R645-301-100 GENERAL INFORMATION

The legal and financial information for the Mill Fork State Lease and Federal Lease UTU-84285 can be reviewed in PacifiCorp's Legal and Financial. PacifiCorp's Legal and Financial Volume contains a complete listing of all licenses, permits, approvals and leases for the Deer Creek Mine.

Surface ownership and subsurface ownership maps of the Deer Creek Mine permit area (includes the Mill Fork State Lease and Federal Lease UTU-84285) are found in Volume 4. Surface and subsurface ownership maps exclusive to the Mill Fork permit area are found in this section.

MAPS

MFS1838D	**Deer Creek Mine: Mill Fork State Lease ML-48258/UTU-84285 Surface Ownership Map**
MFU1837D	**Deer Creek Mine: Mill Fork State Lease ML-48258/UTU-84285 Coal Ownership**

INTRODUCTION

The Mill Fork State Lease ML-48258 and adjacent Federal Lease UTU-84285 lie within the Huntington Canyon-Gentry Mountain and the Ferron Canyon, Cottonwood-Trail Mountain Multiple-Use Evaluation Areas as described in the Manti-La Sal National Forest Land and Resource Management Plan (Forest Plan). The Forest Plan Environmental Impact Statement (EIS) and record of Decision makes these areas available for consideration for coal leasing.

COAL LEASING PROCESS

The first step in the leasing evaluation process was to delineate a tract. Tract delineation was completed by the BLM on October 2, 1996. Named the Mill Fork Tract, the area encompassed approximately six thousand four hundred forty (6,440) acres.

A no action alternative and three action alternatives were developed during the Environmental Assessment process to provide a full range of reasonable alternatives that sharply define the significant issues.

A. Alternative 1 - No Action

Forest Service would not consent to, and the BLM would not approve leasing.

B. Alternative 2 - Offer for lease with standard BLM Lease Terms, Conditions and Stipulations

Forest Service would consent to, and the BLM would approve, offering six thousand four hundred forty (6,440) acres, as delineated for competitive leasing. The lease would only have the standard BLM terms, conditions and stipulations that are included on the BLM coal form.

C. Alternative 3 - Offer for lease with application of Special Coal Leasing Stipulations for Protection of Non-Coal Resources

Forest Service would consent to, and the BLM would approve, offering six thousand four hundred forty (6,440) acres, as delineated for competitive leasing. The lease would have the standard BLM terms, conditions and stipulations that are included on the BLM coal form along with eighteen (18) Special Coal Lease Stipulations from Appendix B of the Forest Plan and two (2) additional tract specific stipulations.

D. Alternative 4 - Offer a modified tract for lease with application of Special Coal Lease Stipulations for Protection of Non-Coal Resources

In addition to those activities addressed in Alternative 3, Alternative 4 specifically focuses on concerns identified as water issues. The portion of the lease tract east of the northeast quarter of Section 7 is removed from the leasing offering, to protect the water quality and quantity of Little Bear watershed and spring, reducing the overall tract by eight hundred eighty (880) acres.

Based on the USFS Record of Decision, the BLM offered for lease the Mill Fork Tract excluding the eight hundred eighty (880) acres (total tract approximately five thousand six hundred sixty three [5,663] acres, refer to Figure 1). The modified lease excluded the northeastern portion of the lease tract which encompasses the Little Bear Canyon watershed (designated as a Municipal Water Supply [MWS]). Exclusion of the eight hundred eighty (880) acres was intended to protect the Little Bear MWS and minimize potential disruptions or degradation to surface and groundwater resources.

On June 6, 2000, Genwal Resources Inc. re-applied for the eight hundred eighty (880) acres which were excluded during the 1997 Environmental Assessment for the Mill Fork Tract. Bureau of Land Management (BLM) and United States Forest Service (USFS) evaluated the Lease-By-Application (BLM assigned Federal Coal Lease serial number UTU-78953) referred to as the South Crandall Canyon Tract and issued the FONSI on February 18, 2003. Genwal Resources acquired the South Crandall coal lease on June 12, 2003.

MILL FORK STATE LEASE ML-48258 ACQUISITION

PacifiCorp successfully acquired the Mill Fork Lease and entered COAL MINING LEASE AND AGREEMENT with the State of Utah on April 1, 1999. The coal tract as described in the lease contains approximately 5,562.82 acres, more or less. With the leasing of the Mill Fork Tract in 1999, PacifiCorp controls through ownership and leasing certain fee coal lands together with assigned federal coal leases nearly 30,000 acres of contiguous minable property located in Emery County, Utah.

MILL FORK WEST EXTENSION TRACT LBA/UTU-84285

On January 25 (revised March 20), 2006, PacifiCorp filed an application for a federal coal lease by application (LBA) for access to unleased federal coal adjacent to the Mill Fork State Lease. The serial number assigned to this LBA is UTU-84285.

Leasing of the Mill Fork West Extension Tract would encourage and enable the greatest ultimate recovery and conservation of this natural resource, while promoting full development of the economically recoverable coal located between the western lease line of the Mill Fork State Lease ML-84258 and the Joes Valley Fault zone which would otherwise become subject to bypass. This would be accomplished by allowing westward mine development and extraction beyond the existing Mill Fork western lease boundary until mining advancement is terminated due to the actual location of the Joes Valley Fault. Mine development and extraction would include extending the current proposed gateroads, bleeders and setup entries, and longwall panels into the proposed lease tract in an attempt to maximize coal recovery where possible; provided geologic, engineering, safety, environmental and economic conditions are conducive and in the best interest of all entities considered.

DEER CREEK MINE AND RECLAMATION PLAN

On March 5, 2003 the Division of Oil, Gas & Mining approved the inclusion of the Mill Fork State Lease ML-48258 (5,562.8 acres) to the Deer Creek Mine permit.. As stated above, on January 25 (revised March 20), 2006, PacifiCorp filed an application for a federal coal lease by application, serial number UTU-84285 (213.57 acres), for access to unleased federal coal adjacent to the Mill Fork State Lease. Together, the Mill Fork State Lease (5,562.8 acres) and the Federal lease UTU-84285 (213.57 acres) increased the Deer Creek permit area by 5,776.37 acres. Because of the geographic location, the Mill Fork State Lease and adjacent Federal Lease

UTU-84285is referred to as the "Mill Fork Permit Area". This application addresses only proposed Mill Fork permit area, refer to the highlighted area shown on Figure 1.

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7th East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. Prior to any surface disturbance, Energy West will secure all necessary permits.

It is proposed to transport coal mined in the Hiawatha (lower) and Blind Canyon (upper) seams through the existing Deer Creek mine workings to the portal in Deer Creek Canyon. From this point, the coal will be transported to the Huntington Power Plant coal storage area via the existing overland beltline. All coal mined from the Mill Fork area will be utilized as fuel for the applicant's owned power plants.

PERMIT ORGANIZATION

The following sections of this mining application pertain to all applicable coal mine permit application requirements of the Utah R645-Coal Mining Rules (revised March 25, 2002). Applicable sections herein include:

Introduction

R645-301-100. General Information

R645-301-200. Soils

R645-301-300. Biology

R645-301-400. Land Use and Air Quality

R645-301-500. Engineering

R645-301-600. Geology

R645-301-700. Hydrology

R645-301-800. Bonding

R645-301-200 SOILS SECTION

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MAPS

R645-301-200. SOILS

R645-301-220. ENVIRONMENTAL DESCRIPTION

The soils in the permit area are developed primarily from sandstone and shale parent materials of the North Horn, Upper Price River, Castlegate, and Blackhawk formations. Along the highest parts of the ridge of East Mountain, a few spots have soils developed from the Flagstaff Limestone. The regolith consists of both residual and colluvial materials, yielding soils that range from shallow to very deep. Most soils are well drained with potentially rapid runoff due to the steepness of most of the slopes.

The range of elevations (from 8,100 to over 10,700 feet) and steep slopes with varying aspects are the cause of large soil temperature and moisture differences. The soils on lower elevation / south facing slopes are hot and dry, and those at higher elevations and north facing slopes are cool and moist. Soil temperature regimes include cryic (cold) and frigid and the soil moisture regimes are udic (moist) and ustic (semiarid). The aspen and spruce-fir vegetation types are characteristic of the cryic/udic environment and the lower elevation mountain brush with some pinion-juniper is characteristic of the frigid/ustic environment.

Soils on sandstones are typically cobbly or stony with textures of loamy sand, sandy loam, or loam. Rock outcrops are common, expecially in areas of the Castlegate Sandstone. These soils are most common along the east side of the permit area.

