Penstemon thompsoniae (A. Gray) Rydb.	Thompson's Penstemon
	Phlox hoodii Rich.	Hood's Phlox
	Ranunculus cymbalaria Pursh	Rocky Mountain Buttercup
	Senecio multilobatus Torr. & Gray	Lobeleaf Groundsel
(a)	*Sisymbrium altissimum* L.	Tumblemustard
	Solidago canadensis L.	Goldenrod
	Stanleya pinnata (Pursh) Britton	Prince's Plume
	Taraxacum officinale Weber	Common Dandelion
	Trifolium repens L.	White Clover
	Urtica dioica L.	Stinging Nettle
	Valeriana edulis Nutt.	Edible Valerian
	Viola adunca J.E. Smith	Violet

(a) annuals

TABLE 9-2

RIPARIAN TREE DATA*

Species	No. of Individuals	Density Trees/Acre	Relative % Density	Basal Area in^2	Relative % Dominance	% Cover	Relative % Cover	% Frequency	% ΣF	Importance Value	Relative Importance	C x F Index†
Trees												
Populus angustifolia	39	85.6	97.5	2287.4	99.3	40	100	100	90.9	387.7	96.9	9090
Prunus virginiana	1	2.2	2.5	15.9	.7	0	0	10	9.1	12.3	3.1	0
Totals	40	87.8	100.0	2303.3	100.0	40	100	110	100.0	400.0	100.0	9090
Saplings and Seedlings												
Populus angustifolia	38	847.4	95.0					100	83.3	178.3	89.2	
Picea pungens	1	22.3	2.5					10	8.3	10.8	5.4	
Juniperus scopulorum	1	22.3	2.5					10	8.3	10.8	5.4	
Totals	40	892.0	100.0					120	99.9	199.9	100.0	
Trees plus Saplings and Seedlings												
Populus angustifolia	77	933	96.2									
Picea pungens	1	22.3	1.3									
Juniperus scopulorum	1	22.3	1.3									
Prunus virginiana	1	2.2	1.3									
Totals	80	979.8	100.1									

*Tree density and frequency by the point-quarter method; cover by the line intercept method.

†Maximum possible value is 100 x 100 = 10,000.

TABLE 9-3

RIPARIAN UNDERSTORY VEGETATION ANALYSIS: Cover, Frequency and Density Data From Quadrats

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 30 Quadrats	Relative % of Cover	% of ΣF	% Density	Importance Value	% Importance	C x F Index
Tree Seedlings and Saplings*									
Betula occidentalis	0.07	3.3	1	0.20	0.49	0.03	0.72	0.24	0.10
Juniperus scopulorum	0.68	16.7	4	1.91	2.47	0.11	4.49	1.50	4.72
Populus angustifolia	3.93	33.3	14	11.06	4.92	0.38	16.36	5.45	54.42
Pseudotsuga menziesii	0.67	6.7	2	1.89	0.99	0.05	2.93	0.98	1.87
Subtotal	5.35	60.0	21	15.05	8.87	0.57	24.50	8.17	61.10
Shrubs									
Clematis ligusticifolia	1.17	50.0	37	3.29	7.39	1.01	11.69	3.90	24.31
Cornus stolonifera	.07	3.3	0	0.20	0.49	0	0.69	0.23	0.10
Rosa woodsii	.77	10.0	5	2.17	1.48	0.14	3.79	1.26	3.28
Symphoricarpos oreophilus	.50	13.3	4	1.41	1.97	0.11	3.49	1.16	2.78
Subtotal	2.51	76.6	46	7.06	11.32	1.25	19.66	6.55	30.47
Grasses									
Dactylis glomerata	4.05	50.0	500	11.39	7.39	13.06	31.84	10.61	84.17
Poa pratensis	5.54	76.7	1,945	15.59	11.34	53.06	79.99	26.67	176.79
Subtotal	9.59	126.7	2,445	26.98	18.73	66.69	111.83	37.28	260.96
Forbs									
Achillea millefolium	0.26	16.7	39	0.73	2.47	1.06	4.26	1.42	1.80
Aster chilensis	7.77	96.7	421	21.86	14.29	11.48	47.63	15.88	312.38
Artemisia ludoviciana	0.26	20.0	21	0.73	2.96	0.57	4.26	1.42	2.16
Astragalus lentiginosus	0.11	10.0	6	0.31	1.48	0.16	1.95	0.65	0.46
Castilleja applegatei	0.33	10.0	9	0.93	1.48	0.25	2.66	0.89	1.30
Castilleja linariaefolia	0.02	6.7	2	0.06	0.99	0.05	1.10	0.37	0.06

*Understory data measured by quadrats. See Tree Tables for canopy data measured by point-quarter and line intercept methods.

TABLE 9-3 CONTINUED

Species	Average Cover per Quadrat	Absolute Frequency	Number of Stems in 30 Quadrats	Relative % of Cover	% of ΣF	% Density	Importance Value	% Importance	C x F Index
FORBS continued									
Cirsium undulatum	0.53	66.7	31	1.49	9.86	0.85	12.20	4.07	14.69
Equisetum arvense	6.51	90.0	431	18.32	13.30	11.76	43.38	14.46	243.66
Fragaria vesca	0.003	3.3	1	0.01	0.49	0.03	0.53	0.18	0.01
Galium multiflorum	0.03	3.3	2	0.08	0.49	0.05	0.62	0.21	0.04
Glycyrrhiza lepidota	0.12	13.3	7	0.34	1.97	0.19	2.50	0.83	0.67
Hedysarum boreale	0.17	6.7	3	0.48	0.99	0.08	1.55	0.52	0.48
Solidago canadensis	0.60		36	1.69	0.49	0.98	3.16	1.05	0.83
Habenaria hyperborea	0.03	3.3	3	0.08	0.49	0.08	0.65	0.22	0.04
Taraxacum officinale	1.26	53.3	139	3.55	7.88	3.79	15.22	5.07	27.97
Trifolium repens	0.01	3.3	3	0.03	0.49	0.08	0.60	0.20	0.04
Subtotal	18.01	403.3	1,154	50.68	59.60	31.48	142.27	47.43	606.64
Cryptogams									
Lichens	0.08	10.0	-	0.23	1.48	-	1.71	0.57	0.34
Subtotal	0.08	10.0	-	0.23	1.48	-	1.71	0.57	0.34
TOTALS: Living Plants	35.54	676.6	3,666	100.00	100.00	100.00	299.97	100.00	959.52

Non-Living Cover	
Litter	50.56
Rock	2.63
Soil	8.60
Total	61.79

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TABLE 9-4

SPECIES PRESENCE LIST: PINYON-JUNIPER PLANT COMMUNITY

Species (Total = 62)	Common Name
TREES (6)	
Abies concolor (Gord. & Glend.) Lindl.	White Fir
Juniperus osteosperma (Torr.) Little	Utah Juniper
Juniperus scopulorum Sarg.	Rocky Mountain Juniper
Pinus edulis Engelm.	Pinyon Pine
Pinus flexilis James	Limber Pine
Pseudotsuga menziesii (Mirb.) Franco	Douglas Fir
SHRUBS (13)	
Amelanchier utahensis (Nutt.) Nutt.	Utah Serviceberry
Artemisia tridentata Nutt.	Big Sage
Atriplex confertifolia (Torr.& Frem.) S. Wats.	Shadscale
Cercocarpus ledifolius Nutt.	Curlleaf Mountain Mahogany
Chrysothamnus nauseosus (Pall.) Britton	Rubber Rabbitbrush
Chrysothamnus viscidiflorus (Hook.) Nutt.	Douglas or Yellowbrush Rabbitbrush
Ephedra viridis Cov.	Green Ephedra, Mormon Tea, Joint Fir
Gutierrezia sarothrae (Pursh) Britton	Broom Snakeweed
Holodiscus dumosus (Hook.) Heller	Bush Oceanspray
Mahonia repens G. Don	Oregon Grape, Creeping Barberry
Pachistima myrsinites (Pursh) Raf.	Mountain Lover
Physocarpus malvaceus (Greene) Kuntze	Mallow Ninebark
Symphoricarpos oreophilus A. Gray	Mountain Snowberry
GRASSES (7)	
Agropyron spicatum (Pursh) Scrib. & Smith	Bluebunch Wheatgrass
Agropyron trachycaulum (Link) Malte	Slender Wheatgrass
Bromus inermis Leyss.	Smooth Brome
Bromus tectorum L.	Cheatgrass
Oryzopsis hymenoides (Roem. & Schult.) Ricker	Indian Ricegrass
Poa secunda Presl	Sandberg's Bluegrass
Poa sp.	an unidentified bluegrass species

Continued on next page...

TABLE 9-4 CONTINUED

Species	Common Name
FORBS (36)	
Antennaria rosea Greene	Rose Pussytoes, Everlasting
Arabis drummondii A. Gray	Drummond's Rock Cress
Arabis holboellii Hornem.	Rockcress
Arabis pendulina Greene	Rockcress
Artemisia ludoviciana Nutt.	Louisiana Sage, Wormwood
Chenopodium fremontii S. Watts	Fremont's Goosefoot, Pigweed
Cirsium undulatum (Nutt.) Spreng	Wavyleaf Thistle
Coryphantha vivipara Britton & Brown	Mammillaria
Cryptantha humilis (Greene) Payson	Cryptantha, Dwarf Catseye
**Cryptogramma stelleri* (Gmel.) Prantl	Rockbrake
(a) *Descurainia pinnata* (Walt.) Britton	Tansymustard
Descurainia richardsonii (Sweet) O.E. Schulz	Tansymustard
Erigeron engelmannii A. Nels.	Engelmann's Fleabane
Eriogonum corymbosum Benth.	Buckwheat
Galium aparine L.	Catchweed Bedstraw
Galium multiflorum Kellogg	Shrubby Bedstraw
Haplopappus nuttallii Torr. & Gray	Golden Weed
Heterotheca villosa Welsch & Moore	Golden Aster
Hymenopappus filifolius Hook.	Fineleaf Hymenopappus
Ipomopsis aggregata V. Grant	Skyrocket Gilia, Scarlet Gilia
(a) *Lappula redowskii* (Hornem.) Greene	Stickseed
Lepidium montanum Nutt.	Mountain Pepperweed
Leptodactylon pungens (Torr.) Nutt.	Prickly Phlox
Leucelene ericoides (Torr.) Greene	Fleabane
(a) *Lithospermum arvense* L.	Stoneseed
Opuntia polyacantha Haw.	Plains Prickly Pear
Penstemon eatonii A. Gray	Eaton's Penstemon
Penstemon thompsoniae (A. Gray) Rydb.	Thompson's Penstemon
Petradoria pumila (Nutt.) Greene	Rock Goldenrod
Phlox hoodii Rich.	Hood's Phlox
Senecio integerrimus Nutt.	Groundsel, Old Man
Senecio multilobatus Torr. & Gray	Lobeleaf Groundsel
Sisymbrium linifolium Nutt.	Tumblemustard
Solidago canadensis L.	Goldenrod
Stanleya pinnata (Pursh) Britton	Desert Prince's Plume
Townsendia incana Nutt.	Hoary Townsendia

* Fern

(a) annuals

TABLE 9-5

PINYON-JUNIPER TREE DATA*

Species	No. of Individuals	Density Trees/ Acre	Relative Density	Basal Area	Relative % Dominance	% Cover	Relative % Cover	% Frequency	% ΣF	Importance Value	Relative Importance	C x F Index
rees												
uniperus scopulorum	6	14.9	15.0	433.5	10.9	3.1	14.9	60	30	70.8	17.7	447.0
inus edulis	27	66.9	67.5	2960.4	74.2	11.0	52.9	90	45	239.6	59.9	2380.5
inus flexilis	1	2.5	2.5	103.8	2.6	4.2	20.2	10	5	30.3	7.6	101.0
seudotsuga menziesii	6	14.9	15.0	490.6	12.3	2.5	12.0	40	20	59.3	14.8	240.0
Totals	40	99.2	100.0	3988.3	100.0	20.8	100.0	200	100	400.0	100.0	3168.5
eedlings and Sap-lings												
uniperus scopulorum	8	26.8	20.0					50	23.8	43.8	21.9	
inus edulis	19	63.6	47.5					80	38.1	85.6	42.8	
inus flexilis	2	6.7	5.0					20	9.5	14.5	7.2	
eudotsuga menziesii	11	36.8	27.5					60	28.6	56.1	28.1	
Totals	40	133.9	100.0					210	100.0	200.0	100.0	
ees plus Saplings d Seedlings												
niperus scopulorum	14	41.7	17.5									
nus edulis	46	130.5	57.5									
nus flexilis	3	9.2	3.8									
eudotsuga menziesii	17	51.7	21.2									
Totals	80	233.1	100.0									

'ree density, dominance, and frequency by the quarter method and cover by line intercept method

TABLE 9-6

PINYON-JUNIPER UNDERSTORY VEGETATION DATA:
Cover, Frequency and Density Data from Quadrats

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 51 Quadrats	Relative % of Cover	% of ΣF	% Density	Importance Value	% Importance	C x F Index
Tree Seedlings and Saplings*									
Juniperus scopulorum	.12	3.92	2	.51	1.03	.34	1.88	.63	.53
Pinus edulis	.29	1.96	0	1.24	.52	0	1.76	.59	.64
Pseudotsuga menziesii	.53	3.92	5	2.26	1.03	.85	4.14	1.38	2.33
Subtotal	.94	9.80	7	4.01	2.58	1.19	7.78	2.60	3.50
Shrubs									
Amelanchier utahensis	4.00	23 51	7	17.09	6.18	1.19	24.46	8.15	105.62
Artemisia tridentata	.08	1.96	1	0.34	.52	.17	1.03	.34	.18
Gutierrezia sarothrae	.01	1.96	1	0.04	.52	.17	.73	.24	.02
Symphoricarpos oreophilus	.02	3.92	1	0.09	1.03	.17	1.29	.43	.09
Subtotal	4.11	31.35	10	17.56	8.24	1.70	27.51	9.17	105.91
Grasses									
Agropyron spicatum	.59	7.84	21	2.52	2.06	3.58	8.16	2.72	5.19
Agropyron trachycaulum	11.27	84.31	363	48.16	22.17	61.95	132.28	44.09	1067.71
Oryzopsis hymenoides	.12	3.92	1	0.51	1.03	.17	1.17	.57	.53
Poa secunda	1.01	27.45	22	4.32	7.22	3.75	15.29	5.10	31.19
Subtotal	12.99	123.52	407	55.51	32.48	69.46	157.44	52.48	1104.61

Continued on next page...