Most of the area at higher elevations have clayey soils derived from the North Horn Formation. Textures of clay loam, silty clay loam, and clay are common. The subsoils often have a higher clay content than those of the surface soils. They have higher water holding capacities and are prone to slope failures. These clayey soils typically have high self-healing capabilities, and tend to buffer the effects of tension cracks created in the soil zone that are occasionally formed by subsidence.

Topsoil development is most pronounced in areas with aspen vegetation types. It is commonly 10 to 20 inches thick in these areas, and has relatively high organic matter and nutrient contents. On the steep, north-facing slopes that support spruce-fir type forests, topsoil thicknesses may vary from three to ten inches.

Major soil limitations in the lease area include high soil erosion potentials, slope instability, cold temperatures and a short growing season, stoniness, and some droughty soils on the lower elevation /south facing slopes.

R645-301-221. PRIME FARMLAND INVESTIGATION

In the Environmental Assessment for the Mill Fork Lease Tract, LBA #11, prepared by the U.S.D.A. Forest Service (6/97), Chapter 1, Section G, states:

"There are no prime farmlands, rangelands, or alluvial valley floors within the proposed lease area. Leasing of the tract should not result in significant impacts to paleontological resources; threatened or endangered plant or animal species. Protection of these resources is provided under the lease stipulations and Federal and State laws and regulations."

Energy West has conducted numerous reconnaissance surveys of the Mill Fork permit area, consulted existing soils surveys and aerial photography, and concludes that there is no Prime Farmland or cropland within the permit area. This conclusion is based on the steep and rugged character of the terrain over the entire permit area. Historically, the permit area has been used only for cattle and sheep grazing.

R645-301-222. SOIL SURVEY

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7th East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. As these details become more definite, the applicable governmental agencies will be notified and the permitting process will be initiated. As part of this permitting process, a complete soil survey of each and every mining and reclamation operation within the Mill Fork area will be detailed in this section. However, the Mill Fork area has been mapped as part of a Soil Survey conducted by the Manti Division, Manti-LaSal National Forest.

R645-301-222.100. A Map Delineating Different Soils

Map MFS 1834B shows the areal distribution of the different soil types in the Mill Fork Permit area. Refer to the Map Section for review of these areas.(D. Larsen, in progress).

R645-301-222.300. Soil Description

The soil units shown on the map MFS 1834B are described below.

Map Unit Number	Soil Units	Percent (%)
8	***Greyback Family - Echard - Cryorthents Complex***	
	1. Greyback family soils	40

Map Unit Number	Soil Units	Percent (%)
	2. Echard family soils	20
	3. Cryorthents	20
	Inclusions:	
	1. Clayey soils with lower rock fragment content	20
20	***Strych - Pathead - Podo Families - Rubbleland Complex***	
	1. Strych family soils	30
	2. Pathead family soils	30
	3. Podo family soils	15
	4. Rubbleland	15
	Inclusions:	
	1. Rock outcrops	10
42	***Aquic Cryoborolls, Loamy - Skeletal, Mixed***	
	1. Aquic cryoborolls, loamy-skeletal, mixed, loam, 5 to 15% slopes	90
	Inclusions:	
	1. Typic Cryoborolls, loamy-skeletal, mixed, loam, 5 to 15% slopes	08
	2. Aquic Cryorthents, loamy-skeletal, mixed, loam, 30 to 30% slopes	02
81	***Bundo - Lucky Star - Scout Families Complex***	
	1. Typic Paleboralfs, loamy-skeletal, mixed, fine sandy loam, 40 to 70% slopes	70
	2. Boralfic Cryoborolls, loamy-shkeetal, mixed, loam, 30 to 60% slopes	20
	Inclusions:	
	1. Pachic Cryoborolls, fine-loamy, mixed, loam, 30 to 60% slopes	10
100	***Gralic - Behanin - Elwood Families Complex***	

Map Unit Number	Soil Units	Percent (%)
	1. Typic Cryothents, loamy-skeletal, mixed (non-acid), cobbly fine sandy. loam, 50% slopes	40
	2. Pachic Cryoborolls, loamy-skeletal, mixed, loam, 30 to 60% slopes	25
	3. Argic Cryoborolls, loamy-skeletal, mixed, very stony loam, 40 to 70 %	20
	Inclusions:	
	1. Typic Cryoborolls, fine loamy, mixed	07
	2. Typic Cryorthents, fine loamy, mixed, calcareous, shallow, 40 to 60 % slopes	06
	3. Rock outcrops	02
107	***Curecanti - Elwood - Duschene Families Complex***	
	1. Loamy-skeletal, mixed typic Argiborolls	35
	2. Loamy-skeletal, mixed typic Cryoborolls	25
	3. Loamy-skeletal, mixed typic Cryoboralfs	25
	Inclusions:	
	1. Contrasting inclusions of rock outcrops and shallow soils	15
109	***Elwood Family Soils***	
	1. Loamy, skeletal, mixed Argic Cryoborolls	85
	Inclusions:	
	1. Contrasting inclusions of soils with lower content of rock fragment	15
301	***Greyback - Loamy, Mixed (non-acidic) Lithic Cryrothents - Bacholor Families Complex***	
	1. Typic Cryoborolls, loamy-skeletal, mixed, cobbly loam, 30 to 50% slopes	35
	2. Lithic Cryorthents, loamy-mixed (non-acid), stony, fine, sandy loam, 30 to 80 % slopes	25
	3. Typic Cryorthents, fine-loamy, mixed (calcareous), loam, 30 to 50 % slopes	20

Map Unit Number	Soil Units	Percent (%)
	Inclusions:	
	1. Rock outcrops	05
	2. Typic Cryorthents, fine-loamy, mixed (calareous), bouldery, loam 5 to 30 % slopes	05
	3. Argic Pachic Cryoborolls, fine-loamy, mixed, loam, 5 to 15 % slopes	05
401	***Adel - Merino Families Complex***	
	1. Pachic Cryoborolls, fine-loamy, mixed, loam, 30 to 60 % slopes	40
	2. Lithic Cryoborolls, loamy-skeletal, mixed (non-acid), cobbly, loam, 8 to 60 % slopes	23
	3. Typic Cryorthents, loamy, mixed (non-acid), shallow, cobbly, loam, 8 to 30 % slopes	20
	Inclusions:	
	1. Pachic Cryoborolls, fine-loamy, mixed, cobble, clay-loam, moderately deep, 8 to 30 % slopes	15
	2. Rock outcrops	02
560	***Clayburn - Broad Canyon Family Complex***	
	1. Argic Pachic Cryoborolls, fine loamy, mixed, loam, 5 to 40 % slopes	45
	2. Typic Cryoborolls, loamy-skeletal, mixed, cobbly loam, 30 to 50 % slopes	40
	Inclusions:	
	1. Typic Cryoborolls, fine-loamy, mixed, shallow	05
	2. Boralfic Cryoborolls, loamy-skeletal, mixed, loam, 30 to 60 % slopes	05
	3. Pachic Cryoborolls, coarse-loamy, over sandy or sandy-skeletal, mixed, fine sandy loam, 30 to 60 % slopes	05
561	***Claybyrn - Faim - Behanin Families Comples***	
	1. Argic Pachic Cryoborolls, fine-loamy, mixed, loam, 5 to 20 % slopes	55

Map Unit Number	Soil Units	Percent (%)
	2. Argic Pachic Cryogorolls, fine, montmorillonitic, loam, 5 to 20 % slopes	20
	3. Pachic Cryoborolls, loamy-skeletal mixed, loam, 10 to 30 % slopes	15
	Inclusions:	
	1. Lithic Cryoborolls, loamy-skeletal, mixed	09
	2. Rock outcrop	01
711	***Bundo - Lucky Star - Adel Families Complex***	
	1. Typic Paleboralfs, loamy-skeletal, mixed, loam, 40 to 70 % slopes	50
	2. Boralific Cryoborolls, loamy-skeletal, mixed loam, 30 to 60 % slopes	20
	3. Pachic Cryoborolls, fine-loamy, mixed, loam, 30 to 60 % slopes	20
	Inclusions:	
	1. Typic Cryorthents, loamy, mixed (non-acid), shallow, loam, 30 to 60 % slopes	10
820	***Lucky Star - Bundo - Adel Families Complex***	
	1. Boralfic Cryoborolls, loamy-skeletal, mixed, loam, 30 to 60 % slopes	55
	2. Typic Paleboralfs, loamy-skeletal, mixed, fine sandy loam, 40 to 70 % slopes	20
	3. Pachic Cryoborolls, fine-loamy, mixed, loam, 30 to 60 % slopes	20
	Inclusions:	
	1. Typic Cryorthents, loamy, mixed (non-acid), shallow	05

R645-301-230. OPERATION PLAN

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7^{th} East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. Prior to any surface disturbance, Energy West will secure all necessary permits.

R645-301-300 BIOLOGY SECTION

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R645-301-300 BIOLOGY

R645-301-310. BIOLOGY INTRODUCTION

The following vegetative, fish, and wildlife resource information has been taken from the Data Adequacy document (Data Adequacy L.B.A No. 11, December 1996) and the Environmental Assessment (Mill Fork Federal Coal Lease Tract UTU-71307, Environmental Assessement document, Lease By Application, No. 11) reported by the Manti LaSal National Forest in June, 1997.

R645-301-320. ENVIRONMENTAL DESCRIPTIONS

R645-301-321. VEGETATION INFORMATION

The Mill Fork area contains very steep and narrow east-west trending canyons with rounded narrow ridge tops. Contour elevations range from approximately 8,100 feet to over 10,700 feet. Vegetative cover and species composition within this elevation range are very diversified. Ecosystems within this portion of East Mountain contain various habitats that are mostly influenced by the steep and broken slopes and their orientations. Distinguishable ecosystems within the area are grasslands, perennial forb lands, sagebrush lands, mountain brush lands, coniferous forest lands, aspen forest lands, and pinyon/juniper woodlands. Refer to Map MFS1821D in the Maps Section for the diverse vegetative communities.

Grasslands - These lands make up only a small portion of the Mill Fork Lease Area. Grasslands include both perennial and desert grasses at high and low elevations. Salina wild rye grass is the dominant grass at the lower elevations and Letterman needle grass dominates the high elevation ridge top sites. They are predominately found on slopes with a south to southwestern exposure.

Perennial Forb Lands - Perennial forbs exist mainly on or near ridge tops. Common species found include sages, vetches, and clovers. These forbs are important food source for deer and elk populations as well as cattle and sheep.

Sagebrush Lands - This vegetative type is found on most of the steep south slopes and high elevation ridge tops. Less than 10% of the Mill Fork area occur in this type. Grasses are interspersed within this community. Salina wild rye grass is the dominant grass at the lower elevations and Letterman needle grass dominates the high elevation ridge top sites. Few forbs are present in this type. The sagebrush species common in this vegetative type are black sagebrush and big mountain.

Mountain Brush Lands - Mountain brush vegetative types occur mostly on the mid-elevation south slopes, high elevation ridges and in the upper basins within the Mill Fork area. This type is present on about 15% of the area. The lower elevation sites are heavily used by wintering elk and deer and the higher elevation ridges and basins are used by sheep during the summer. Most of the vegetative types is classed as unsuitable for use by livestock, because of steep inaccessible slopes.

Coniferous Forest Lands - It is estimated that about half the Mill Fork area is covered with conifer timber vegetative type. These types are mostly found on the northerly exposed slopes of the canyon. Douglas fir make up about 85% of the conifer cover with alpine fir and spruce trees present only at the higher elevation ridge and in the upper basin. The dense forest growth on the steep canyon slopes provide a good scenic view, a good watershed cover and wildlife habitat. Understory vegetation in this ecosystem is generally poorly developed due to shading.

Aspen Forest Lands - Aspen type occur on an estimated 20-25% of the Mill Fork area. They occur mostly on mid and higher elevation sites and on the lower canyon slopes. Most of the aspen types with the area are in either early or mid-seral condition. Only a few stands at high elevation and some isolated sites are in late seral condition. Stands of aspen mostly at higher elevations are being invaded by Douglas fir trees. The aspen ecosystem provide a very important habitat component for many wildlife species, both animal and birds. It also has a high value for livestock grazing and watershed values.

Pinyon-juniper ecosystems - These areas are dominated by pinyon pine and juniper. This ecosystem occurs only in the submontane ecological association. A diverse vegetative understory community is often lacking over wide expanses of the ecosystem. Thus, irregular shaped, but sometimes extensively sized openings have been created in the pinyon-juniper ecosystem for conversion to more productive sagebrush-grass, mountain brush or grassland settings.

Threatened, Endangered and Sensitive Plant Species

Threatened, endangered, and sensitive plant species of interest include *Astragalus monti, Hedysarum occidentale var. canone, Silene petersonii, and Aquilegia flavescens.* Populations of these species have been found to inhabit areas near the Mill Fork Lease area. The information discussed on the above listed species was provided by the Manti-LaSal Nationl Forest and gained through personal interviews with Mr. Bob Thompson, Botanist, Manti-LaSal National Forest. The species are discussed below.

Astragalus montii - Monti's milkvetch

This plant is found at high elevations (10,000 to 11,000 feet) on the Flagstaff limestone outcrops. Populations are located on top of Heliotrope, Ferron and White mountains (Ferron Ranger District). This plant is associated with low growing sub-alpine vegetation.

Hedysarum occidentale - Canyon Sweetvetch

Scattered populations of this plant occur in Lower Huntington Canyon, Straight Canyon, and near Joes Valley, Ferron District (5,500 to 7,000 feet). Plants are usually found on sites with a high water table, near springs or along stream beds, and along riparian sites within the Pinyon Juniper ecosystems. River birch and Squawbush are plants most commonly associated with this species.

Silene petersonii- Peterson catchfly

Scattered populations have been found mostly on Flagstaff limestone outcrops on higher elevation ridges and snowdrifts. Occurrences have been found from the Wagon Road Ridge, south to the top of White Mountain. This plant is part of the sub-alpine low forb plant community.

Aquilegia flavescens - Link trail columbine

This plant occurs in springs, seeps and perennial wet sites. Populations have been found in Link Canyon, Box Canyon, Muddy Creek drainage, Straight Canyon and Joes Valley.

Erigeron carringtoniae - Carrington daisy

"...Endemic at high elevations on the Wasatch Plateau (Emery, Sampete, and Sevier cos.), *E. carringtoniae* grows on flat to gently sloping plateau margins and adjoining steep, eroding slopes, predominantly on the white Flagstaff Limestone (Stone, 1993a). Soils are generally quite shallow with little or no profile development, and consist of gravelly calcareous clays or clay loams overlain by a thin layer of loose, angular limestone fragments or gravel. Ten occurrences of *E. carringtoniae* are currently known (including two with > 1000 plants as recorded by B. Thompson in 1991)..." (Inventory of Sensitive Species and Ecosystems in Utah, Utah Division of Wildlife Resources, 1998). Occurrence has been confirmed by Mr. Bob Thompson (personal interview) in the southern end of the lease, however, in his opinion, there should be no impacts to this species due to subsidence.

Listed rare and other high interest plant species have been found to occur near the Mill Fork Lease area. The species are *Chrysothamnus nauseocus var. psilocarpus, Gentiana prostrata, Gentianopsis barbellata, Ligusticum porteri.* Mr. Bob Thompson indicated during a personal interview that no threatened, endangered or sensitive plant species have been found to occur within the Mill Fork Lease area. He believes that the four high interest species do not occur within the lease, however, no surveys have been conducted to verify their existence or absence. It was also Mr. Thompson's opinion that impacts to vegetation due to mining induced subsidence will be negligable to vegetation within the Mill Fork Lease.

R645-301-322. FISH AND WILDLIFE INFORMATION

The Mill Fork area consists of portions of Crandall Creek, Mill Fork and Rilda canyons to the east and unnamed canyons to the west. Runoff from the area contributes to Crandall Creek, Little Bear Creek, Mill Fork, and the Right Fork of Rilda Creek ; all are tributaries to Huntington Creek. The western side of the Mill Fork area consists of tributaries to Indian Creek. The southern portion contributes runoff to a small portion of the Cottonwood Creek. Crandall Creek and Indian Creek are the only tributaries considered perennial, all other tributaries are intermittent/ephermal. Continuous flows usually occur in spring and early summer as snowmelt. During late summer and fall, isolated thunderstorms are typical in the region.

Surface and ground water sources is provided for an abundance of fish and wildlife species in the Mill Fork area. Perennial streams support naturally-reproducing trout fisheries and aquatic communities typical to mountain environments. Water resources provides habitat for a variety of big and small game animals, non-game animals and birds. A complete listing of all theatened and endangered fish and wildlife species that have the potential to be present near and/or within the Mill Fork lease can be found in the County lists of Utah's Federally Listed Species (UDWR, 8/14/02, at http://www.utahcdc.usu.edu/ucdc/.) A complete listing of all sensitive fish and wildlife species that have the potential to be present near and/or within the Mill Fork lease can be found at this same internet address. Some important species are discussed below.