*Understory data measured by quadrats. See Tree Tables for canopy data measured by point-quarter and line intercept methods.

TABLE 9-6 CONTINUED

Species	Average Cover per Quadrat	Absolute Frequency	Number of Stems in 51 Quadrats	Relative % of Cover	% of ΣF	% Density	Importance Value	% Importance	C x F Index
Forbs									
Antennaria rosea	.10	5.88	8	.43	1.55	1.37	3.35	1.12	.67
Arabis drummondii	.04	7.84	5	.17	2.06	.85	3.08	1.03	.35
Arabis pendulina	.04	1.96	10	.17	0.52	1.71	2.40	.80	.09
Aster chilensis	.07	3.92	4	.30	1.03	.68	2.01	.67	.31
Chenopodium fremontii	.02	3.92	2	.09	1.03	.34	1.46	.49	.09
Cirsium undulatum	.10	1.96	1	.43	.52	.17	1.12	.37	.22
Cryptantha humilis	.01	1.96	1	.04	0.52	.17	.73	.24	.02
rn) *Cryptogramma stellari*	.02	1.96	1	.09	.52	.17	.78	.26	.05
Descurainia richardsonii	.07	5.88	37	.30	1.55	6.31	8.16	2.72	.47
Erigeron engelmannii	.03	5.88	3	.13	1.55	.51	2.19	.73	.20
Galium multiflorum	.11	7.84	23	.47	2.06	3.92	6.45	2.15	.97
Haplopappus nuttallii	.29	17.64	17	1.24	4.64	2.90	8.78	2.93	5.64
Lappula redowskii	.01	1.96	2	.04	.52	.34	.90	.30	.02
Lepidium montanum	.16	3.92	5	.68	1.03	.85	2.56	.85	.70
Penstemon eatoni	.02	1.96	2	.09	.52	.34	.95	.32	.05
Phlox hoodii	.92	31.37	31	3.93	8.25	5.29	17.47	5.82	32.42
Senecio integerremus	.04	5.88	4	.17	1.55	.68	2.40	.80	.26
Senecio multilobatus	.09	7.84	6	.38	2.06	1.02	3.46	1.15	.78
Subtotal	2.14	119.57	162	9.15	31.44	27.65	68.25	22.75	42.64
Cryptogams									
Moss	.57	23.53		2.44	6.19		8.63	2.88	15.10
Lichens	2.65	72.55		11.32	19.09		30.40	10.13	215.99
Subtotal	3.22	96.08		13.76	25.26		39.03	13.01	231.09
TOTALS: Living Plants	23.40	380.32	586	100.00	100.00	100.00	300.01	100.01	1487.75
Non-living Cover									
Litter	26.02								
Rock	27.27								
Soil	22.57								
Total	75.86								

TABLE 9-7

SPECIES PRESENCE LIST: GRASSLAND-SHRUB COMMUNITY

Species (Total = 37)	Common Name
TREES (3)	
Abies concolor (Gord. & Glend.) Lindl.	White Fir
Juniperus scopulorum Sarg.	Rocky Mountain Juniper
Pseudotsuga menziesii (Mirb.) Franco	Douglas Fir
SHRUBS (11)	
Amelanchier utahensis (Nutt.) Nutt.	Utah Serviceberry
Artemisia tridentata Nutt.	Big Sage
Atriplex confertifolia (Torr. & Frem.) S. Wats.	Shadscale
Cercocarpus ledifolius Nutt.	Curlleaf Mountain Mahogany
Chrysothamnus viscidiflorus (Hook.) Nutt.	Douglas or Yellowbrush Rabbitbrush
Ephedra viridis Cov.	Green Ephedra, Mormon Tea, Joint Fir
Gutierrezia sarothrae (Pursh) Britton	Broom Snakeweed
Holodiscus dumosus (Hook.) Heller	Bush Oceanspray
Physocarpus malvaceus (Greene) Kuntze	Mallow Ninebark
Rosa woodsii Lindl.	Wild Rose
Symphoricarpos oreophilus A. Gray	Mountain Snowberry
GRASSES AND SEDGES (6)	
Agropyron spicatum (Pursh) Scribn. & Smith	Bluebunch Wheatgrass
Agropyron trachycaulum (Link) Malte	Slender Wheatgrass
Carex geyeri Boott	Elk Sedge
Oryzopsis hymenoides (Roem. & Schult.) Ricker	Indian Ricegrass
Poa pratensis L.	Kentucky Bluegrass
Poa secunda Presl	Sandberg's Bluegrass
FORBS (17)	
Arabis drummondii A. Gray	Drummond's Rock Cress
Aster chilensis Nees	Aster
Cirsium undulatum (Nutt.) Spreng	Wavyleaf Thistle
Coryphantha vivipara Britton & Brown	Mammillaria
Cryptantha humilis (Greene) Payson	Cryptantha, Dwarf Catseye
Eriogonum corymbosum Benth.	Buckwheat
Galium multiflorum Kellogg	Shrubby Bedstraw
Haplopappus nuttallii Torr. & Gray	Golden Weed
Heuchera parvifolia Nutt.	Common Alumroot
Hymenoxys richardsonii (Hook.) Cockerell	Hymenoxys
(a) *Lappula redowskii* (Hornem.) Greene	Stickseed
Lepidium montanum Nutt.	Mountain Pepperweed
Penstemon humilis Nutt.	Low Penstemon
Penstemon thompsoniae (A. Gray) Rydb.	Thompson's Penstemon
Phlox hoodii Rich.	Hood's Phlox
Sisymbrium linifolium Nutt.	Tumblemustard
Stanleya pinnata (Pursh) Britton	Desert Prince's Plume

(a) annual

TABLE 9-8

GRASSLAND-SHRUB UNDERSTORY VEGETATION DATA: Cover, Frequency and Density Data from Quadrats

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 50 Quadrats	Relative % of Cover	% of ΣF	% Density	Importance Value	% Importance	C x F Index
Trees*									
Abies concolor	1.10	2	1	2.02	.48	.20	2.70	.98	.97
Juniperus scopulorum	.80	2	1	1.47	.48	.20	2.15	.78	.71
Pseudotsuga menziesii	.64	4	3	1.18	.97	.59	2.74	.99	1.14
Subtotal	2.54	8	5	4.67	1.93	.99	7.59	2.76	2.82
Shrubs									
Amelanchier utahensis	1.24	10	4	2.28	2.42	.79	5.49	1.99	5.52
Artemisia tridentata	.20	2	1	.37	.48	.20	1.05	.38	.18
Atriplex confertifolia	4.93	32	14	9.06	7.73	2.77	19.56	7.10	70.03
Chrysothamnus viscidiflorus	1.60	14	8	2.94	3.38	1.58	9.90	2.87	9.94
Gutierrezia sarothrae	.51	14	26	.94	3.38	5.14	9.46	3.43	3.18
Rosa woodsii	.02	2	1	.04	.48	.20	.72	.26	.02
Subtotal	8.50	74	54	15.62	17.87	10.67	44.18	16.04	88.86
Grasses and Sedges									
Agropyron spicatum	.20	4	2	.37	.97	.40	1.74	.63	.36
Agropyron trachycaulum	31.18	100	251	57.28	24.15	49.60	131.03	47.57	1383.31
Carex geyeri	.30	4	3	.55	.97	.59	2.11	.77	.53
Oryzopsis hymenoides	.10	2	1	.18	.48	.20	.86	.31	.09
Poa pratensis	.04	2	1	.07	.48	.20	.75	.27	.03
Poa secunda	1.54	14	16	2.83	3.38	3.16	9.37	3.40	9.57
Subtotal	33.36	126	274	61.29	30.43	54.15	145.86	52.95	1393.89

Continued on next page...

*Understory data measured by quadrats.

TABLE 9-8 CONTINUED

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 50 Quadrats	Relative % of Cover	% of ΣF	% Density	Importance Value	% Importance	C x F Index
orbs									
rabis drummondii	.10	8	7	.18	1.93	1.38	3.49	1.27	.35
ster chilensis	.04	2	2	.07	.48	.40	.95	.34	.03
ryptantha humilis	.12	10	6	.22	2.42	1.19	3.83	1.39	.53
oryphantha vivipara	.40	2	1	.73	.48	.20	1.41	.51	.35
riogonum corymbosum	1.3	14	13	2.39	3.38	2.57	8.34	3.03	8.08
alium multiflorum	2.96	40	85	5.42	9.66	16.80	31.88	11.57	52.36
aplopappus nuttallii	.56	16	14	1.03	3.86	2.77	7.66	2.78	3.98
ymenoxys richardsonii	.20	4	4	.37	.97	.79	2.13	.77	.36
epidium montanum	.02	2	1	.04	.48	.20	.72	.26	.02
hlox hoodii	.52	18	25	.96	4.35	4.94	10.25	3.72	4.18
enstemon humilis	.02	2	1	.04	.48	.20	.72	.26	.02
isymbrium linifolium	.13	10	12	.24	2.42	2.37	4.85	1.76	.58
tanleya pinnata	.12	4	2	.22	.97	.40	1.59	.58	.21
Subtotal	6.49	132	173	11.92	31.88	34.19	77.82	28.25	74.08
ryptogams									
oss	.44	16		.81	3.86		4.67		
ichens	3.10	58		5.70	14.01		19.71		
Subtotal	3.54	74		6.51	17.87		24.38		
Total Living Cover	54.43	414	506	100.00	100.00	100.00			
Non-Living Cover									
Litter	8.72								
Rock	20.46								
Soil	16.39								

TABLE 9-9

SPECIES PRESENCE LIST: CONIFER PLANT COMMUNITY

Species (Total = 42)	Common Name
TREES (6)	
Abies concolor (Gord. & Glend.) Lindl.	White Fir
Acer glabrum Torr.	Rocky Mountain Maple, Smooth Maple
Juniperus scopulorum Sarg.	Rocky Mountain Juniper
Pinus edulis Engelm.	Pinyon Pine
Pinus flexilis James	Limber Pine
Pseudotsuga menziesii (Mirb.) Franco	Douglas Fir
SHRUBS (9)	
Amelanchier utahensis Koehne	Utah Serviceberry
Artemisia tridentata Nutt.	Big Sage
Cercocarpus ledifolius Nutt.	Curlleaf Mountain Mahogany
Chrysothamnus viscidiflorus (Hook.) Nutt.	Douglas or Yellowbrush Rabbitbrush
Holodiscus dumosus (Hook.) Heller	Bush Oceanspray
Mahonia repens G. Don	Oregon Grape, Creeping Barberry
Physocarpus malvaceus (Greene) Kuntze	Mallow Ninebark
Ribes cereum Dougl.	Wax Currant
Symphoricarpos oreophilus A. Gray	Mountain Snowberry
GRASSES AND SEDGES (6)	
Agropyron trachycaulum (Link) Malte	Slender Wheatgrass
Carex geyeri Boott	Elk Sedge
Dactylis glomerata L.	Orchard Grass
Elymus glauca Buckl.	Blue Wildrye
Elymus salina E. Jones	Salina Wildrye
Poa secunda Presl	Sandberg's Bluegrass
FORBS (22)	
Antennaria parvifolia Nutt.	Pussytoes, Everlasting
Arabis drummondii A. Gray	Drummond's Rock Cress
Arabis pendulina Greene	Rock Cress
Arabis pulchra M.E. Jones	Rock Cress
Aster chilensis Nees	Aster
Castilleja linariaefolia Benth.	Wyoming Painted Cup, Indian Paintbrush
Chamaechaenactis scaposa (Eastw.) Rydb.	False Yarrow
Clematis pseudoalpina (Kuntze) A. Nels.	Rocky Mountain Clematis
Cryptantha humilis (Greene) Payson	Cryptantha, Dwarf Catseye
Erigeron engelmannii A. Nels.	Engelmann's Fleabane
Erysimum wheeleri (Rothr.) Rydb.	Wallflower
Galium multiflorum Kellogg	Shrubby Bedstraw
Haplopappus nuttallii Torr. & Gray	Golden Weed
Heuchera parvifolia Nutt.	Common Alumroot
Hymenoxys acaulis (Pursh) Parker	Hymenoxys
Malcolmia africana (L.) R. Br.	African Mustard
Penstemon eatoni A. Gray	Eaton's Penstemon
Penstemon thompsoniae (A. Gray) Rydb.	Thompson's Penstemon
Phlox hoodii Rich.	Hood's Phlox
Senecio multilobatus Torr. & Gray	Lobeleaf Groundsel
Sisymbrium altissimum L.	Tumblemustard
Stellaria jamesiana Torr.	Tuber Starwort

TABLE 9-10

CONIFER COMMUNITY TREE DATA

Species	No. of Individuals	Density Trees/ Acre	Relative % Density	Basal Area	Relative % Dominance	% Cover	Relative % Cover	% Frequency	% ΣF	Importance Value	Relative Importance	C x F Index
Trees												
Abies concolor	16	29.5	40	843.52	35.41	34.6	57.4	80	36.4	169.2	42.3	2089.4
Juniperus scopulorum	1	1.8	2.5	23.75	1.00	2.2	3.6	10	4.5	11.5	2.9	16.2
Pinus edulis	7	12.9	17.5	380.88	15.99	0	0	40	18.2	51.7	12.9	0
Pinus flexilis						3.4	5.6		0	5.6	1.4	0
Pseudotsuga menziesii	16	29.5	40	1133.98	47.60	20.2	33.4	90	40.9	161.9	40.5	1366.1
Totals	40	73.7	100.0	2382.13	100.00	60.4	100.0	220	100.0	400.0	100.0	3471.7
Saplings and Seedlings												
Abies concolor	10	125.9	25					70	26.9	51.9		
Juniperus scopulorum	7	90.7	18					60	23.1	41.1		
Pinus edulis	2	25.2	5					10	3.8	8.8		
Pinus flexilis	2	25.2	5					20	7.7	12.7		
Pseudotsuga menziesii	19	236.7	47					100	38.5	85.5		
Totals	40	503.7	100.0					260	100.0	200.0		
Trees and Saplings and Seedlings												
Abies concolor	26	155.4	32.5									
Juniperus scopulorum	8	92.5	10.0									
Pinus edulis	9	38.1	11.3									
Pinus flexilis	2	25.2	2.5									
Pseudotsuga menziesii	35	266.2	43.8									
Totals	80	577.4	100.0									

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TABLE 9-11

CONIFER UNDERSTORY VEGETATION DATA: Cover, Frequency and Density Data from Quadrats

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 30 Quadrats	Relative % of Cover	% of ΣF	% Density	Importance Value	% Importance	C x F Index
Trees*									
Abies concolor	.70	16.6	2	3.0	3.39	.15	6.54	2.18	10.17
Juniperus scopulorum	.76	16.6	5	3.31	3.39	.38	7.08	2.36	11.22
Pinus flexilis	2.00	3.3	2	8.72	.67	.15	9.54	3.18	5.84
Pseudotsuga menziesii	2.73	10.6	3	11.90	2.16	.23	14.29	4.76	25.70
Subtotal	6.19	47.1	12	26.98	9.61	.91	37.45	12.49	52.94
Shrubs									
Amelanchier utahensis	2.35	16.6	4	10.24	3.39	.30	13.93	4.64	34.71
Chrysothamnus viscidiflorus	.03	3.3	1	.13	.67	.08	.88	.29	.09
Mahonia repens	1.30	20.0	66	5.67	4.08	4.95	14.70	4.90	23.13
Symphoricarpos oreophilus	.13	6.7	2	.57	1.37	.15	2.09	.70	.78
Subtotal	3.81	46.6	73	16.61	9.51	5.47	31.60	10.54	58.72
Grasses and Sedges									
Agropyron trachycaulum	6.27	80.0	833	27.33	16.32	62.54	106.19	35.40	446.03
Carex geyeri	1.18	33.3	37	5.14	6.79	2.78	14.71	4.90	34.90
Dactylis glomerata	.23	10.0	7	1.00	2.04	.53	3.57	1.19	2.04
Elymus glauca	1.13	33.3	128	4.93	6.79	9.61	21.33	7.11	33.47
Elymus salina	.20	6.7	5	.87	1.37	.38	2.62	.87	1.19
Subtotal	9.01	163.3	1010	39.28	33.32	75.83	148.42	49.48	517.63

Continued on next page...