I. Aquatic Species - The Utah Division of Wildlife Resources (UT DWR) has conducted game fish surveys of the perennial and intermittent streams in the Mill Fork area. Their reports show a variety of salmonid species in each of the streams; Crandall Creek, Little Bear Creek, Mill Fork Creek, Right Fork Rilda Creek, and Indian Creek. The following summarizes each stream with each representative game species.

- Crandall Creek
  - Colorado Cutthroat *(Oncorhynchus clarki pleuriticus)*
  - Rainbow Trout *(Salmo gairdneri)*
  - Yellowstone Cutthroat *(Oncorhynchus clarki)*
- Little Bear Creek
  - Yellowstone Cutthroat *(Oncorhynchus clarki)*
  - Rainbow Trout *(Salmo gairdneri)*

- Mill Fork Creek — Yellowstone Cutthroat *(Oncorhynchus clarki)*; Rainbow Trout *(Salmo gairdneri)*
- Right Fork Rilda Ck. — Yellowstone Cutthroat *(Oncorhynchus clarki)*; Rainbow Trout *(Salmo gairdneri)*
- Indian Creek — Brook Trout

In addition to the species listed above, the drainages are also likely to support populations of the following non-game species; speckled dace *(Rhinichthys osculus)*, mottles sculpin *(Cottus bairdi),* bluehead suckers *(Pantostius delphinus),* and mountain suckers *(Catostomus platyrhynchus)* (Chistopherson, UT DWR).

Benthic Invertebrates - The USGS in cooperation with the Utah DNR and Utah DOGM conducted a comprehensive hydrologic study (from July 1977 through September 1980) of the upper drainages of the Huntington and Cottonwood creeks. Data on benthic invertebrates were collected from 16 sites in October 1977, July and October 1978, and October 1979. This data will be cited and used as a baseline evaluation for the Mill Fork Tract. Refer to United States Geological Survey, Water-Resource Investigations, Open-File Report 81-539, Salt Lake City, Utah, 1981.

As written from the report, "...data indicate that there were significant seasonal differences in the benthic invertebrate population at a given site in addition to areal differences...These organisms appeared in their maximum numbers in the July samples collected at sites in the higher altitudes of the study area, but they were not present in any of the October samples. The large numbers found in July, reflected a seasonal cycle rather than an unnatural condition that allowed one species to dominate." The average diversity (Shannon-Weiner diversity index) found between 1977 and 1979 in Crandall and Mill

Fork canyons was 2.38 and 2.09, respectively. During hydrologic baseline data collection (2000-2002), the '77 through '79 study area in Mill Fork Canyon was dry.

II. Terrestrial Species - The Mill Fork and surrounding area contains habitat for a variety of wildlife including a potential of 84 mammals, 140 birds, and 25 reptiles and amphibians (Mill Fork Federal Coal Lease Tract UTU-71307, Environmental Assessment, LBA Application #11. June, 1997).

Mule deer *(Odocoilius hemionus)* and elk *(Cervus elaphus)* are common in the area. These species typically occupy the higher elevations for summer ranges from May through late October. These areas are important for grazing/browsing before the onsets of winter. Lower elevations are occupied for winter range habitat. Deer and elk summer and high value winter range areas are outlined on maps MFS1849B and MFS1822B in the Maps Section. Population trends of both deer and elk can be found on the DWR website (http://www.wildlife.utah.gov/hunting/biggame.html). This information can be reviewed for the Manti region by opening the appropriate .pdf file under Big Game Reports.

A number of raptors occupy the Mill Fork area. These species include the Golden eagle *(Aquila chrysaetos)*, Goshawk (*Accipiter gentillis)*, Red-tailed Hawk *(Buteo jamaicensis)*, Sharp-shinned Hawk *(A. striatus),* American kestrel *(Falco sparverius)*, and Great Horned Owl *(Bubo virginiana)* (Mill Fork Federal Coal Lease Tract UTU-71307, Environmental Assessment, LBA Application #11. June, 1997). These species have been seen in the area in the spring and summer months. Nesting areas have been located along the high cliff areas and the aspen-conifer habitats during the Raptor reconnaissance survey conducted in May, 2001. These surveys are conducted annually using helicopter transport and with Division of Wildlife Resources personnel as well as company representatives. Map MFS1852B located in the Confidential and Private Volume (Deer

Creek tab: Deer Creek Mine :Volume 12 R645-301-300 Biology) illustrates each located nest in and near the Mill Fork permit area.

PacifiCorp in cooperation with Division of Wildlife Resources conducts annual raptor reconnaissance surveys within the Mill Fork area, including the State Lease ML-48258 and Federal Coal Lease UTU-84285 (refer to Map MFS1852B, located in the Confidential and Private Volume [Deer Creek tab: Deer Creek Mine :Volume 12 R645-301-300 Biology]). Number of nest and status of each nest (i.e. active, inactive, tended, dilapidated, not found) is reported in Annual Reports submitted to the Division. This information is also available for review by the regulatory agencies at the Division of Wildlife Resources. Based on the September 2005 mine layout, none of the nests are within the projected subsidence affected area (refer to maps MFS1866D in the Engineering Section and MFS1839D located in the Confidential and Private Volume [Deer Creek tab: Deer Creek Mine :Volume 12 R645-301-500 Engineering]).

R645-301-322.210. Threatened and Endangered Species

The referenced Environmental Assessment reports "No threatened or endangered wildlife species are known to inhabit the proposed lease area. A Bald Eagle (*Haliaeetus leucocephalus)* nest near the Hunter Power Plant is approximately 26 miles southeast of the coal lease. The coal lease area is outside of the foraging area for the Bald Eagles. Two peregrine falcons (*Falco peregrinus*) were observed approximately 13 miles north in 1996. The falcons were observed during nesting season but no nest site was ever confirmed. It is generally accepted that peregrine falcons will forage up to 15 miles from their eyrie, however given the prey base available it is doubtful that the falcons would forage over the coal lease area. No roost sites have been found in the lease area ..."

Mexican Spotted Owls (MSO) have recently become a species of interest since the U.S. Fish and Wildlife Service (USFWS) designated (in January, 2001) 4.6 million acres on federal lands in Arizona, Colorado, New Mexico, and Utah as critical habitat. The designation includes 3.2 million acres in Utah. More specifically, the designation includes areas west of the Colorado River within the West Tavaputs Plateau in Carbon County and the northeast corner of Emery County east of US Highway 6. Other areas in Utah have been designated as critical habitat, however, these areas exist in the southern portion of the state. Typical MSO, habitat according to the 2001 Environment Assessment, consists of "a diverse array of biotic communities. Nesting habitat is typically in areas with a complex forest structure or rocky canyons, and contains uneven-aged, multi-storied mature or old growth stands that have high canopy closure (Ganey and Balda 1989, USDI 1991). In the northern portion of the range (southern Utah and Colorado), most nests are in caves or on cliff ledges in steep-walled canyons....typically characterized by the cooler conditions...frequently contain small clumps or stringers of ponderosa pine, Douglas fir, white fir, and/or pinion-juniper".

Dr. Dave Willey from Montana State University, known MSO expert, modeled representative habitat using the 2000 Willey-Spotskey Mexican Spotted Owl Habitat Model. The model included all areas of the Mill Fork Lease Tract. Figure 1 shows the lease boundary and surrounding area. Areas identified in black, are areas of potential nesting habitat. The greens are identified as potential foraging areas of steep sloped mixed conifers. However, it is reported in the DWR's *Inventory of Sensitive Species and Ecosystems in Utah, 1997* that foraging, nesting and roosting habitats are "dominated by Douglas-fir and/or white fir...In the northern portion of the range (southern Utah and Colorado), most nests are in caves or on cliff ledges in steep-walled canyons." Potential steep sloped, mixed conifer foraging habitats of this type are found on the extreme northeastern border, extreme western border, and a small area in the southwest corner of the lease area as illustrated in Figure 1. Large ponderosa pines are typically found in lower elevations in the rocky canyons to the east of the lease tract. The west side of the tract supports

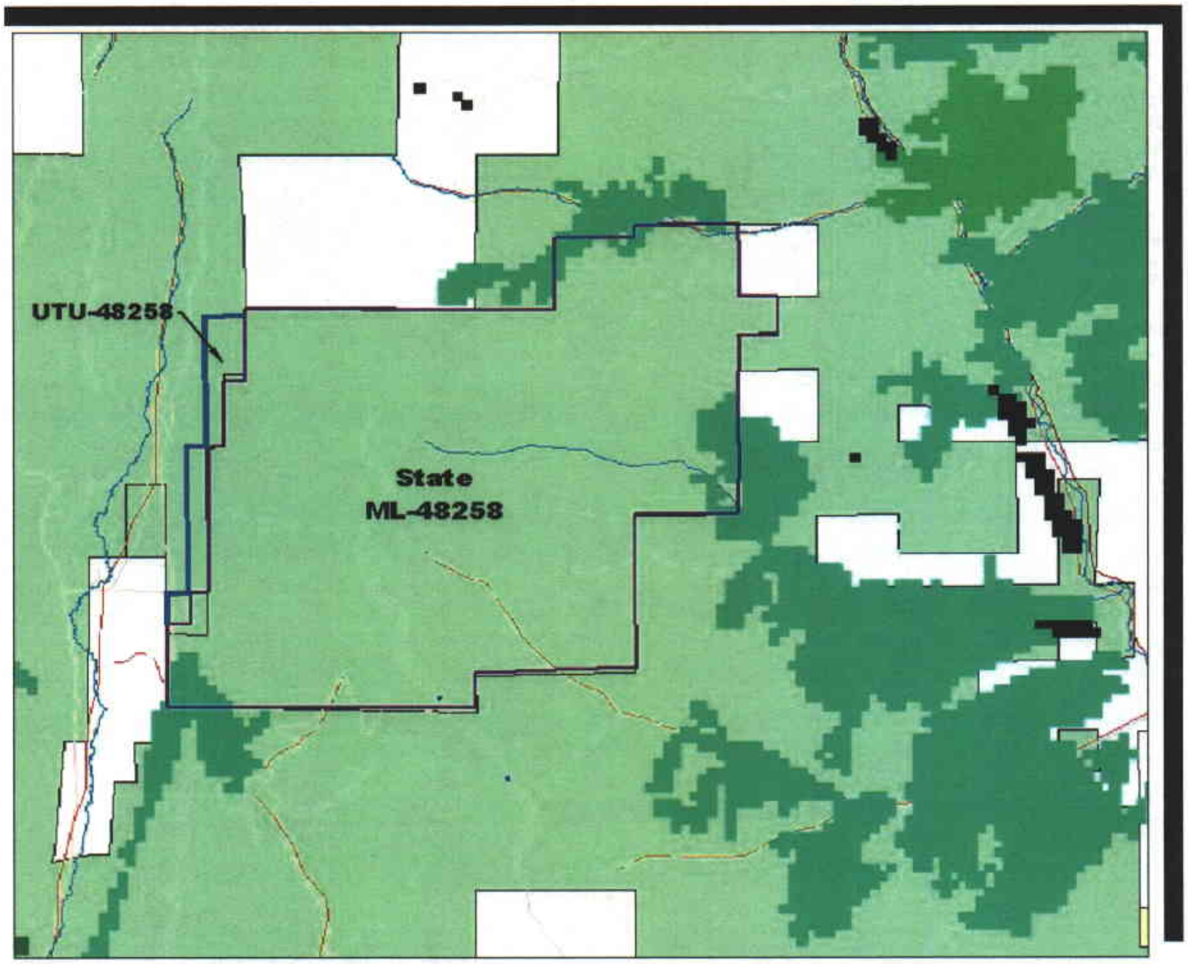

Figure 1: Mexican Spotted Owl nesting and foraging areas (Dr. Dave Willey, Montana State University, 2000)

both aspen and Douglas fir stands, however, this area lacks cliff ledges or steep walled canyons recognized as typical nesting habitats. Figure 2 shows the only area on the lease that supports potential MSO habitat subsidence. There are no potential MSO habitat within the lease that could be impacted by subsidence.

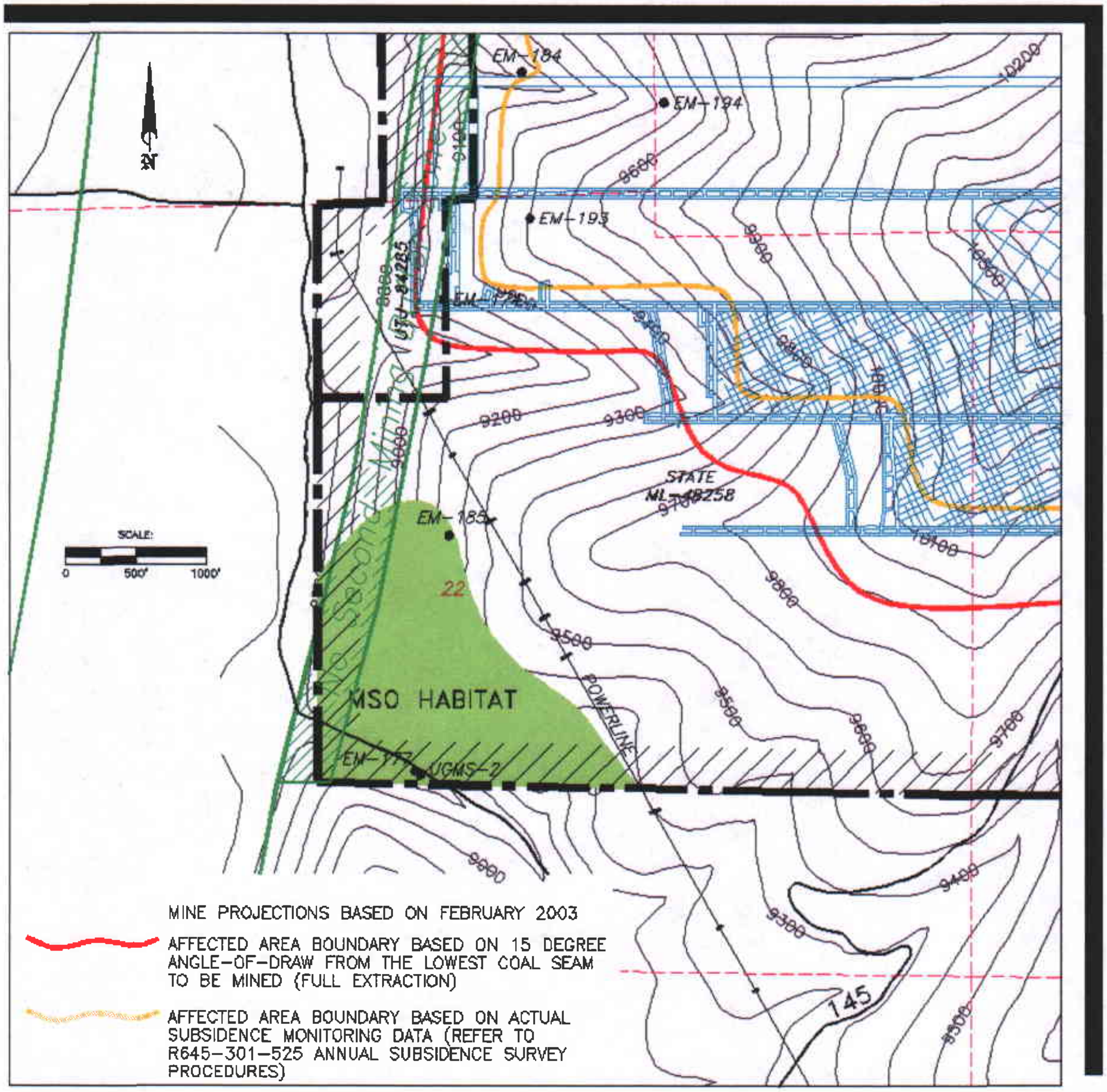

Figure 2: Southwest corner of Mill Fork State Lease. The green shading is steep slope mixed conifer habitat (Douglas fir/white fir). Light blue lines indicate location of proposed mining.

No sightings of the Mexican Spotted Owl have been made on the Mill Fork Lease Area (personal communication with Rod Player, USFS - Price District). Areas west of the San Rafael have been surveyed two years in a row and no owls were found (Mexican Spotted Owl Training Class, Lora Romin, Frank Howell - DWR Instructor, March 21, 2002, Moab, Utah). It is PacifiCorp's opinion that with the facts given, mining will have no effect on the Mexican Spotted Owl if they occur in the lease area.

R645-301-322.230. Sensitive Species

The Colorado river cutthoat is thought to be present in the Crandall Creek drainage. Genetic testing is on-going to confirm if these fish are pure-strain Colorado cutthroats, however, no definitive data is currently available.