*Understory data measured by quadrats. See Tree Tables for canopy data measured by point-quarter and line intercept methods.

TABLE 9-11 CONTINUED

Species	Average % Cover per Quadrat	Absolute Frequency	Number of Stems in 30 Quadrats	Relative % of Cover	% of ΣF	% Density	Importance Value	% Importance	C x F Index
Forbs									
Castilleja linariaefolia	.01	6.7	2	.04	1.37	.15	1.51	.50	.05
Chamaechaenactis scaposa	.10	3.3	2	.44	.67	.15	1.26	.42	.29
Cryptantha humilis	.01	3.3	1	.04	.67	.08	.79	.26	.03
Erigeron engelmannii	.12	3.3	3	.52	.67	.23	1.42	.47	.35
Galium multiflorum	1.44	60.0	130	6.28	12.24	9.76	28.28	9.43	76.87
Haplopappus nuttallii	.03	3.3	1	.13	.67	.08	.88	.29	.09
Hymenoxys acaulis	.44	10.0	6	1.92	2.04	.45	4.41	1.47	3.92
Malcolmia africana	.01	3.3	2	.04	.67	.15	.86	.29	.03
Penstemon thompsoniae	.05	13.3	6	.22	2.71	.45	3.38	1.13	.60
Phlox hoodii	1.28	80.0	76	5.58	16.32	5.26	27.16	9.06	91.07
Senecio multilobatus	.27	13.3	10	1.18	2.71	.75	4.64	1.55	3.20
Sisymbrium altissimum	.01	3.3	1	.04	.67	.08	.79	.26	.03
Stellaria jamesiana	.01	10.0	3	.04	2.04	.23	2.31	.77	.08
Subtotal	3.78	213.1	237	16.48	43.45	17.79	77.69	25.90	176.59
Cryptogams									
Moss	.07	10.0		.35	2.04		2.39	.80	.71
Lichens	.08	10.0		.35	2.04		2.39	.80	.71
Subtotal	.15	20.0		.70	4.08		4.78	1.60	1.43
Total Living Cover	22.94	490.1	1332	100.00	100.00	100.00	299.94	100.00	807.30
Non-Living Cover									
Litter	23.37								
Rock	19.23								
Soil	34.40								
Total Non-Living Cover:	77.00								

TABLE 9-12

VEGETATIVE PRODUCTIVITY IN THE RIPARIAN PLANT COMMUNITY,
TRAIL MOUNTAIN MINE PLAN AREA, JULY 18, 1981

(Table entries are grams/M^2)

Sample Number	TREES Fresh Weight	TREES Air Dry	SHRUBS Fresh Weight	SHRUBS Air Dry	GRASSES Fresh Weight	GRASSES Air Dry	FORBS Fresh Weight	FORBS Air Dry	ANNUALS Fresh Weight	ANNUALS Air Dry	TOTALS Fresh Weight	TOTALS Air Dry
1	33	13	18	15	124	53	188	64	0	0	363	145
2	90	35	4	1	244	99	116	30	0	0	454	165
3	0	0	16	6	336	125	220	48	0	0	572	179
4	0	0	220	92	100	41	272	77	0	0	592	210
5	0.1	0.04	180	75	8	3	80	23	0	0	268	101
6	0	0	0	0	280	114	420	119	0	0	700	234
7	38	15	0	0	220	90	260	74	0	0	518	178
8	0	0	600	250	8	3	6	2	0	0	614	255
9	0	0	108	32	148	63	140	44	0	0	396	140
10	0	0	120	50	44	18	104	30	0	0	268	98
Average (g/M^2)	16	6	127	52	151	61	181	51	0	0	475	170
Lb./Acre	143	54	1,132	464	1,346	544	1,614	455	0	0	4,236	1,516
Percent of Total	3.4	3.6	26.7	30.6	31.8	35.9	38.1	30.0	0	0	100.0	100.0

TABLE 9-13

VEGETATIVE PRODUCTIVITY IN THE GRASSLAND-SHRUB COMMUNITY, TRAIL MOUNTAIN MINE PLAN AREA, JULY 19, 1981

(Table entries are grams/M^2)

Sample Number	TREES Fresh Weight	TREES Air Dry	SHRUBS Fresh Weight	SHRUBS Air Dry	GRASSES Fresh Weight	GRASSES Air Dry	FORBS Fresh Weight	FORBS Air Dry	ANNUALS Fresh Weight	ANNUALS Air Dry	TOTALS Fresh Wright	TOTALS Air Dry
1	0	0	22	11	188	105	68	32	0	0	278	148
2	0	0	6	4	138	75	6	2	0	0	150	81
3	0	0	35	18	100	54	0	0	0	0	135	72
4	0	0	0	0	168	91	2	1	0	0	170	92
5	0	0	3	2	30	16	45	17	0	0	78	35
6	0	0	3	1	230	125	42	16	0	0	275	142
7	0	0	71	36	190	103	34	13	0	0	295	152
8	0	0	0	0	210	114	10	4	0	0	220	118
9	0	0	23	7	176	92	24	7	0	0	223	106
10	0	0	18	9	56	30	95	36	0	0	169	75
Average (g/M^2)	0	0	18	9	149	81	33	13	0	0	199	102
Lb./Acre	0	0	161	80	1,329	722	294	116	0	0	1,774	910
Percent of Total	0	0	9.1	8.8	74.9	79.3	16.6	1.4	0	0	100.0	100.0

Table 9-14

VEGETATION SAMPLING PRECISION

A. Number of Sampling Units Required for 20% Precision at the 80% Confidence Level

	Community			
		Pinion	Grassland-	
	Riparian	Juniper	Shrub	Conifer
Tree DBH, Basal Area, Dominance	13	9	-	8
Tree Density	33	6	-	19
Sapling Density	22	19	-	22
Canopy Cover (Tree)	24	97	-	37
Understory Cover				
Total Living Plants	8	22	9	30
Dominant Life Form*	19(f)	49(g)	13(g)	39(g)
Non-Living Total (litter, rock, soil)	3	2	11	3
Dominant Non-Living Category**	10(L)	20(R)	40(S)	17(S)
Understory Vegetation Density				
Total Living Plants	10	73	11	36
Dominant Life Form*	16(f)	85(g)	11(g)	68(g)

* t = trees, s = shrubs, g = grasses, f = forbs, c = cryptograms

** L = litter, R = rock, S = soil

B. Actual Precision Obtained at 80% Confidence Level

		Community		
		Pinion		Grassland-
	Riparian	Juniper	Shrub	Conifer
Tree DBH, Basal Area, Dominance	±11%	±9%	-	±9%
Tree Density	±18%	±7%	-	±13%
Sapling Density	±15%	±13%	-	±15%
Canopy Cover (Tree)	±22%	±44%	-	±27%
Understory Cover				
Total Living Plants	±10%	±13%	±9%	±20%
Dominant Life Form*	±16%(f)	±19%(g)	±10%(g)	±22%(g)
Non-Living Total (litter, rock, soil)	±5%	±4%	±9%	±5%
Dominant Non-Living Category**	±11%(L)	±12%(R)	±18%(S)	±15%(S)
Understory Vegetation Density				
Total Living Plants	±12%	±24%	±9%	±22%
Dominant Life Form*	±15%(f)	±26%(g)	±9%(g)	±30%(g)

* t = trees, s = shrubs, g = grasses, f = forbs, c = cryptograms

** L = litter, R = rock, S = soil

CHAPTER 10

FISH AND WILDLIFE RESOURCES

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FISH AND WILDLIFE RESOURCES

10.1 SCOPE

Prior to any perturbation or manipulation of the environment, it is essential to conduct a pre manipulation study. This facilitates understanding the dynamics of the environment such that perturbation consequences can be predicted and avoided or considered in any situation requiring mitigation for ecological and/or economic reasons. Although the operation of the Mine is different than most projects of this sort in that it is an existing operation, it is no exception when it comes to consideration of the potential impacts of continued operation.

The Mine is a relatively small operation with reserves expected to last 7 to 10 years, and continued mining will potentially affect only an additional one square mile of habitat. It is unlikely that there will be an appreciable increase in traffic along the access road to the mine, and the affect on the stream should remain status quo. There is the possibility of subsidence in the newly mined area. The major issue is: what will continued operations do to the existing fish and wildlife resources living in or utilizing the area of concern? This area of potential impact contains distinct vegetation and cliff habitats potentially occupied by faunal components of concern to management agencies and vested interested groups. Therefore, it was essential that sufficient information on these biotic components be gathered, synthesized and analyzed to facilitate proper evaluation of the proposed action and its alternatives. The alternative in this case being no mining.

The objectives of the this chapter are two fold: (1) to present collected fish and wildlife resources information in sufficient detail to allow management decisions to be made in relationship to the magnitude of the potential disturbance from continued operation; and (2) to generate a wildlife protection plan that will meet the needs and requirements of the permitting agencies.

10.2 METHODOLOGY

This study was designed to quantitatively and qualitatively evaluate the fish and wildlife resources in habitats that might be potentially impacted by expansion and operation of the Mine. The scope of work and intensity of effort on a given group of organisms was restricted due to the comments regarding low and high level efforts of the various regulatory and management agencies.

A thorough literature review was conducted in February, March and April, 1981. This task was of paramount importance since the study was restricted in scope to a synopsis and synthesis of previously collected data for species requiring a low level effort. Efforts were made to review pertinent unpublished theses and state and federal agency reports. Information was gleaned from visits to appropriate management agencies, particularly the regional UDWR office in Price. Subsequent information has been gathered since that time, through various studies that are presented in the appendices of this chapter.

The project site was initially visited in March and again in April to familiarize the researchers with specific edifice and vegetative areas. This facilitated proper determinations regarding placement of species into preferred habitats, habitat affinities and the potential impact of perturbation actions. The early visits were also necessary to check on any courtship behavior which might aid in determining the location and number of sites necessary to collect high level raptor date.

Using the information obtained from the initial visits and maps, it was determined that the entire area would be traversed and observed for raptor use and activity. Since so few raptors occurred in or utilized the area of concern, considerable effort was expended to determine raptor use in adjacent areas. This was thought necessary if adequate understanding was to be given to the low level of raptor presence and use in the present and proposed mining area.

The terrestrial vertebrate species observed or known to inhabit the potential area of concern or similar habitats were identified. The species were listed phylogenetically by habitat in tabular form and categorized as: (1) game species, (2) threatened or endangered species, (3) resident species, (4) migratory species, (5) restricted range species, (6) ubiquitous species and/or (7) high interest species.

Extensive field observations were made biweekly from mid April through July. This was initiated in April so observations could be made on courtship displays, territorial establishment and nest site selection of raptors. However, since only kestrel's were seen, concern was raised as to the timing of the observations. Were they too late? Had these reproductive activities already occurred and were the birds incubating eggs? Detailed cliff searches were conducted and the entire area of concern traversed on foot at sufficiently close intervals to flush not only raptors but the passerine types. One golden eagle in flight, at least two pair of kestrels and many passerines were observed, but raptor use was low. Nevertheless biweekly monitoring has occurred to determine if any raptors move into the area following fledgling in adjacent areas, or if any expand their hunting territories and fly over the area.

Although density data were not specifically determined, each species tabulated was placed into one of four categories: A = abundant, C common, u = uncommon or Ca = casual. This was determined by the in consultation with literature references and appropriate management personnel or people with expertise specific to the area, habitat, or species of concern.

Since no detailed data were available for the aquatic organisms inhabiting the stream, field work was conducted. Samples of the macroinvertebrates were taken by use of modified Serber nets and turning of rocks. Four replicate samples were taken both above and below the perturbation source for comparison. Fish were searched for, but none were found. The macroinvertebrate samples were sorted taxonomically and tabled.

10.3 EXISTING FISH AND WILDLIFE RESOURCES

Literature and field data were summarized for terrestrial and aquatic vertebrates and aquatic macroinvertebrates of concern according to the level indicated in the scope of work. The species were categorized to determine habitat affinities and high interest status. The results are reported in tabular form (Table 10-9). They are listed according to their various ecological classifications (Dalton et al. 1978; Durrant 1952; Hall and Kelson 1959; Hall 1981; Hayward et al. 1958). Terrestrial vertebrate species whose ranges appear to overlap the potential area of impact are listed. No discussion is included in this section of the report. The high interest species of concern are discussed individually in a separate section of this chapter as are the overall impacts by action.

Generally speaking, the terrestrial portion of the proposed project area could potentially be inhabited by about 140 avian, 74 mammalian, 6 amphibian and 17 reptilian species. The stream could be inhabited by 20 different families in 9 orders of invertebrates. Some of these macroinvertebrates are high interest species since they provide forage to trout and other fishes in Lower Cottonwood Creek, a class 3 fishery. The high interest species are not mapped individually because their ranges are essentially ubiquitous and could not be meaningfully mapped. Their distribution is too broad to be of importance in a small area such as that of the Mine. Only one endangered or threatened species was observed with the boundary or within sufficiently close proximity to the boundary to be considered.