The Spotted Bat *(Euderma maculatum)* depends on cliffs for roost/hibernation areas. These areas exist in isolated locations in the eastern portion of the Mill Fork permit area. Energy West Mining Company and Genwal Resources in 1997, contracted Richard Sherwin, Dr. Duke Rogers, and Carl Johansson to conduct a bat survey in the areas of Huntington Canyon, Straight Canyon, and Cottonwood Canyon. The purpose of this survey was to assess the distribution, abundance, and habitat requirements of the Townsand big-eared and Spotted Bats. These parameters were investigated for the following: 1) areas under consideration as potential lease sites for mining (North Rilda Area, Cottonwood Canyon LBA and the Mill Fork lease); 2) sites where subsurface coal mining is onging, and 3) sites (both on and off the Manti-La Sal National Forest) that serve as controls (no mining activties). The results of this survey (Refer to the Appendix A: *Assessments of Spotted Bat (Euderma maculatum) and Towsend's Big-eared Bat (Corynorhinus townsendii) in the Proposed Cottonwood Canyon, North Rilda Area and Mill Fork Lease areas, Manti La Sal National Forest, Emery County, Utah.)* are summarized as follows:

Use assessment for Townsend's big-eared bats in specified areas

No Townsend's Big Bats were located within the survey areas during the project.

Use assessment for Spotted bats in specified areas

No Spotted Bats were mist netted during these studies, refer to Appendix A Table 1 for a summary of results. There is some indication that water source(s) may not be as critical for the Spotted bat as for other species of bats with which it co-occurs. In a study of urine concentrating ability among selected species of bats, the Spotted Bat could concentrate its urine more effectively than any species of bats evaluated, with the exception of two typically "desert species", the Pallid Bat (Antrozous pallidus) and the Western pipistrelle (Pipistrellus hesperus - Geluso, 1978). It is likely that the Spotted bats were using water sites specifically to forage rather than drink, making netting extremely difficult.

Spotted Bats were observed throughout the eastern (lower elevation) portions of the study areas. The highest concentration of calls were recorded in Rilda and Huntington Canyons. These canyons seem to best represent "classic" Spotted Bat habitat with an abundance of fractured sandstone cliffs, and large areas of suitable foraging habitat.

From three studies, it appears that Spotted Bats are using the cliffs as roosting areas and the canyons as flyways to reach the lower elevation foraging areas. The principal Spotted bat foraging areas are located over the lower elevation riparian habitat located near the mouth of Huntington Canyon. Spotted bats concentrated foraging efforts above the upper canopy of intact riparian vegetation, particularly cottonwood trees (Populus ssp.).

Spotted Bats were not restricted to the study areas, but rather are widely distributed in low densities throughout the entire area. In fact, Spotted Bats were detected in suitable habitat throughout the area (including utilizing the parking lots of the Village Inn Motels in Huntington and Castle Dale).

There also is evidence that the Spotted Bats tolerate at least moderate human disturbance while foraging. Surveys were conducted at several sites near roads with light to moderate vehicular traffic (Crandall Canyon, Huntington Canyon), including tandem trucks used for hauling coal from the Genwal Mine portal located in Crandall Canyon. Spotted Bats were observed foraging at low elevations sites off the lease areas, sometimes within 30 meters of the right of way.

Spotted Bats are common throughout the Huntington Canyon area. They were identified utilizing the lease areas (North Rilda and Mill Fork), the active mine permit areas and the control sites (refer to Appendix A, Table 2). Based on the number of individuals observed and their habitat use patterns, it does not appear that current mining practices represent a long term threat to the viability of this population. The bat communities in all areas sampled consist of the same suit of species among all areas of similar habitat and complexity (this includes sites in actively mined areas, control sites, and proposed lease areas (North Rilda and Mill Fork).

The fact that Spotted Bats are relatively common in active and previously mined areas implies that past cliff failures have not dramatically impacted resident populations. As a cliff roosting species, it is likely that they have adapted to tolerate natural rock falls and subsidence. Mine related cliff failures do not generally result in a net loss of habitat (ie. cliffs), but rather provide replacement habitat which may later be colonized by members of the local population. The results of the study indicate that Spotted Bats are "common" enough throughout the area that the localized failure of cliffs (as a result of coal mining within the proposed lease areas [North Rilda Area and Mill Fork]) does not pose a serious threat to the population as a whole.

R645-301-323. MAPS AND AERIAL PHOTOGRAPHS

Maps for vegetation diversity, deer and elk habitat, and raptor nest locations are included in the Maps Section of R645-301-300. Biology. The reader should review these maps to locate these environmental resource items of interest. In addition to biologic base maps provided in this section, PacifiCorp conducts annual reconnaissance surveys, including subsidence monitoring (annual aerial photogrammetric surveys), infra-red photography (5 year intervals), and hydrologic monitoring.

R645-301-330. OPERATION PLAN

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7th East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. Prior to any surface disturbance, Energy West will secure all necessary permits.

R645-301-332. ANTICIPATED IMPACTS DUE TO SUBSIDENCE

Multiple surveys have been conducted on the portion of the surface of East Mountain that could possibly be affected by the full extraction or second mining of coal from the Mill Fork Permit area. It has already been determined that there are renewable resources present in the area in the forms of springs, water seeps, grazing land, timber, and wildlife. Also present in the permit area are unimproved roads, trails, a gas well and pipelines, power transmission lines, and some portions of the Castlegate Sandstone escarpment (see Pre-Subsidence Survey Map MFS1839D located in the Confidential and Private Volume [Deer Creek tab: Deer Creek Mine :Volume 12 R645-301-500 Engineering]).

Known springs and seeps that are located within the Mill Fork Lease second mining areas are shown on the Pre-Subsidence Survey Map. The Hydrologic Section of the Mill Fork MRP, Appendix A, contain a listing of sampling sites and a monitoring schedule. Most of the streams within the permit area are ephemeral and/or intermittent. The Crandall Canyon Creek and the lower portion of Rilda Canyon Creek is considered perennial. The streams that flow into Mill Fork Canyon are fed by springs that emanate primarily from the North Horn Formation within the permit boundary. Portions of the headwaters of the drainage basins that feed Crandall and Rilda canyons are within the Mill Fork Lease. Second mining, i.e. longwall extraction or room & pillar mining, of the Mill Fork area will not occur beneath the main stream channels of these canyons. First mining development of access mains from Deer Creek Mine to the Mill Fork Lease will occur to the north of the Right Fork of Rilda Canyon.

The entire permit surface area is utilized for grazing of sheep and cattle during the summer season. Experience from the existing PacifiCorp permit areas has shown that the effects of subsidence on grazing and grazing lands are minimal.

All existing timber resources on the Mill Fork permit area are administered by the U.S.D.A. Forest Service. Experience on the existing PacifiCorp permit areas over the last 25 years has shown that subsidence does not affect timber resources or access to timber resources.

Experience on the existing PacifiCorp permit areas over the last 25 years has shown that the effects of subsidence on vegetation and wildlife resources are minimal (Rod Player, Bob Thompson, USFS, personal communication). As mentioned above, PacifiCorp conducts annual aerial surveys for monitoring subsidence. On 5 year intervals, infra-red photography technology is used. This photo documentation will be used as a monitoring tool to record any changes in vegetation. Monitoring will be conducted as stated until the Division approves a permit area reduction of the affected area.

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 presubsidence reasonably foreseeable uses.

R645-301-333. MINIMIZATION OF DISTURBANCES AND ADVERSE IMPACTS TO FISH AND WILDLIFE

In review of this mining permit application, the USFWS have identified that water consumption by underground coal mining operations could jeopardize the continued existence of or adversely modify the critical habitat of the Colorado River endangered fish species: Colorado pikeminnow, humpback chub, bonytailed chub, and razorback sucker. The USFWS has determined that water consumption by underground operations could potentially have adverse effects on the Colorado River basin. The USWFS considers consumption to include; evaporation from ventilation, coal preparation, sediment pond evaporation, subsidence on springs, alluvial aquifer abstractions into mines, postmining inflow to workings, coal moisture loss, and direct diversions. These consumption processes are discussed below.

Evaporation from ventilation - In mine water loss due to evaporation is a fairly easy calculation when the barometric pressure and vapor pressures are known. For example, on a 570,000 CFM mine fan, typical volumes of evaporation are approximately 18,000,000 gallons/year. However, this result is dependent on temperature and relative humidity. The evaporation evolves primarily from the inactive hydrologic systems mentioned above.

Coal Preparation - PacifiCorp owns water rights for use in their coal preparation plants.