10.3.1 Wildlife Habitats in Mine Plan Area

There are five distinct terrestrial wildlife habitats plus the small stream in the Mine plan area. Although these can be vegetatively divided into smaller units, the smaller units are not significant to wildlife distribution. The terrestrial habitats are: pinion juniper, grass aspen, cliff, mixed conifer, mixed mountain shrub and riparian. None of the habitats are unique or restricted to the area of the Mine plan area nor are they considered crucial critical to the fauna inhabiting them in this area. The habitats in the portal vicinity have been destroyed by mining activity, but the activities have been confined to a relatively small area and are not proposed for expansion. The steepness of the canyon walls has and will restrict habitat use and disruption by man.

10.3.2 Wildlife

The wildlife section contains tables and discussions of each wildlife group.

Terms used in tables are defined as follows:

1. **Abundant**: Those organisms perennially observed in high numbers throughout the community the most obvious organisms in the community.
2. **Common**: These species are easily trapped or observed in the community.
3. **Uncommon**: Organisms that are not ordinarily encountered in the community.
4. **Casual**: These species are seldom identified or only occasionally observed.
5. **Resident**: Those species that are found in the community throughout the year.
6. **Summer only**: These species breed in the area and migrate elsewhere in the winter.

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7. **Winter only**: Organisms that breed elsewhere and migrate into the communities listed.

8. **High Interest**: Any species that is endangered, threatened or of economic or recreational value.

9. **Game Species**: Any species that is hunted or trapped as a game animal and requires a hunting license.

10. **Endangered**: Any species that is in immediate danger of extinction.

11. **Threatened**: A species whose numbers are decreasing rapidly and likely to become endangered if the present trend continues.

12. **Raptors**: Any bird that seizes and carries its prey by force. Typically they are characterized by carnivorous habits, great powers of flight, seize their prey with sharp curved claws and have a short curved beak.

10.3.2.1 Aquatic Wildlife and Habitat and Value Determination

During the initial study, the aquatic macroinvertebrate wildlife found on site in Cottonwood Creek listed in Table 10-1 were taken above the portal and loadout facilities, and the data in Table 10-2 were taken below the portal and loadout facilities. (See Figure 10-1). Additional macroinvertebrate studies on this area are summarized in the appendices portion of this Chapter.

The stream habitat is considered of critical value to the areas wildlife even through fish do not actually occupy the area of concern. It is a feeder stream to a class 3 fishery in Lower Cottonwood Creek.

10.3.2.2 Terrestrial Wildlife and Habitat and Value Determination

The classes of terrestrial vertebrate wildlife are listed separately by relative abundance status according to season of occupancy by habitat type in Table 10-3 through 10-5. These tables are constructed to accommodate sections 10.3.2.3

Mammals, 10.3.2.4 Birds, and 10.3.2.5 Reptiles and Amphibians. Of the wildlife habitats present on the mine plan area, riparian habitats, canyon bottomlands, and the high ridges where elk winter are considered by UDWR to be critical value habitats to wildlife and must be protected. The cliffs, talus slopes, mountain brush, and the aspen and conifer forests are considered high priority habitats. Critical habitats are those considered necessary to sustain the existence and perpetuation of one or more species of wildlife during crucial periods in their life cycle. High priority areas are intensive use areas but not restricted in area for the wildlife species of concern.

10.3.2.3 Mammals

Refer to Table 10-3.

10.3.2.4 Birds

Refer to Table 10-4.

10.3.2.5 Reptiles and Amphibians

Refer to Table 10-5.

10.3.3 Species of Special Significance

Refer to Table 10-6.

10.3.3.1 Threatened and Endangered Species

Refer to Table 10-7.

10.3.3.2 Raptors

Refer to Table 10-8.

10.4 EXPECTED IMPACTS OF MINING OPERATIONS ON FISH AND WILDLIFE

The known impacts of mining on fish and wildlife resources are many and varied according to the type, location and age of the mine and technology used to remove the coal. Additionally the floral and faunal components in the mining area determine the resultant impact. It is desirable that environmental protection be accomplished during the aspects of the life of the mine from construction through final reclamation, but the degree of environmental protection is often difficult to determine. This is particularly true in cases where mining operations that have been functioning for many years prior to serious environmental awareness and are asked to meet new improved standards. Such mining operations do not have the benefit of modern setting, design, construction, and technology and have often already impacted the environmental resources such that continued operation would not be of additional serious consequence. This is the case with the Mine.

Continued operation of the Mine will continue to impact the fish and wildlife resources in the area; therefore consideration of these continued impacts is warranted. Reclamation also needs to be considered since discontinuation of the operation would potentially facilitate a return of the habitat to its "normal state." The impacts of concern that have and could result in perturbations to the environment and ultimately relate to the stability of fish and wildlife in the area of concern are directly related to: (1) surface disturbance, (2) loss of habitat, (3) noise and (4) human activity. Both aquatic and terrestrial habitats are of concern since the portal, loading facilities and haul roads occupy riparian habitat adjacent to a small stream, and the mine underlies a variety of terrestrial communities that are potentially important habitats for several species that are considered of high interest to various management agencies because these species are of economic or recreation value.

There are two general ways to look at the impact: (1) by action and (2) by species or taxonomic group.

1) Impact by Action: Surface Disturbance

Surface disturbance in most mining operations is a major concern since extensive surface facilities are usually constructed to facilitate processing, loading and transporting coal once it is brought to the surface. Such is not the case with the Mine. The impact has already occurred since the portal facilities and haul road are in existence and additional surface acreage will not be needed, even for ventilation shafts. Similarly mined areas in comparable habitats to the existing Trail Mountain Mine have experienced little subsidence. There is little or no visible surface disturbance, and it is probable that the integrity of the above ground terrestrial

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vertebrate communities to be undermined will remain status quo. Occurrence of occasional fractures and minor slippages will not impact the terrestrial wildlife in the area as they have not impacted other undermined and non disturbed areas.

There is no question that surface disturbance due to construction and operation of Trail Mountain Mine has in the past impacted the aquatic and terrestrial wildlife. However, since the mine has been in operation for some time, the fauna initially in the area of impact have likely habituated, adapted, moved, or been lost. Therefore the operation will not create additional surface disturbance impacts to these faunal groups.

Habitat Loss

Obviously habitat loss is related to surface disturbance as are noise and human activity, but they are treated separately. Although approximately an additional 1300 acres is proposed for undermining, essentially no additional acreage will be lost for habitation and production by aquatic and terrestrial wildlife. Obviously the immediate vicinity of the mine portal, access and haul roads, loading and limited storage facilities has already been lost as habitat. There is a potential to reclaim all but the roads once the mine is discontinued, but the acreage is small and likely of little consequence to the overall density of terrestrial wildlife. As such it warrants little further consideration. The stream, however, is a different situation. The surface facilities have encroached upon and altered the stream. The riparian community at the portal and load out area has been lost. (See Chapter 7 for programs initiated by the mine to eliminate the problems of sedimentation load and for water quality data.) The stream is now culverted beneath the mine site, and is further protected by adequate runoff and sedimentation controls on the site.

Noise

Noise created from the operation of the mine is not expected to increase in the existing areas of disturbance associated with the mining activity. Therefore, the animals will detect no change with the expansion, and populations should remain status quo.

Human Activity

Since this is an existing mining operation, little increased human activity is expected; therefore, the impacts of human activity have likely stabilized in the area of concern. It is especially important that wildlife not be harassed during critical periods in their life history. During winter, wildlife are often in a delicate energy state, and unnecessary disturbance by man causes them to use up critical and limited energy that often times results in mortality. In less severe cases, the fetus being carried by gestating mammals may be resorbed or aborted thus reducing reproductive success and productivity of the population. For this particular mine, this is a concern for mule deer. During breeding season, disturbance by man can negatively affect reproductive success by disrupting territorial selection or defense, interrupting courtship displays and disturbing mating animals. This is most likely to occur with mule deer as they move onto the wintering area and would be a significant impact on raptors if they were utilizing the area.

During parturition, lactation, and early in the rearing process, young animals need to be undisturbed. It is during this time that young animals gain the strength and ability to elude predators and man. Undisturbed habitats allow the young animals to develop in a relatively unstressed situation and to utilize habitats that are secure from predators.

2) Impact by Species or Taxonomic Group

The perturbation rating used in this part of the application (Table 10-9) is explained in the methodology section. Basically, it is a scale ranging from 0 -10 with 0 being little or no impact and 10 being the loss of the species.

It is projected that the area of potential impact in the mine plan area could possibly be occupied by or provide habitat for approximately 245 species of wildlife according to the Utah Division of Wildlife Resources (UDWR) publication No. 78 16: 74 mammal species, 140 bird species, 17 reptile species, 6 amphibian species, and 8 fish species. Sixty-one are of high interest to UDWR, and approximately 83 percent are protected by law. On site visits, however, reduced this potential number to approximately 187 species: 52 mammal species, 121 bird, 12 reptile, 2 amphibian and no fish species.

Similar proportions are protected and of high interest. The numerical data from on site visits are used as the base for this report; however, all species listed by UDWR have been considered.

Mammals

Based on literature and on site visits, the potential area of impact could provide habitat for approximately 51 species of mammal (Table 10-3). Approximately 30 percent are protected and considered of high interest to the State of Utah. As such, each might be considered in relation to the potential perturbations, but only those of major concern to management agencies or those likely to impacted are individually or collectively discussed.

Snowshoe Hare

The snowshoe hare is present in and dependent upon the mixed conifer and nearby aspen and riparian habitats year round. This combination of habitat types is limited in size and located in relatively inaccessible areas on the mine plan area. Therefore, the proposed actions are sufficiently removed that they will do little to harm the high priority value habitat type and the hare populations' dependent upon it. The impact of the proposed actions rate as 0 for this species.

Mountain Cottontail

The entire project represents a substantial value use area for cottontails. Their young are born between April and July, which is considered a crucial period for maintenance of cottontail populations, but due to the reproductive life history of the species and the extent of disturbance, the proposed actions are not likely to seriously alter the reproductive potential of the population.

Most of their habitat is relatively inaccessible, and what is not will readily be repopulated from the adjacent areas. Hunting pressure will likely not increase nor will illegal kills since increased human activity is not projected. The perturbation impact of the project on this species rates as 0.

Furbearers

Limited portions of the area of concern and adjacent areas provide substantial value habitats for a few species categorized by management agencies as furbearers: ermine, long tailed weasel, badger, and the stripped skunk. Obviously, the breeding and rearing activities of these non migratory species occurs within the proposed area of concern, and their den and burrow systems are crucial to maintenance of their populations, but it is highly unlikely that the proposed actions of this small project will seriously impact the stability of their populations. Although riparian habitats are important to these species, the species are wide spread and adaptable to the activities of man.

The marten and wolverine are possible inhabitants of the mine site, but even if present they would occupy the upper reaches of the area and would not be seriously impacted. The perturbation impact of the proposed actions on the furbearers rates as 0.

Small Mammals

Although small mammals do not qualify individually as high interest species, they represent a significant part of the ecosystem. The majority are herbivores and are the primary source of food for higher trophic levels, particularly raptors, canids and felids. This trophic importance warrants consideration, but since this project only involves the continuation of an ongoing operation, there will not be additional habitat loss. Subsidence is also projected to be minimal, so interruption of underground burrow systems is not a serious concern. The perturbation impact of the proposed actions on the small mammals rates as 0.

It is important to note that most small mammal species of importance to predators do not occupy the rocky, steep slopes characteristic of most of the mining area. Few, particularly diurnal species, were evidenced in on site visits. Those that were found were on the upper reaches that were relatively undisturbed by the mine. This paucity of prey likely accounts for the similar paucity of predators particularly raptors. No raptors other than kestrels were found to occupy the mine plan area. It was not until the narrow canyon widened 1 - 2 miles above the loading facility that sufficient numbers of ground squirrels and pocket gophers were found to support nesting raptors. Several goshawks were observed in this area above the mine. Admittedly raptors could have occupied or nested on the area of concern and readily gotten to these areas to feed, but in spite of extensive field efforts over a five month period, none were found.

Bobcat

The mine and adjacent areas provide substantial habitat for bobcats who are often associated with precipitous terrain. Although none were evidenced by observation or tracks, they are known to occupy or use all of the terrestrial habitats in the area of concern. Their primary source of prey is small mammals, birds, or other small animals, but since populations of these preys were low, few bobcats may be using the area. Nevertheless their crucial periods would be in February during parturition and May and June when initial foraging and play occurs. The former period is of little consequence for this project, but the latter is of concern since young bobcats are not as secretive or wary of man as are cougars. They are less likely to avoid high human disturbance areas during these months and are open to human harassment and vulnerable to illegal kills. Such activities should not increase over past numbers, but the company will educate their employees and alert law enforcement officials to curb such actions. The perturbation impact of the project rates as 1 for this species.

Mountain Lion (Cougar)

The Mine plan area provides substantial valuable, yearlong habitat for cougar. The animal ranges throughout the area, but its movements are often dictated by migration patterns of the primary food source, mule deer, and by human disturbance. Although cougar have been faced with a problem since the advent of the mine in that mule deer winter in the lower reaches of the canyon where human disturbance is highest, the impact is probably negligible due to the secretive nature of the species.

Cougar populations in the area of concern are not at or near saturation levels;

therefore, the cougars can avoid the concentrated human activity areas and still maintain a status quo population. If populations of cougar in adjacent areas were at or near saturation, the project would have a depressant impact on the population. The perturbation impact of the project on this species rates as 1.

Mule Deer

The mule deer in the environs of concern utilize the entire area but seasonally concentrate in and more heavily utilize specific habitats and areas. During the summer, the mule deer concentrate in the mixed mountain shrub and grass aspen habitats in the mid to upper elevations of the mine plan area. At this time, although crucial for reproduction, they are little impacted by the ongoing operation.

In winter a portion of the project, particularly the canyon bottom along the stream and haul and access road, represents critical value winter range for UDWR deer herd unit 35. According to UDWR, critical value sites must be protected from disturbance by man when the deer are physically present on the range. Vehicle strikes can readily occur and people can harass the animals when they are in a weakened energy state due to snow and cold. The perturbation impact of the project on mule deer rates as 3. It should be noted that vehicle speeds are now reduced during critical times, and employee training is conducted at least annually to help reduce this impact.

Rocky Mountain Elk

A portion of the proposed project site represents winter range for the Manti elk herd unit 12. This was substantiated by on site visits. The high ridges associated with the mine plan area are used during the winter and are rated as critical winter range by UDWR. According the UDWR such critical ranges must be protected from disturbance by man when elk are physically present on the range.

This is not difficult in the case of this project. The high ridges are not easily viewed from the road or portal facilities and are basically inaccessible to all vehicles but snowmobiles when the animals are present. The impact of the mine and its attendant activities will not significantly impact the herd. Harassment by snowmobile operators is not likely to be associated with mine activities beyond the fact that the road will be kept open to the portal. At that, it is a long distance from the portal by negotiable terrain for snowmobilers to reach the elk. There are many easier ways, non project associated, to access the elk during the winter.

Elk often calve between the wintering grounds and summer area, so some calving might take place on the ridge top northwest of the mine. However, no elk calving areas are known or likely exist within the project boundaries. The perturbation impact of the project on this species rates at 0.

Moose

The project site represents substantial value, yearlong range for the Southeastern Utah moose herd Joe's Valley drainage, but it is doubtful that moose have used or are using the specific site or any area likely to be impacted by permitting the ongoing mine. Admittedly there is riparian habitat present within the project boundary, and on a regional basis winter ranges for moose are characterized as riparian habitats, but the riparian habitat within the project boundary is not likely the kind to support moose. The closest such habitat is 4-5 miles upstream or downstream and even that is questionable. In addition, the steep, rocky terrain surrounding the riparian habitat in the area of concern is not the type of habitat that would normally be associated with moose.

Although seasonal use areas for moose proximal to the proposed area of concern have not yet been determined, they are not likely to include the project area. The perturbation impact of the project on moose rates as zero (0).

Birds

Based on literature and on site visits, the potential area of impact could provide habitat for approximately 121 species of birds (Table 10-4). All bird species are protected and up to 29 species potentially inhabiting the area of concern are determined to be of high interest to the State of Utah. As such each high interest species might be considered in relation to the potential perturbations, but only those of major concern to management agencies or those likely to be impacted are individually or collectively discussed.

Raptors General

The project and adjacent areas potentially provide substantial value habitat for many raptors: turkey vulture, bald and golden eagles, four species of falcons (prairie, American and arctic peregrine falcons, and American Kestrel), six species of hawks (goshawk, sharp shinned, Cooper's, red tailed, Swainson's hawks and Ferruginous hawk) and seven species of owls (barn, screech, flammulated, great horned, pygmy, long eared, and saw whet owls.). Since many of these species are of high federal interest due to 43 CFR,346.1 (n 1) and all are of high interest to the State of Utah, considerable high level effort was given to determine their status in the area of concern.

It was recognized that realistically, nesting habitat does not exist on the specific area of the project or adjacent areas for all species. However, if a species were to court, nest, or feed, on or adjacent to the project area, it would specify crucial periods when protection from disturbance would be necessary. This is particularly true for nesting aeries which need protection from significant or continual on line of sight disturbance within a one kilometer radius of the nest during the time the nest is occupied.

It is acknowledged that the current level of data relative to site specific use of the area by raptors is unsatisfactory and that there are potentially aeries that have not been identified. Therefore, cursory surveys were made of the site and the immediately adjacent area beginning in February and intensive surveys conducted beginning in April and continuing through July. The paucity of raptor use was surprising. (See Figure 10-2).

Golden Eagles

Golden eagles are common yearlong residents of the environs of the mine plan area, and although no known active aerie territories were associated with the project, it was believed by UDWR and the consultants that such existed. This belief was based upon the fact that seemingly suitable nesting habitat is widespread on the specific mine site and throughout the local area. No golden eagle nesting sites were found and although many eagles were observed courting and hunting in the valley near Wattis and Orangeville, only an occasional fly over occurred on site within a 3 - 5 mile radius. It is likely that the steep and narrow nature of the canyon and the surprising and decided lack of suitable and easily accessible prey preclude use of the specific area. Food is much easier seen and captured in other areas.

No high priority concentration areas or critical roost trees for golden eagles are known to exist nor were any found on the project area. The perturbation impact of the project rates as 0 for this species.

Northern Bald Eagle

The northern bald eagle is an endangered winter resident of the local area, but to date no known high priority concentration areas or critical roost trees have been found on or adjacent to the area. There is no known historic evidence of the northern bald eagle nesting on the mine plan or adjacent areas. The perturbation impact of the project rates as 0 for this species.

American Peregrine Falcon

This relatively low abundance species is potentially a yearlong resident of the mine plan and adjacent area. It uses cliff sites for nesting, but according to UDWR and on site surveys no suitable nesting habitat is found on the mine plan or adjacent areas. The perturbation impact rates at 0.

Arctic Peregrine Falcon

The endangered arctic peregrine falcon is a winter resident (November 15 to March 15) of the local area but has not and was not observed to utilize the environs on or adjacent to the mine plan area. Its occasional presence is possible but the perturbation impact of the project rates as 0 for this species.

Prairie Falcon

This relatively abundant species is a known yearlong resident of the general environs of the mine plan area and is a cliff nesting falcon, but none were observed or found on or in the immediately proximate areas to the project. It is possible but doubtful that the current level of activity has precluded their use of the canyon. There is ample cliff habitat sufficiently distant and not visible from the surface disturbance areas to accommodate this species. It is more likely that the steep and narrow nature of the canyon and the paucity of prey renders the site specific area energetically undesirable. The perturbation impact on the project on this species rates as 0.

Kestrel

This species was found on and adjacent to the mine site and was actively resting and feeding within one hundred yards of the portal. This species likes riparian habitat and although quite adaptable to the activities of man is likely impacted slightly by such activities as occur on or near the portal. The stability of this falcon in the area is not in jeopardy, and the perturbation impact of the project rates as 1 for this species.

Blue Grouse

The blue grouse is a yearlong resident of the project area. In the fall and winter, they prefer the open stands of conifer and aspen in the higher elevations, but during the spring and summer they reverse migrate into the mountain brush and occasionally pinion juniper. These habitats are considered critical to the species as are the crucial periods of occupancy, but the habitats and birds are sufficiently removed from the significant perturbation sources near the portal and haul roads and relatively inaccessible to project personnel so that negative impacts on blue grouse will be minimal. The perturbation impact of the project on this species is considered as 0.

Ruffed Grouse

The ruffed grouse is a yearlong but not abundant resident of the project area. They potentially traverse the habitats present but are often dependent of proximity of a quarter of a mile to a stream. They use staminate buds of aspen for food in winter and are; therefore, dependent upon it. This critical habitat type is sufficiently inaccessible and unperturbed and will remain so that stability of ruffed grouse should remain status quo. The perturbation impact of the project rates as 0 for this species.

Mourning Dove

Mourning doves normally inhabit the project and adjacent areas where they prefer the pinion juniper and riparian habitats for nesting. These high priority habitats are abundant in the project area, but maximal disturbance has occurred to and habitat lost in the riparian area near the portal. This has obviously reduced the potential mourning dove population, but it is likely insignificant on a total population, basis. Therefore, the perturbation impact of the project on this species rates as no more than 1.

Passeriformes

Many passeriform species of high interest occupy the area, primarily on a seasonal basis. Some are permanent. They serve as potential prey for predators and occupy important links in the trophic structure of the habitats present. Little is known about the passerines on the specific project site, but the impact of the project to the stability of any given species has already occurred if it is going to. The operation will not create additional habitat loss nor will human harassment increase. The perturbation impact of the project on this taxonomic group is rated as 0.

Reptiles and Amphibians

Based on literature and on site visits, the area of potential impact could provide habitat for 17 species of reptile and 6 species of amphibian (Table 10-5). Reptile and amphibian species are protected, but only two of the reptile and one of the amphibian species are considered of high interest to the State of Utah.

Utah Milk Snake

The Utah milk snake is a yearlong resident animal of the project area and potentially could occupy all habitats. It is secretive, mostly nocturnal, and is often found inside or under rotten logs, stumps, boards, rocks, or other hiding places. Since no such places are scheduled for removal or disturbance, and activity of the species is primarily nocturnal as it seeks small vertebrates for prey, little impact has likely occurred to this species and no additional impact is likely. Should any denning site be located, UDWR personnel will be notified. The impact of the project on this species rates as 0.

Utah Mountain Kingsnake

This species is a year round resident of the project area that prefers dense vegetation habitats near water. Little of this preferred habitat is present but none is scheduled for destruction. This coupled with the nocturnal habits of the species render impact beyond that which has already occurred unlikely. The population of the species should remain status quo, so the perturbation impact of the project on this species rates as 0.

Tiger Salamander

The tiger salamander is a yearlong resident animal potentially occupying any moist underground habitat or similarly moist above ground areas such as rotten logs, cellars or animal burrows. It is dependent upon open water, primarily in pools or ponds for reproduction and larval development, and migrates to such areas on rainy or moist nights. Little of this habitat is present on site, and none that would cause migration across the transportation routes in numbers that if run over would seriously impact the population. The perturbation impact of the project on this species rates as 0.

Fish

Although there are no fish in Cottonwood Creek, its flow of water is considered by UDWR of value for reproductive success of spawning trout and growth of other fishes in section 2 of Lower Cottonwood Creek, a class 3 fishery for which it is a tributary water. Drift of macroinvertebrates from this stream represent an important contribution of forage to trout and other fishes in Lower Cottonwood Creek.

Aquatic habitats associated with the mine plan area support three species of game and five non-game species of fish. All are protected, and four have been determined of high interest to Utah: yellowstone cutthroat, rainbow, and brown trout, plus the mottled sculpin. Mine plans do not include additional perturbations upon Cottonwood Creek. Sediments from the portal facility have seriously altered the stream habitat and caused the macroinvertebrate populations to be seriously reduced in numbers and diversity from the point of impact downstream. Based upon site studies, the macroinvertebrate community above the portal is considered healthy while that below the pollution source is considered under stress and unhealthy. Population diversity and numbers are low, thus seriously reducing macroinvertebrate drift to the class 3 fishery in Lower Cottonwood Creek. The perturbation impact of the project on the macroinvertebrates is rated at 4 and ultimately high interest fish species as 3 and action is recommended. (Note: Corrective measures have been taken at the site to control sediment and protect the stream. Subsequent studies have shown the macroinvertebrate populations to be stabilized and not severely impacted.)

10.5 MITIGATION AND MANAGEMENT PLANS

Mitigation of mining impacts on wildlife is usually considered and the plans for implementation approved prior to any perturbation. Mitigation actions often follow one of three general forms: (1) design of facilities and access or transportation modes to minimize impacts, (2) operation of the mine and associated facilities to minimize impacts and (3) enhancement of wildlife habitat both in the vicinity of and away from the mine in order to mitigate losses that may occur from mining.

In new mine operations, it is easy to suggest, provide, and implement mitigative measures, but in the case of the Trail Mountain Mine, preconstruction design and mitigation does not apply nor can it be implemented without major additions or modifications that in and of themselves would likely cause more problems than status quo operation. The Trail Mountain Mine has been in operation sufficiently long and is sufficiently small that little can or should now be done to change the design of the portal facilities to lessen the impacts. Most non-avian terrestrial vertebrates of concern inhabiting and utilizing the area in question have likely habituated to the present facilities and level of operative disturbance by adjusting their behavior including migration so that change would be more impacting than status quo. Exceptions to this are where the impact is continual and could be easily mitigated. These are in the areas of harassment during critical stages of the life history of species and in sedimentation of the stream. This is of particular significance to mule deer and fish.

PacifiCorp will perform the following mitigation measures in order to minimize disturbances and impacts on wildlife and their habitats that could be impacted during continued operation of the mine. The mitigative measures will meet the requirements of R645-301-322 and will be consistent with the

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performance standards of R645-301-358.

The permittee will make significant efforts to educate employees associated with their on site mine operation to the intricate values of the wildlife resources within the current mine plan area. High interest species, critical habitats, and critical life history periods will be emphasized. This will be done by brochure and periodic printed reminders distributed at selected times. Each employee will be advised not to unnecessarily or without proper permits or licenses harass or take any wildlife including young thought to be abandoned. They will be advised not to unnecessarily stop vehicles to view wildlife and will be forbidden to leave the road by vehicle within the mine plan area. They will be encouraged to voluntarily establish a game alert program wherein they report violators of company rules or legal statutes to the proper company officials or authorities for reprimand or prosecution. They will be advised that they, as hunting and recreation users, stand to gain the most by preserving and conserving what they have in proximity to their places of work and abode.

The Company will maintain the relative inaccessibility of the mine plan area. No unnecessary, additional access roads will be built nor will off road vehicle use be allowed within the permit area. Discharge of firearms by employees will be prohibited on company controlled property during working hours.

In winter, a portion of the project, particularly the canyon bottom along the stream and haul and access road, is inhabited by mule deer, and the potential for road strikes and harassment when the animals are in a weakened energy state due to snow and cold is present. Drivers will be informed of the concerns for protection of wildlife and encouraged to reduce speed in the canyon between November 1 and May 15 when mule deer are abundant.

Although no fish occupy Cottonwood Creek, sedimentation of the stream has (in the past) been identified as a problem for class 3 fishery, Lower Cottonwood Creek into which Cottonwood Creek flows. PacifiCorp will take precautions to keep all forms of coal or other sediments generated by the operation of the mine from inadvertently entering the stream. Haulage vehicles and storage piles will be appropriately wetted to prevent airborne particulates. The roads will be maintained to prevent material from bouncing out. (See Chapter 7 for details on sedimentation and drainage controls).

Wildlife habitats will be maintained or improved if disturbed. This will be done by using native or

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other vegetation approved for reclamation, habitat improvement or screening. No new actions will be undertaken that compromise wildlife or their use areas without prior approval by the appropriate management or regulatory agency.

10.6 STREAM BUFFER ZONES DETERMINATION

The permittee will set up buffer zones at the inlet and outlet of Cottonwood Creek to protect the aquatic environment (see Figure 10-3). The extent of the buffer zone will be from the culvert outlet downstream 50 feet with a width from the road on the east to 50 feet west of the stream. Above the culvert, the extent of the buffer zone will be from the culvert inlet to a point 50 feet above the disturbed area. The width will be from the road on the east to the disturbed area on the west. (This buffer zone proposal has been approved by DOGM).

Signs are posted indicating a buffer zone and indicate that the area should not be disturbed. A description of the signs is found in the operation section. (Chapter 3).