Sediment pond evaporation - The sediment pond is used to hold rain and snow runoff that flows over disturbed areas of the coal mining and reclamation operations until accumulated sediment has dropped out. At that point the water is discharged into a receiving stream. This would not be considered a consumption mechanism.

Subsidence effect on springs - In twenty-five years of mining, there have been no reported effects on springs due to subsidence. Refer to the Hydrology Section R645-301-728 and Appendix B, Section 11, Probable Hydrologic Consequences (reported by Mayo and Associates, 2001).

Alluvial abstractions into mines - There will be no water infiltrations from alluvial systems into the mine.

Postmining inflow into workings - There currently no proposed mine openings for the Mill Fork Lease. Currently, there is a planned postmining water discharge associated with the Deer Creek portals (refer to the Deer Creek reclamation plan).

Coal moisture loss - Typically the inherent moisture in coal mined at Deer Creek is approximately 5%. Run-of-mine moisture averages approximately 8.5 %. Deer Creek is scheduled to mine 4.2 million tons in 2002. Using these values the consumption is approximately 161 acre feet of water.

Direct diversion - no consumption.

Adding the two losses due to mining operations (Evaporation + Coal Moisture) equals 161 plus 55 acre feet of water consumed. The resultant is approximately 216 acre feet of water per year. If mine discharge is added to the equation, an enhancement to the hydrologic resource would be achieved. In 2001, the Deer Creek mine discharged nearly 2,670 acre feet into the Huntington Canyon drainage system. Theoretically, this would be a net gain of 2,453 (2,670-216) acre feet of water into the Colorado River Basin. Therefore, it is the opinion of PacifiCorp and Energy West that water consumption by underground coal mining operation will not jeopardize the existence of or adversely modify the critical habitat of the Colorado River endangered fish species.

R645-301-340. RECLAMATION PLAN

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7^{th} East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. Prior to any surface disturbance, Energy West will secure all necessary permits.

R645-301-400 LAND USE & AIR QUALITY

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APPENDICIES

MAPS

REFERENCES

Hauck, F.R.

1979b Cultural Resource Evaluation in Central Utah - 1977. Cultural Resource Series, No.3, Bureau of Land Management, Salt Lake City,

Hauck, F.R.

1994 Cultural Resource Evaluation Proposed Well 42-14H in the East Mountain Locality of Emery County, Utah. AERC Paper No. 22, Archeological Environmental Research Corporation, Bountiful.

Hauck, F.R.

1995 A Class II (Sample Survey) Cultural Resource Evaluation in the East Mountain Locality of Emery County, Utah. AERC Project No. 1494, Archeological Environmental Research Corporation, Bountiful.

R645-301-400 LAND USE AND AIR QUALITY

R645-301-410. LAND USE INTRODUCTION

Historical use of the Mill Fork portion (including the Mill Fork State Lease and Federal Lease UTU-84285) of the Deer Creek permit area has been grazing, wildlife, and recreation. Cattle are moved through the area to graze at the higher elevations. Native big game (deer, elk, bear, etc.), as well as, small game and non-game animals inhabit the area as described in R645-301-300: Biology. Recreation consists of hunting, sightseeing, and other miscellaneous outdoor activities.

The existing land use classification for the Deer Creek permit area is grazing and wildlife. This classification has been extended to the Mill Fork area for any areas that could potentially be affected by coal mining and reclamation activities. No areas are presently planned for surface disturbances.

A land use map has been constructed that documents the locations of all items discussed in the following sections. The reader should refer to map MFS1835B in Appendix A to review each items' location.

R645-301-411. ENVIRONMENTAL DESCRIPTIONS

There have been numerous coal exploration drilling projects conducted within the Mill Fork area. These areas were occupied by both industry and government. All drill sites and access roads have been reclaimed to Forest Service requirements and stipulations.

One producing gas well (EM32-23) is located near the southern border of the Mill Fork area. Merit Energy Company owns and operates the well, which has disturbed approximately two (2) acres of surface land. A buried 4-inch diameter steel gas pipeline runs from the well south along

FR 245 and down Flat Canyon. Merit Energy intends to expand the field by drilling additional holes within the Mill Fork area, but plans are currently on hold.

The land surface in the Mill Fork area has, however, been previously used for other non-mining activities. The southwestern portion of the area has a special use permit issued to Utah Power and Light Company. The company uses this 120 x 3,150 foot corridor for a 345 KV power transmission line.

Another power transmission line (69 KV) travels across the NW¼NW¼ of Section 8, T17S, R6E, SLB&M. The transmission line supplies power to the Genwal Resources, Crandall Canyon Mine.

An old limestone quarry is located east below Bald point and west of FR 245. The quarry was developed to gravel the Flat Canyon road for access to the top of East Mountain for gas well development. The associated access road, as well as the quarry, is no longer in use and has been fully reclaimed

The Flat Canyon road, which provides access to the East Mountain top, enters and leaves the southern boundary of the Mill Fork area. The road was upgraded to a single lane graveled surface road with drainage structures. The road provides access for mineral resource development, recreation, cattle range management, and firewood gathering. Traffic is approximately 5 to 10 vehicles per day (Mill Fork Federal Coal Lease Tract UTU-71307, E.A., L.B.A. #11).

Two grazing allotments are present within the Mill Fork area. Sheep graze on the northern end of the area, whereas, cattle graze on the southern end. Grazing is conducted throughout the summer and into the fall months of the year.

Numerous prescribed controlled burns have been conducted by the Forest Service in the past to encourage aspen and shrub growth, however, in 1995, a prescribed burn near the North Rilda Ridge area became uncontrolled and left approximately 135.0 acres affected.

Drawing MFS1856B shows the forest management plan for land use within the Mill Fork permit area Area. Out of the 5562.82 acres, 97.8% is dedicated as Range Forage Production, 2% is for Wood Fiber Production and Utilization, and 0.02% is utilized for Municipal Water Supply. It is not expected that any of the above stated land uses will be affected/impacted by underground mining related activities.

Any areas affected/disturbed by coal mining and reclamation activities will be restored to its approximate original condition pursuant to the land owners requests and wishes, as well as, State and Federal regulations.

R645-301-411.141. Cultural and Historic Resources

Mill Fork Tract (Mill Fork State Lease ML-48258)

An archeological, historical, and cultural resource evaluation was conducted in 1995 for the Mill Fork area. The evaluation included the majority of the Mill Fork Tract and the South Crandall Tract. As reported in the Data Adequacy Report (Hauck 1995), the evaluation consisted of surveying 15% of the total 4710 acre study zone to assess its potential for containing significant resources that could be adversely affected by future subsidence activities related to mining. The evaluation consisted of both a file search, and a Class II, or stratified sample survey, of the 4710 acre study zone.

The file search was conducted of the study area at the State Historic Preservation Office (SHPO) in Salt Lake City, Utah , within the AERC database, and the US Forest Service in

Price. The National Register of Historic Places has was consulted and no registered historic or prehistoric properties will be affected by the proposed mining. Numerous surveys have been conducted within and adjacent to the Mill Fork Tract and have been cited in the Data Adequacy, December, 1996.

The areas under study contained all or part of State Sections 11, 12, 13, and 14 of Township 16 South, Range 6 East SLBM, and Sections 5, 6, 7, 8, and 18 of Township 16 South, Range 7 East SLBM. The majority of the study occurred on accessible highlands in the western and central portain of the study area. Of these 4710 total acres, AERC archaeologists, Glade Hadden, Doug Edwards, and Liz Mcomer intensively examined 405 acres or 8.6% of the total study area between July 25 and 27, 1995. Records in the Utah State Antiquities Section and AERC archives indicate that an additional 302 acres in the study area have been previously inventoried (Hauck 1979b, 1994).

The Class II sample survey was conducted by the archaeologists walking a series of 5 to 25 meter wide transects across the surface within the survey area. The width of the survey area depended on the slope, aspect, and ground cover. Localities having a moderate potential for containing cultural resource presence were subjected to transects of less than 12 meters in width.

The Class II sample survey of the 4710 acres was non-randomly developed due to the limited amount of acreage that was accessible for an archeological evaluation; a large percentage of the surfaces within the study area consist of narrow valleys, escarpments and densely forested steep slopes associated with the East Mountain locality. Thus, AERC's intensive evaluations were confined to the upper ridges and lower valleys, those accessible localities where prehistoric activities were most likely to have occurred.

Because of the surface alterations of excess ground cover, road blading, cattle and wildlife activities, much of the survey area was not easily evaluated for general archeaological presence. However, cultural resources were easily obtained.