10.7 FISH AND WILDLIFE MONITORING

There are few species that will be significantly impacted by the proposed actions. There are no identified active aeries being occupied by high interest species of raptors, nor any readily accessible reproductive sites for game species that are critical to perpetuation of the species. However, should raptors, moose, or any threatened or endangered species subsequently move into or be found in the mine area, appropriate DOGM,UDWR, and USFWS personnel will be notified and mutually agreed upon monitoring instituted.

The mitigation action planned is such that it will require little to no monitoring, but enforcement by company officials and management or law enforcement personnel will be necessary. An exception might be the activities planned to reduce sediment loads in the stream. This action lends itself to before and after comparisons to determine the effectiveness. Additional macroinvertebrate studies have been concluded and are now discontinued. Water quality monitoring is an ongoing program for the life of the operation.

The permittee has made a commitment with the Utah Division of Wildlife Resources and with the United States Fish and Wildlife Services to jointly monitor occurrence of road killed mule deer in the

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mine area and access area to the mine site.

When a road kill is sighted by anyone associated with the Mine, that person is to notify the Company mine management of such an occurrence. Mine management will promptly notify UDWR and/or USFWS of occurrence and location. UDWR and USFWS have an on going program in this area of monitoring the road kill of mule deer. They map areas of road kill and if they arrive at the site before the carcass of the animal has spoiled, they will dress the animal out and preserve the meat and dispense of it to needy organizations.

Mitigation measures were also employed for the loss of approximately 0.21 acres of riparian habitat due to the upstream culvert extension in 1990. This consisted of the installation of 20 rock check dams in the lower portion of Cottonwood Creek to enhance water retention and possible fish survival. See Appendix 7-13 for details on this mitigation.

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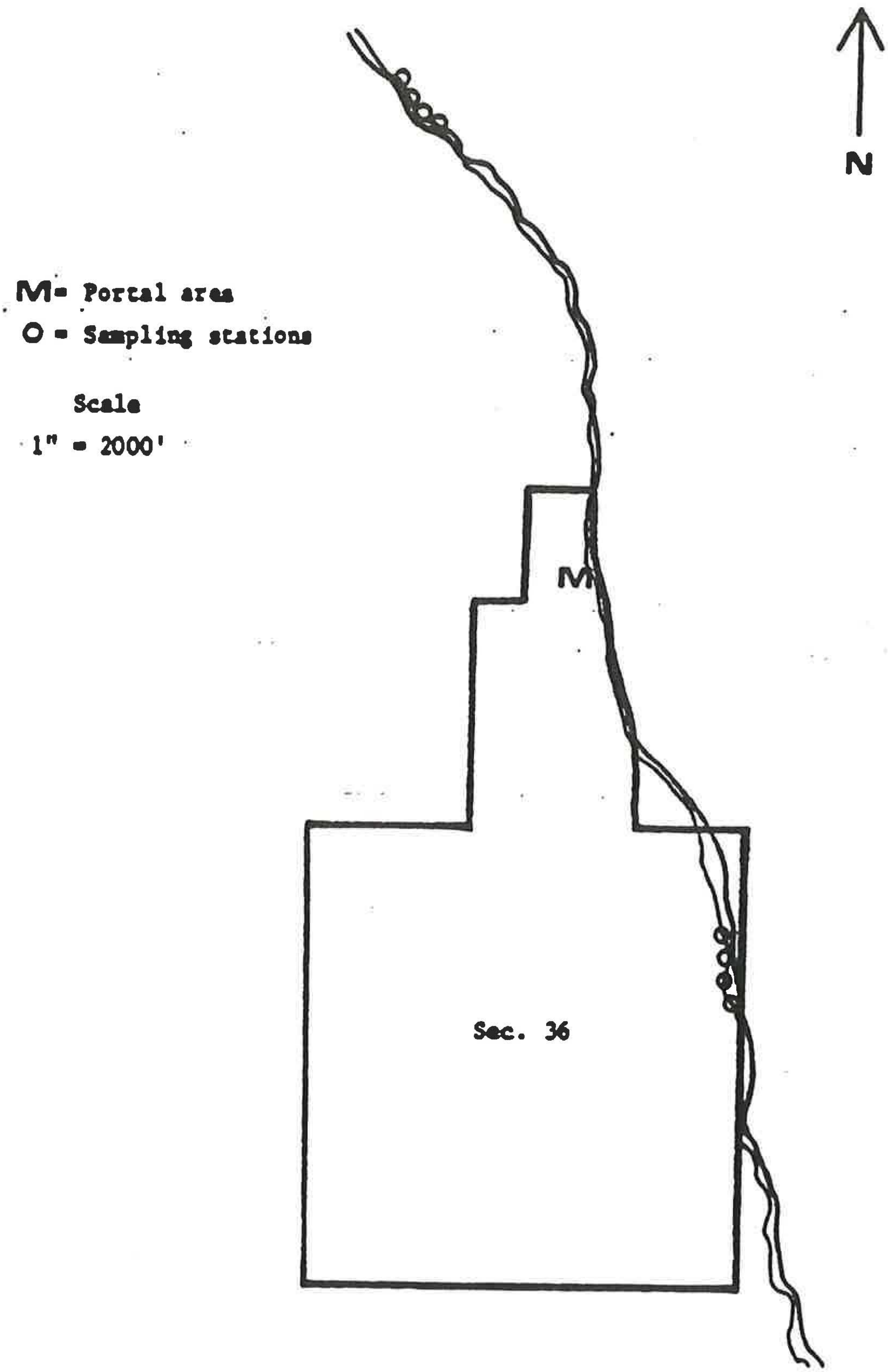

Figure 10-1. Macroinvertebrate Sampling Stations in Relation to Trail Mountain Mine Portal and Loading Facilities (T17S, R6E).

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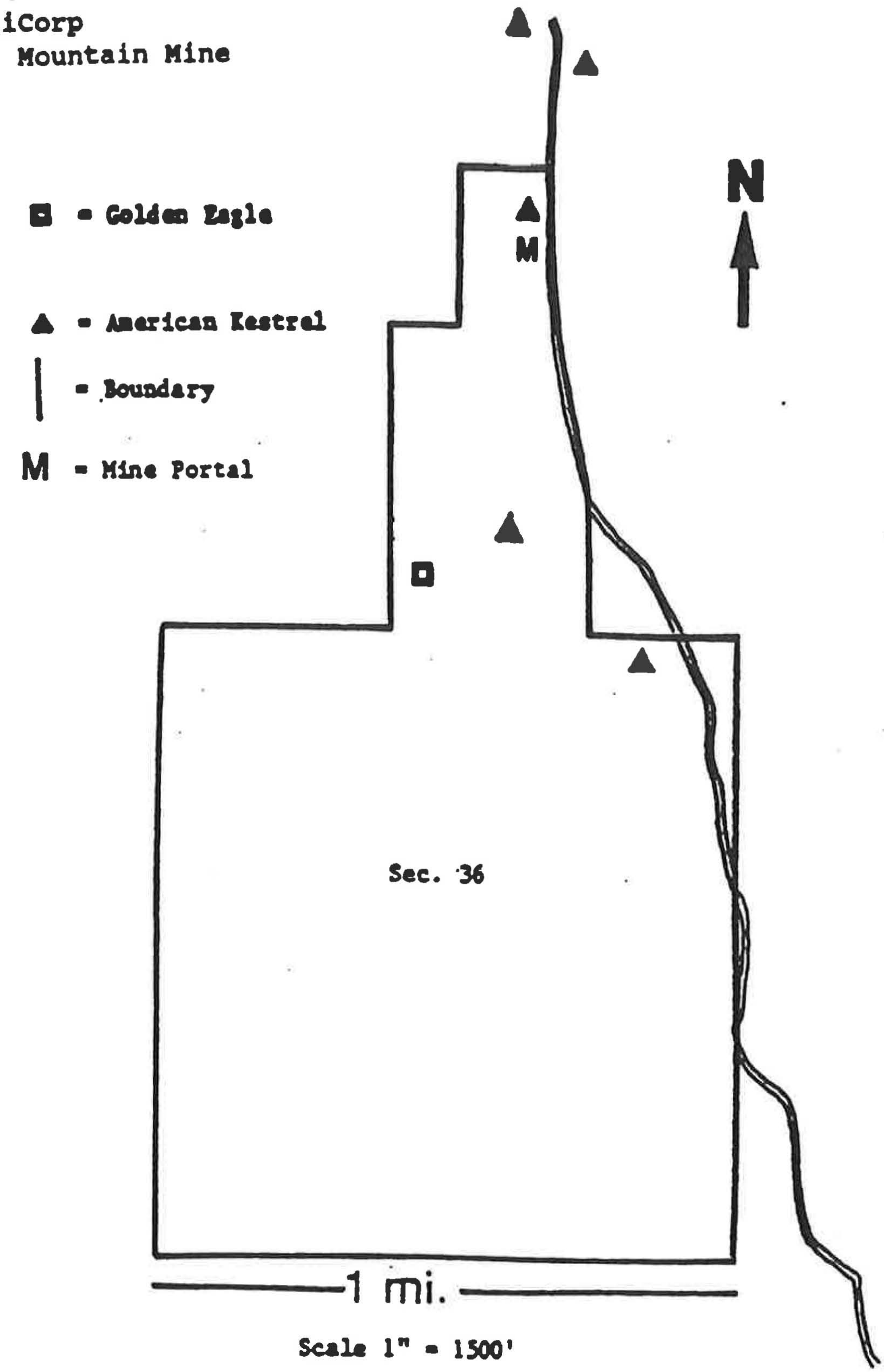

Figure 10-2. Raptor Sightings on Trail Mountain Mine Property and Adjacent Areas (T.17S, R.6E).

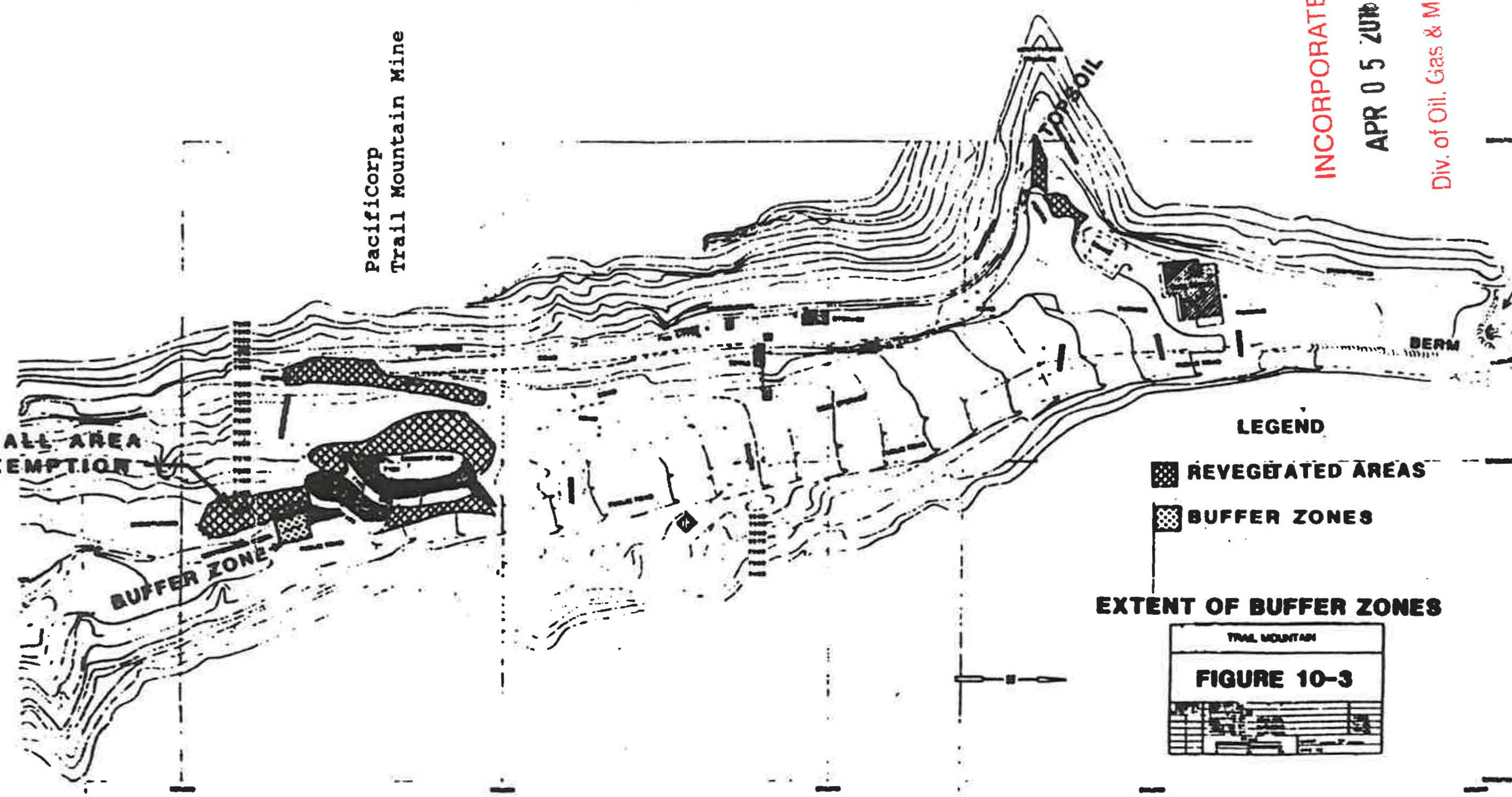

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FIGURE 10-3

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Table 10-1. List of Macroinvertebrates found in Cottonwood Creek above Trail Mountain Mine Site.

A = Abundant - greater than $100/m^2$
C = Common - between 99 and $10/m^2$
U = Uncommon - less than $10/m^2$

	Relative Abundance	Indicator good stream condition
Class Turbellaria		
Order Tricladida	A	
Class Crustacea		
Order Ostracoda	U	
Class Insecta		
Order Ephemeroptera		
Family Baetidae		
Baetis	A	
Family Heptageniidae		
Cinygmula	C	X
Family Ephemerellidae		
Cphemerella grandis	C	X
Order Plecoptera		
Family Nemouridae		
Ampinemura	C	X
Famliy Perlodidae		
Isoperla	C	X
Order Trichoptera		
Family Hydropsychidae		
Hydropsyche	A	
Family Limnephilidae		
Hesperophylax	C	
Family Brachycentrus		
Brachycentrus	A	X
Order Coleoptera		
Famliy Elmidae	U	
Order Diptera		
Family Tipulidae		
Antocha monticola	C	
Dicranota	U	
Holorusia grandis	C	
Eriocera	U	
Family Psychodidae		
Pericoma	U	
Family Chironomidae	U	
Family Empididae		
Hemerodromia	U	

Table 10-2. List of Macroinvertebrates Found in Cottonwood Creek below Trail Mountain Mine Site.

A = Abundant - greater than $100/m^2$
C = Common - between 99 and $10/m^2$
U = Uncommon - less than $10/m^2$

	Relative Abundance	Indicator of good stream conditions
Class Oligochaeta	U	
Class Arachnida		
Order Hydracarina	C	
Class Insecta		
Order Ephemeroptera		
Family Baetidae		
Baetis	A	
Family Heptageniidae		
Cinygmula	U	X
Order Plecoptera		
Family Perlodidae		
Isogenoides ziinensis	U	
Isoperla	U	X
Order Trichoptera		
Family Hydropsychidae		
Hydropsyche	U	
Order Coleoptera		
Family Dytiscidae	U	
Family Elmidae	U	
Order Diptera		
Family Simuliidae	U	
Family Chironomidae	U	

10.3.2.3 Mammals
(See Table 10-3)

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Trail Mountain Mine

Table 10-3 Species List and Classification of Mammals whose Published Ranges Overlap the Area Studied for Trail Mountain Mine.

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
Masked Shrew *Sorex cinereus*					UR		
Mirriam Shrew *Sorex mirriami*	UR	UR	UR		UR		
Dusky Shrew *Sorex obscurus*					UR		
Little Brown Myotis *Myotis lucifugus*	CS	US	CS		CS		
Fringed Myotis *Myotis thysanodes*	US	US					
California Myotis *Myotis californicus*	US	US	US				
Small-footed Myotis *Myotis leibii*		US	US		US		
Silver-haired Bat *Lasionycteris noctivagans*					US		
Big Brown Bat *Eptesicus fuscus*					US		
Hoary Bat *Lasiurus cinereus*					US		
Townsend's Big-eared Bat *Plecotus townsendii*	US	US			US		
Brasilian Free-tailed Bat *Tadarida brasiliensis*	US	US	US		US		

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Table 10-3
(cont.)

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
Nuttall's Cottontail <u>Sylvilagus</u> <u>nuttallii</u>	UR		UR		UR		X
Desert Cottontail <u>Sylvilagus</u> <u>audubonii</u>	UR						X
Snowshoe Hare <u>Lepus</u> <u>americanus</u>		CR		CR			X
White-tailed Jackrabbit <u>Lepus</u> <u>townsendii</u>		UR	UR		UR		X
Black-tailed Jackrabbit <u>Lepus</u> <u>californicus</u>	CR						X
Least Chipmunk <u>Eutamias</u> <u>minimus</u>	AR	UR		CR	CR	X	
Cliff Chipmunk <u>Eutamias</u> <u>dorsalis</u>			CR			X	
Uinta Chipmunk <u>Eutamias</u> <u>umbrinus</u>	CR	CR			CR	X	
Yellow-bellied Marmot <u>Marmota</u> <u>flaviventris</u>		CR	CR		CR	X	
White-tailed Antelope Squirrel <u>Ammospermophilus</u> <u>leucurus</u>		CR				X	
Uinta Ground Squirrel <u>Spermophilus</u> <u>armatus</u>		AR			AR	X	
Golden-manteled Ground Squirrel <u>Spermophidus</u> <u>lateralis</u>		UR			UR	X	
Rock Squirrel <u>Spermophilus</u> <u>variegatus</u>					CR	X	
Red Squirrel <u>Tamiasciurus</u> <u>hudsonicus</u>				CR		X	
Northern Flying Squirrel <u>Glaucomys</u> <u>sabrinus</u>		UR			CR		
Northern Pocket Gopher <u>Thomomys</u> <u>talpodes</u>		CR				X	

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Table 10-3
(cont.)

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed on Site	High-Interest Species
Great Basin Pocket Mouse *Perognathus parvus*	UR				UR	X	
Western Harvest Mouse *Raithrodontomys megalotis*	UR	UR			UR	X	
Deer Mouse *Peromyscus maniculatus*	AR	AR	AR	AR	AR	X	
Pinyon Mouse *Peromyscus truei*	CR					X	
Desert Woodrat *Neotoma lepida*	CR						
Bushy-tailed Woodrat *Neotoma cinerea*			CR		CR		
Montane Vole *Microtus montanus*				CR	CR		
Porcupine *Erethizon dorsatum*	CR			CR	CR	X	
Coyote *Canis latrans*	CR	CR	CR	CR	CR		X
Red Fox *Vulpes fulva*	CaR				CaR		X
Gray Fox *Urocyon cinereoargenteus*			UR		UR		X
Black Bear *Ursus americanus*				CaR	CR		X
Ringtail *Bassariscus astutus*	UR		UR		UR		
Raccoon *Procyon lotor*	Ca				Ca		
Marten *Martes americana*				CaR			X

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Table 10-3
(cont.)

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
Ermine _Mustela erminea_		UR		UR			
Long-tailed Weasel _Mustela frenata_	CR	CR	CR	CR	CR		X
Badger _Taxidea taxus_	CR	CR		CR	CR	X	X
Striped Skunk _Mephitis mephitis_	CR	CR	CR	CR	CR	X	X
Mountain Lion _Felis concolor_	UR	UR	UR	UR	UR		X
Bobcat _Lynx rufus_	CR	CR	CR	CR	CR		X
Wapiti or Elk _Cervus elaphus_					CW	X	X
Mule Deer _Odocoileus hemionus_	CR	CR	CR	CR	CR	X	X
Moose _Alces alces_		CaR		CaR			X

10.3.2.4 Birds

(See Table 10-4)

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Table 10-4. Species List and Classification of Birds whose Published Ranges Overlap the Area Studied for Trail Mountain Mine.

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
Turkey Vulture *Cathartes aura*		US	US				X
Goshawk *Accipiter gentilis*		CR		CR		X	X
Sharp-shinned Hawk *Accipiter striatus*		US		US			X
Cooper's Hawk *Accipiter cooperii*		US		US			X
Red-tailed Hawk *Buteo jamaicens*		CR					X
Swainson's Hawk *Buteo swainsoni*		US					X
Rough-legged Hawk *Buteo lagopus*		UW					X
Golden Eagle *Aquila chrysaetos*		CR	CR	CR	CR	X	X
Bald Eagle *Haliaeetus leucocephalus*	UW						
Prairie Falcon *Falco mexicanus*	UR	UR					X
Peregrine Falcon *Falco peregrinus*		CaR					
Merlin *Falco columbarius*	CaW						X
American Kestrel *Falco sparverius*	CS	CS	CS		CS	X	X
Ferruginous Hawk							

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Table 10-4

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
Blue Grouse Dendragapus obscurus		UR		CR	UR		X
Ruffed Grouse Bonasa umbellus		CR		CR	CR		X
Chukar Alectoris chuckar	UR						X
Band-tailed pegeon Columba fasciata		CaS			CaS		
Mourning Dove Zenaidura macroura	CS	CS			CS	X	X
Yellow-billed Cuckoo Coccyzus americanus					CaS		
Screech Owl Otus asio					UR		X
Flammulated Owl Otus flammeolus		UR		UR			X
Great Horned Owl Bubo virginianus	CR	CR	CR	UR	CR		X
Pygmy Owl Glaucidium gnoma		UR	UR		UR		X
Spotted Owl Strix occidentalis					UR		X
Long-eared Owl Asio otus					CR		X
Short-eared Owl Asio flammeus		CR					X
Saw-whet Owl Aegolius acadicus		UR		UR	UR		X
Poor-will Phalaenoptilus nuttallii					CS		

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Table 10-4

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
Common Nighthawk Chordeiles minor	CS	CR			CS		
Black Swift Cypseloides niger			CaS				
White-throated Swift Aeronautes saxatalis			US				
Black-chinned Hummingbird Archilochus alexandri		US			US		
Broadtailed Hummingbird Selasphorus platycercus	CS	CS		CS	CS	X	
Rufous Hummingbird Selasphorus rufus		CS		CS	CS		
Calliope Hummingbird Stellula callipe		CaS		CaS	CaS		
Belted Kingfisher Megaceryle alcyon	CaS						
Common Flicker Colaptes cafer		CR		CR	CR	X	
Levis' Woodpecker Asyndesmus lewis					CaS		
Yellow-bellied Sapsucker Sphyrapicus varius		CR		CR	UR		
Williamson's Sapsucker Sphyrapicus thyroideus				CaS			
Hairy Woodpecker Dendrocopos villosus		CR		CR	CR	X	
Downy Woodpecker Denrocopos pubescens					CR	X	
Northern Three-toed Woodpecker Picoides tridactylus				CaR			

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Trail Mountain Mine
Table 10-4

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
Eastern Kingbird *Tyrannus tyrannus*					CS		
Western Kingbird *Tyrannus verticalis*		US			CS		
Willow (Traill's) Flycatcher *Empidonax traillii*					CS		
Hammonds Flycatcher *Empidonax hammondii*				US			
Dusky Flycatcher *Empidonax oberholseri*					CS		
Gray Flycatcher *Empidonax wrightii*	CaS						
Western Flycathcer *Empidonax difficilis*		CS		CS	CS		
Western Wood Pewee *Contopus sordidulus*		CS		CS	CS		
Olive-sided Flycatcher *Nuttallornis borealis*		US		US	US		
Violet-green Swallow *Tachycineta thalassina*	US					X	
Tree Swallow *Iridoprocne bicolor*	US					X	
Barn Swallow *Hirundo rustica*			CS				
Cliff Swallow *Petrochelidon pyrrhonota*			CS				
Purple Martin *Progne subis*		US		US			
Gray Jay *Perisoreus canadenis*				CS		X	

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Table 10-4

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
Steller's Jay *Cyanocitta stelleri*	CR	CR		CR		X	
Scrub Jay *Aphelocoma coerulescens*					CR	X	
Black-billed Magpie *Pica pica*	CR	CR		CR	CR	X	
Common Raven *Corvus corax*	CR					X	
Pinon Jay *Gymnorhinus cyanocephala*	CR				CR	X	
Clark's Nutcracker *Nucifraga columbiana*				CR		X	
Black-capped Chickadee *Parus atricapillus*	CR	CR		CR	CR	X	
Mountain Chickadee *Parus gambelii*				CS	CS	X	
Plain Titmouse *Parus inornatus*	UR				UR		
Common Bushtit *Psaltriparus minimus*	UR	UR			UR		
White-breasted Nuthatch *Sitta carolinensis*	UR	CR	UR	CR			
Red-breasted Nuthatch *Sitta canadensis*			CR				
Brown Creeper *Certhia familiaris*	CW	CS		CS	CS		
House Wren *Troglodytes aedon*		CS			CS		
Rock Wren *Salpinctes obsoletus*			CR				

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Table 10-4

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
Catbird Dumetella carolinensis					CS	X	
Sage Thrasher Oreoscoptes montanus					CS		
Robin Turdus migratorius	CR	CS		CR	CS	X	
Hermit Thrush Hylocichla guttata		CS			CS		
Swainson's Thrush Hylochichla ustulata		CS		US	CS		
Veery Hylocichla fuscescens					US	X	
Mountain Bluebird Sialia currucoides	CS				CS	X	
Townsend's Solitaire Myadestes townsendi					CS		
Blue-gray Gnatcatcher Polioptila caerulea	CS	CS		US	CS		
Golden-crowned Kinglet Regulus satrapa	UW			US	UW		
Ruby-crowned Kinglet Regulus calendula				US	UW		
Northern Shrike Lanius excubitor	UW				UW		
Loggerhead Shrike Lanius ludovicianus	CS					X	
Starling Sturnus vulgaris	CR				CR	X	
Solitary Vireo Vireo solitarius	US	US			US		

Table 10-4

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
Warbling Vireo *Vireo gilvus*		CS			CS	X	
Orange-crowned Warbler *Vermivora celata*		CS			CS		
Virginia's Warbler *Vermivora virginiae*	US				CS		
Yellow Warbler *Dendroica petechia*		CS			CS	X	
Audubon's Warbler *Dendroica auduboni*					CS	X	
Black-throated Gray Warbler *Dendroica nigrescens*	CS	CS			CS		
Mac Gillivray's Warbler *Oporornis tolmiei*					CR		
Yellowthroat Warbler *Geothlypis trichas*					US		
Yellow-breasted Chat *Icteria Virens*					CS	X	
Wilson's Warbler *Wilsonia pusilla*				CS	CS		
American Redstart *Setophaga ruticilla*		CaS			CaS		
Western Medowlark *Sturnella neglecta*	CR					X	
Bullock's Oriole *Icterus bullockii*					US		
Western Tanager *Piranga ludoviciana*		CS		CS			
Black-headed Grosbeak *Pheucticus melanocephalus*	CS	CS		CS	CS		

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Table 10-4

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
Lazuli Bunting *Passerina amoena*					CS		
Evening Grosbeak *Hesperiphona vespertina*					US		
Cassin's Finch *Carpodacus cassinii*	US	US		US			
House Finch *Carpodacus mexicanus*					US		
Pine Grosbeak *Pinicola enucleator*		US		US			
Black Rosey Finch *Leucosticte atrata*	UW						
Pine Siskin *Spinus pinus*		CS		CS			
American Goldfinch *Spinus tristis*					CS		
Lesser Goldfinch *Spinus psaltria*					US		
Red Crossbill *Loxia curvirostra*				US			
Green-tailed Towhee *Chlorura chlorura*	US				CS	X	
Rufous-sided Towhee *Pipilo erythrophthalmus*					US		
Junco *Junco hyemalis*	UW	CS		CS		X	
Tree Sparrow *Spizella arborea*					UW		
Chipping Sparrow *Spizella passerina*		CS		CS	CS	X	

Table 10-4

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed On Site	High-Interest Species
White-crowned Sparrow *Zonotrichia leucophrys*		CS		CS			
Fox Sparrow *Passerella iliaca*					US		
Song Sparrow *Melospiza melodia*					US		

10.3.2.5 Reptiles and Amphibians
(See Table 10-5)

Table 10-5. Species List and Classification of Reptiles and Amphibians whose Published Ranges Overlap the Area Studied for Trail Mountain Mine.

A = Abundant
C = Common
U = Uncommon
Ca = Casual or Rare
R = Permanent Resident
S = Summer Only
W = Winter Only

	Pinyon-Juniper	Grass-Aspen	Cliff	Mixed Conifer	Mixed Mt. Shrub	Observed on Site	High-Interest Species
Fence Lizard Sceloporus undulatus	US				US	X	
Sagebrush Lizard Sceloporus graciosus	CS		CS		CS	X	
Mountain Short-haired Lizard Phrynosoma douglassi	CS	CS	CS		CS		
Rocky Mountain Rubber Boa Charina bottae					US		
Wandering Garter Snake Thamnophis elegans	CS	US			CS	X	
Western or Yellow-bellied Racer Coluber constrictor	US				US		
Striped Whipsnake Masticophis taeniatus	US				US		
Gopher Snake Pituophis melanoleucus	CS				CS		
Milk Snake Lampropeltis triangulum	US				US		
Utah Mountain Kingsnake Lampropeltis pyromelana	US				US		
Night Snake Hypsiglena torquata					US		
Midget Faded Rattlesnake Crotalus viridus	CS	US			US		
Western Spadefoot Toad Scaphiopus hammondi		US			US		
Woodhouse's Toad Bufo woodhousei		US			US		

10.3.3 Species of Special Significance

(See Table 10-6)

Table 10-6. Game Animals in the Environs of Trail Mountain Mine. Emery County, Utah

Nuttall's Cottontail
Sylvilagus nuttallii

Desert Cottontail
Sylvilagus audubonii

Snowshow Hare
Lepus americanus

Black Bear
Ursus americanus

Mountain Lion
Felis concolor

Bobcat
Lynx rufus

Mule Deer
Odocoileus hemionus

Moose
Alces alces

Wapiti or Rocky Mountain Elk
Cervus elaphus

Bandtail Pigeon
Columba fasciata

Mourning Dove
Zenaidura macroura

Blue Grouse
Dendragapus obscurus

Ruffed Grouse
Bonasa umbellus

Chukar
Alectoris chukar

10.3.3.1 Threatened and Endangered Species
(See Table 10-7)

Table 10-7. Endangered Species of the Environ of Trail Mountain Mine, Emery County, Utah .

Bald Eagle
<u>Haliaeetus leucocephalus</u>

Peregrine Falcon
<u>Falco peregrinus</u>

10.3.3.2 Raptors
(See Table 10-8)

Table 10-8. Raptors of the Environs of Trail Mountain Mine, Emery County, Utah.

Turkey Vulture
Cathartes aura

Goshawk
Accipiter gentilis

Sharp-shinned Hawk
Accipiter striatus

Cooper's Hawk
Accipiter cooperii

Red-tailed Hawk
Buteo jamaicensis

Swainson's Hawk
Buteo swainsoni

Rough-legged Hawk
Buteo lagopus

Golden Eagle
Aquila chrysaetis

Bald Eagle
Haliaeetus leucocephalus

Prairie Falcon
Falco mexicanus

Peregrine Falcon
Falco peregrinus

Merlin
Falco columbarius

American Kestrel
Falco sparverius

Screech Owl
Otus asio

Flammulated Owl
Otus flammeolus

Great Horned Owl
Bubo virginianus

Ferruginous Hawk
Butes regolis

Table 10-8
(cont.)

Pygmy Owl
<u>Glaucidium gnoma</u>

Spotted Owl
<u>Strix occidentalis</u>

Long-eared Owl
<u>Asio otus</u>

Short-eared Owl
<u>Asio flammeus</u>

Saw-whet Owl
<u>Aegolius acadicus</u>

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Trail Mountain Mine

Table 10-9. Projected Impact of the Trail Mountain Mine and Associated Facilities on High Interest Species or Taxonomic Groups Using a Perturbation Rating Scale of 0 to 10 (low to high). (Scientific names of all species are listed in Tables 10-1 through 10-5).

	Perturbation Rating
Birds	
Turkey Vulture	0
Goshawk	0
Sharp-shinned Hawk	0
Cooper's Hawk	0
Red-tailed Hawk	0
Swainson's Hawk	0
Rough-legged Hawk	0
Golden Eagle	0
Bald Eagle	0
Prairie Falcon	0
Peregrine Falcon	0
Merlin	0
American Kestrel	1
Blue Grouse	0
Ruffed Grouse	0
Chukar	0
Mourning Dove	1
Screech Owl	0
Flammulated Owl	0
Great Horned Owl	0
Pygmy Owl	0
Spotted Owl	0
Long-eared Owl	0
Short-eared Owl	0
Saw-whet Owl	0
Mammals	
Nuttall's Cottontail	1
Desert Cottontail	0
Snowshoe Hare	0
White-tailed Jackrabbit	0
Black-tailed Jackrabbit	0
Coyote	0
Red Fox	0
Gray Fox	0

Table 10-9
(cont)

	Perturbation Rating
Mammals	
Black Bear	0
Marten	0
Ermine	0
Long-tailed Weasel	0
Badger	0
Striped Skunk	0
Mountain Lion (Cougar)	1
Bobcat	1
Mule Deer	3
Moose	0
Wapiti or Rocky Mountain Elk	0
Fish	3
Macroinvertebrates	4

CHAPTER 11

GEOTECHNICAL/SUBSIDENCE

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GEOTECHNICAL/SUBSIDENCE

11.1 SUBSIDENCE CONTROL PLAN

This section describes in detail the Applicant's plan to ensure minimal environmental impacts from mine-induced subsidence. The following subsections describe the principal factors involved in controlling subsidence impacts resultant from mining.

11.2 SUBSIDENCE DAMAGE PROBABILITY SURVEY

A survey has been conducted on that portion of the surface which could possibly be affected by the mining of coal from the mining activities. It has been determined that there are renewable resources present in the area in the form of springs, water seeps, grazing land, timber, and wildlife. The water seeps and springs are limited and are an important resource for grazing and wildlife. Most of the streams within the permit area are ephemeral and or intermittent. The streams are fed by spring that emanate primarily in the North Horn formation. Some of the springs feed water troughs maintained for livestock and wildlife. The occurrence of the springs is discussed in the hydrology section and no further discussion will take place here; however, data collected suggest that the springs on the surface will not be affected by the subsidence.

No cabins or man made structures are present within the permit area with the exception of the buildings constructed in support of the mining operation. Subsidence won't occur in the area of these buildings. In lieu of renewable insurance covering damage to existing structures, the applicant, as an alternative, proposes to restore these resources to their pre-subsidence usefulness as mining continues. Since there are no structures or facilities that could be affected by subsidence, except for trails, there is no need for renewable insurance.

There are no oil, gas or water wells located within the permit area, nor are there any gas or oil pipelines or power transmission lines other than the one in Cottonwood Canyon which supplies power to the mine. Subsidence will not impact this power line.

11.3 MINING METHOD

The applicant intends to minimize surface effects of subsidence by adopting the longwall method of mining and mining the coal deposit as completely as possible. The longwall mining method allows almost total extraction of the coal and induces caving of the immediate and upper roof strata. PacifiCorp has established a comprehensive subsidence monitoring program of the areas undermined in the Deer Creek, Des-Bee-Dove and Cottonwood Mines located to the east. Data collected from this program allows predictions to be made as to the amount of subsidence that will be expected when the coal is mined. The subsidence prediction methods developed in that program are also applicable to the Mine permit area because the geologic conditions are virtually identical.

11.4 SUBSIDENCE PREDICTION

Subsidence data collected on East Mountain indicate that the most important factors that influence subsidence listed in order of their importance is; 1) width of the area undermined; 2) total thickness of coal extracted; and 3) the overburden thickness. Areas where only one longwall panel (<600 feet in width) has been extracted have shown little or no subsidence. Whereas areas where two adjacent longwall panels (total width >1,500 feet) have been mined subsidence is about 70 to 80% of the seam extraction height. The British National Coal Board (NCB) developed a method for predicting subsidence that has been widely accepted in the United States. This method utilizes graphs compiled from numerous field observations and takes into consideration the length and width of the mined-out area, thickness of coal extracted, and depth of cover. The method is claimed to be correct to +10% in the majority of cases, assuming certain limiting conditions are met. The amount of total subsidence experienced on East Mountain averages about 83% of the total subsidence predicted by the NCB model.

The angle of draw, which defines the limit between underground excavations and surface effects of subsidence, determines the amount of barrier that must be left around the mine to protect surface features. A recent study over coal mines in Utah and Colorado, undertaken by the USGS, indicates draw angles of 20° in mines with weak to moderately strong overburden 650 to 900 feet thick. This angle tends to steepen to 15° at depths of 900 to 1,000 feet in the Somerset area of Colorado. Data collected by PacifiCorp on East Mountain show draw angles to be steeper, ranging from 3° to 15°. Additional data has been collected regarding East Mountain subsidence using Time Domain Reflectometry technology (TDR). This method shows that subsidence reaches the surface almost immediately after mining. This method documents how rapidly caving propagates up the strata by cementing a coaxial cable in a bore hole extending from the surface of the ground down to mine level above a longwall panel. As mining progresses toward and underneath the bore hole, the cable is electronically interrogated which provides data showing the depth at which stress is present and where shearing of the cable propagates up the cable after mining. The data collected on East Mountain in this way showed no change in the cable prior to undermining by the longwall panel but immediately after mining passed below the cable shearing had begun to occur just above the mine level. Shearing propagated to the surface within six days of being undermined.

The subsidence data collected on East Mountain shows that about 90% of total subsidence occurs within the first year after being undermined. The areas that are undermined generally show no additional subsidence after the second year following the completion of mining.

On Trail Mountain the subsidence that is to be experienced will be between 60% and 90% of the mining height. Most of the subsidence will occur without any visible evidence on the surface. This is because most of the area on Trail Mountain has the North Horn Formation exposed on the surface and this formation contains an abundance of clay minerals that yield to subsidence with plastic deformation and not fracturing. In rare occasions, tension fractures may develop on the surface along the sides or ends of a group of longwall panels. When undermining areas where the Castlegate sandstone is exposed on the surface, subsidence fractures at the surface will be common. This is because the Castlegate sandstone yields to subsidence through brittle deformation rather than plastic deformation.

11.5 SUBSIDENCE CONTROL

The applicant will conduct the underground mining operations so as to prevent subsidence from causing material damage to the surface and to maintain the value and reasonable foreseeable use of that surface in accordance with the subsidence control plan.

The applicant intends to control subsidence by mining as near complete and uniform extraction as possible. The use of longwall mining provides the most uniform and complete coal extraction possible. This minimizes the potential of tension fractures reaching the surface. Coal pillars in the longwall gate roadways will be sized to collapse after the longwall has mined beyond them. This will help form a uniform subsidence on the surface and minimize the impacts of subsidence.

The applicant shall leave a barrier of sufficient size to keep subsidence from occurring outside of the permit boundary taking into account the draw angle.

11.6 PUBLIC NOTICE

Any surface owners that may be affected by subsidence will receive a mining schedule which will detail the area in which mining is to take place and the planned date of that activity. This schedule will be included (pre-2015) with the annual subsidence monitoring report for completeness.

11.7 SUBSIDENCE MONITORING PLAN

The applicant initially adopted a twofold approach to subsidence monitoring on East Mountain to the east of the permit area.

1.) aerial photogrammetry
2.) on-the-ground monumentation

After seven years of comparing the two types of surveys, it was determined that both effectively document the amount of subsidence which has occurred; however, the aerial photogrammetry method has the advantage of showing more detail because more data points can be monitored with less effort. Therefore, in 1987, with the concurrence of the Division, the applicant discontinued on-the-ground monumentation and now collects subsidence data solely by aerial photogrammetry. Subsidence within the permit area will be monitored photogrammetrically along with that on East

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The subsidence monitoring program on East Mountain, conducted since 1980, has produced data which not only documents the amount of subsidence that has occurred but also allows the applicant to predict the amount of subsidence that is likely to occur when mining in new areas.

11.8 AERIAL PHOTOGRAMMETRY

The applicant will maintain survey control aerial targets within the permit boundary necessary to allow the interpretation of coordinates on photos within ±1 foot. Following this procedure, the applicant shall conduct annually, an aerial photo survey of all areas which have been undermined. Elevations of control points within the photos will be determined by photogrammetric means to an accuracy of ±1 foot and compared to corresponding elevations derived from the baseline survey conducted in August 1993. The applicant shall continue monitoring all areas undermined until it is mutually agreed by the applicant and the Division that the subsidence in a given area has become stable and no further monitoring is necessary. The findings of the survey shall be reported to the Division annually in a summary report. The prior owner of the Trail Mountain Mine (ARCO Coal) established a subsidence monitoring program that included on the ground conventional surveying. None of the subsidence stations established had more than one foot of subsidence occur. These data will; however, be factored into the future subsidence interpretations.

11.9 MITIGATION OF SUBSIDENCE DAMAGE

Should significant subsidence impacts occur, the applicant will restore to the extent technologically and economically feasible those surface lands that were reduced in reasonably foreseeable use as a result of such subsidence to a condition capable of supporting reasonably foreseeable uses that such lands were capable of supporting prior to subsidence.

Any roads, fences, stock ponds, earth dams, or water troughs which are materially damaged by subsidence will be repaired and regraded to restore them to their pre-subsidence usefulness.

In order to restore any land affected by the applicant's mining operations to a condition capable of supporting the current and post mining land uses stated herein, the applicant will replace water determined to have been lost or adversely affected as a result of the applicant's mining operations if such loss or adverse impact occurs prior to final bond release. The water will be replaced; from an alternate source in sufficient quantity and quality to maintain the current and post mining land uses as stated herein.

During the course of regular monitoring activities required by the permit, or as the applicant otherwise acquires knowledge, the applicant will advise the Division of the loss or adverse occurrence discussed above, within ten working days of having determined that it has occurred. Within ten working days after the Division notifies the Applicant in writing, that it has determined that the water loss is the result of the Applicant's mining operation, the Applicant will meet with the Division to determine if a plan for replacement is necessary and, if so, establish a schedule for submittal of a plan to replace the affected water. Upon acceptance of the plan by the division the plan shall be implemented. The applicant reserves the right to appeal the Division's water loss determinations as well as the proposed plan and schedule for water replacement as provided by Utah Code Annotated 40-10-22(3)(a).

It is important to point out that the subsidence that has occurred on East Mountain or Trail Mountain has had no impact on the surface or groundwater present. This is due in part to the fact that the clay-rich strata in the North Horn formation form an effective aquiclude even when fractured. If fractures do form in this rock, the clays swell significantly when they become wet and seal off the fracture to groundwater movement. Although it is possible that subsidence could affect the ground water or surface water, prior experience suggests that it is unlikely.