Observations of cultural materials resulted in examinations to determine the nature of the resource. The area was sketched, photographed, and recorded on the Intermountain Antiquities Computer System (IMACS) forms. These sites were then evaluated for there cultural significance which included a mitigation recommendation for preserving the significant resource.

A summary of historic resources is in the Confidential and Private Volume in the tab entitled "Deer Creek Volume 12 R645-301-400 Land Use & Air Quality".

No historic or prehistoric cultural resource activity loci were discovered and recorded during the examination.

Although no "paleontological survey" was conducted during the 1995 Class II survey, observations were made for paleontological artifacts. No paleontological loci were identified during the evaluation.

No impacts to potential cultural/paleo resources are expected since there is no planned surface disturbance. If surface disturbance is planned within the Mill Fork Tract, a paleontological survey will be conducted in this area.

The above sections and citations are taken from the Data Adequacy L.B.A No. 11, December 1996, as reported by A.E.R.C. This report was submitted by Genwal Resources Inc. to the United States Forest Service, Manti-LaSal National Forest, Price, Utah.

Mill Fork West Extension Tract UTU-71307 (Federal Coal Lease UTU-84285)

An archeological, historical, and cultural resource evaluation for the Mill Fork West Extension Tract UTU-71307 (assign as Federal Coal Lease UTU-84285) was conducted during the last week of April 2006 by the Manti-LaSal National Forest Service cultural resource specialist (William Ellis, Heritage Program Manager Region 4, Professional CRM Specialist). A cultural resource report (ML-1189, U-06-FS-0588f, on file at the State Historic Preservation Office and Manti-LaSal National Forest Price Office) along with a Determination of Significance and Effect form was submitted to the State Historic Preservation Office on May 1, 2006 (refer to R645-301-400 Appendix 1 for a copy of the determination document). As stated in the Effect portion of the determination document, "The following actions are proposed to ensure the protection - No sites in proposed project area". State Historic Preservation Office reviewed and concurred with the Forest Service's determinations (refer to Appendix A).

411.142. Protection of Public Parks and Historic Places

No public parks are located in or adjacent to the Mill Fork permit area. Abandoned Mined Lands (AML) areas may lay outside the proposed boundaries. These areas, if applicable, will be reclaimed in cooperation with the Abandoned Mine Reclamation.

R645-301-412. RECLAMATION PLAN

In areas where surface disturbances result from coal mining and reclamation operations, regrading and revegetation will be conducted to restore the areas to their premining conditions which they were capable of supporting prior to mining. The operations, if developed, will be managed according to State and Federal regulations and applicable lease stipulations.

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7th East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. Prior to any surface disturbance, Energy West will secure all necessary permits.

R645-301-413. PERFORMANCES STANDARDS

All disturbed areas will be restored in a timely manner to conditions they were capable of supporting before mining. Liability will be for the duration of the coal mining and reclamation operations and for the period of extended responsibility for achieving successful revegetation. All post mining land use criteria will be satisfied before the bond is fully released.

R645-301-420. AIR QUALITY

Reclamation operations on all areas that have been affected by coal mining and reclamation operations will be conducted in compliance with the requirements of the Clean Air Act (42 U.S.C. Section 7401 et. seq.).

R645-301-500 ENGINEERING

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R645-301-510. INTRODUCTION

Coal mining has occurred since 1946 in Deer Creek Canyon, a tributary of Huntington Canyon in Emery County, Utah. Utah Power & Light Company (now PacifiCorp) purchased the operations and coal leases from Peabody Coal Company in 1977. The Deer Creek Mine portal, mine personnel, and its coal handling facilities are located in Deer Creek Canyon. PacifiCorp successfully acquired the Mill Fork State Lease and entered COAL MINING LEASE AND AGREEMENT with the State of Utah on April 1, 1999. The coal tract as described in the lease contains approximately 5,562.82 acres, more or less. On January 25, 2006 PacifiCorp applied for the Mill Fork West Extension Tract, serial number UTU-84285, adjacent to the western boundary of the Mill Fork State Lease ML-48258. This lease-by-application included 213.57 acres. Mining of this Mill Fork permit area including the Mill Fork State Lease and the adjacent Federal Lease UTU-84285 will be accomplished through the use of the Deer Creek portals and existing facilities and production of this area will continue in the Blind Canyon and Hiawatha coal seams.

A variety of engineering principles and techniques are applied in the Deer Creek Mine operation. More detail about the methodologies used to plan the coal mining activities for the expected life of mine at this operation can be found in Volume 2, Part 3 of the MRP.

R645-301-511. GENERAL REQUIREMENTS

This document will include the general requirements to meet the State of Utah's regulatory requirements to mine coal in the Mill Fork Area as part of the Deer Creek Mine. The proposed new mining plan will include new information or reference the existing mine plan when appropriate. The potential impact to the environment will also be addressed. As reflected by its format, this amendment to the plan attempts to follow the Rules general format within R645-301-500 regulations.

R645-301-512. CERTIFICATION

Applicable cross sections and maps have been included or referenced within this document. They have been prepared by, or under the direction of, and certified by a qualified, registered, professional engineer or land surveyor, with assistance from experts in related fields such as hydrology, geology and biology.

R645-301-513. COMPLIANCE WITH MSHA REGULATIONS AND MSHA APPROVALS

As required by MSHA regulations, the surface of the mine site is inspected on a quarterly basis, and on spot inspections as deemed necessary by the governing agency. All mine openings are inspected on a quarterly basis and /or more often if deemed necessary by MSHA. Compliance with the requirements of both DOGM and MSHA regarding these facilities shall be adhered to by PacifiCorp.

Because the area is a permitted coal mine, existing coal processing waste dams, embankments, impoundments, sediment ponds, and refuse piles comply with MSHA regulations governing them. Any new or additional structures proposed for mining the Mill Fork Area shall also be subject to these regulations.

Underground development waste, coal processing waste and excess spoil will continue to be disposed of in accordance with plans approved by MSHA and DOGM. There are no plans to return coal processing wastes to the underground workings at Deer Creek Mine.

R645-301-514. INSPECTIONS

All appropriate engineering inspections and reports will be conducted by a qualified registered professional engineer or other qualified professional specialist under the direction of the professional engineer.

R645-301-515. EMERGENCY PROCEDURES

R645-301-515.10. Reporting a Slope Failure

At any time a slide occurs which may have a potential adverse effect on public, property, health, safety, or the environment, the operator will notify DOGM promptly of the problem and of any remedial measures planned to correct the problem. PacifiCorp will comply with any remedial measures requested by DOGM and agreed upon by the operator.

R645-301-515.20 Impoundment Hazards

No new impoundments are planned for the Mill Fork permit area. At the existing facilities, if any examination or inspection discloses that a potential hazard exists with any impoundment structure, the operator will notify DOGM promptly and detail the emergency procedures required for public protection and remedial action. If adequate procedures cannot be formulated or implemented, DOGM will be notified immediately.

R645-301-515.30 Temporary Cessation

Where temporary cessation of operations is necessary for a period beyond 30 days, the operator will submit proper notification and comply with the requirements of R645-301-300 regarding this action.

R645-301-520. OPERATION PLAN

R645-301-521. Introduction

The plan for ~~the~~ mining in the Mill Fork Area includes references maps, cross sections, narratives, descriptions, and calculations indicating how the relevant requirements are met. The plan describes and identifies the lands subject to coal mining and reclamation over the estimated life of the operations and describes the size, sequence, and timing of the sub-areas for which it is anticipated that individual permits for mining will be sought.

R645-301-521.110. Previously Mined Areas

Areas previously mined at the Deer Creek Mine are shown on Volume 4, Map 1-3 and Maps MFU1840D and MFU1841D included in this section.

R645-301-521.120. Support Facilities

Surface facilities of the Deer Creek Mine include the following: sediment pond, embankment fills, coal surge bin, transfer tower, breaker station, crusher station, coal weigh bin, truck load-out facility, conveyors, overland conveyor, parking lot, parking garage, office-bathhouse, warehouse-shop, materials storage area, access and service roads, mine ventilation fan, power supply and substation, water treatment system, high pressure pumphouse, water storage tank, sewer treatment system, and drainage system (see Volume 5, Maps 3-9 and 3-9A).

Another support facility of the mine is located in the Left Fork of Rilda Canyon. This facility includes an access road and a pad area which supports two portals, a substation, power line, fan, water storage tank, and pumphouse. Topsoil removed prior to construction of the site is also stored within the permit area of the Rilda Canyon facilities. Additional information about this facility is provided in Volume 2, Part 3 and Volume 5, Map 3-9A.

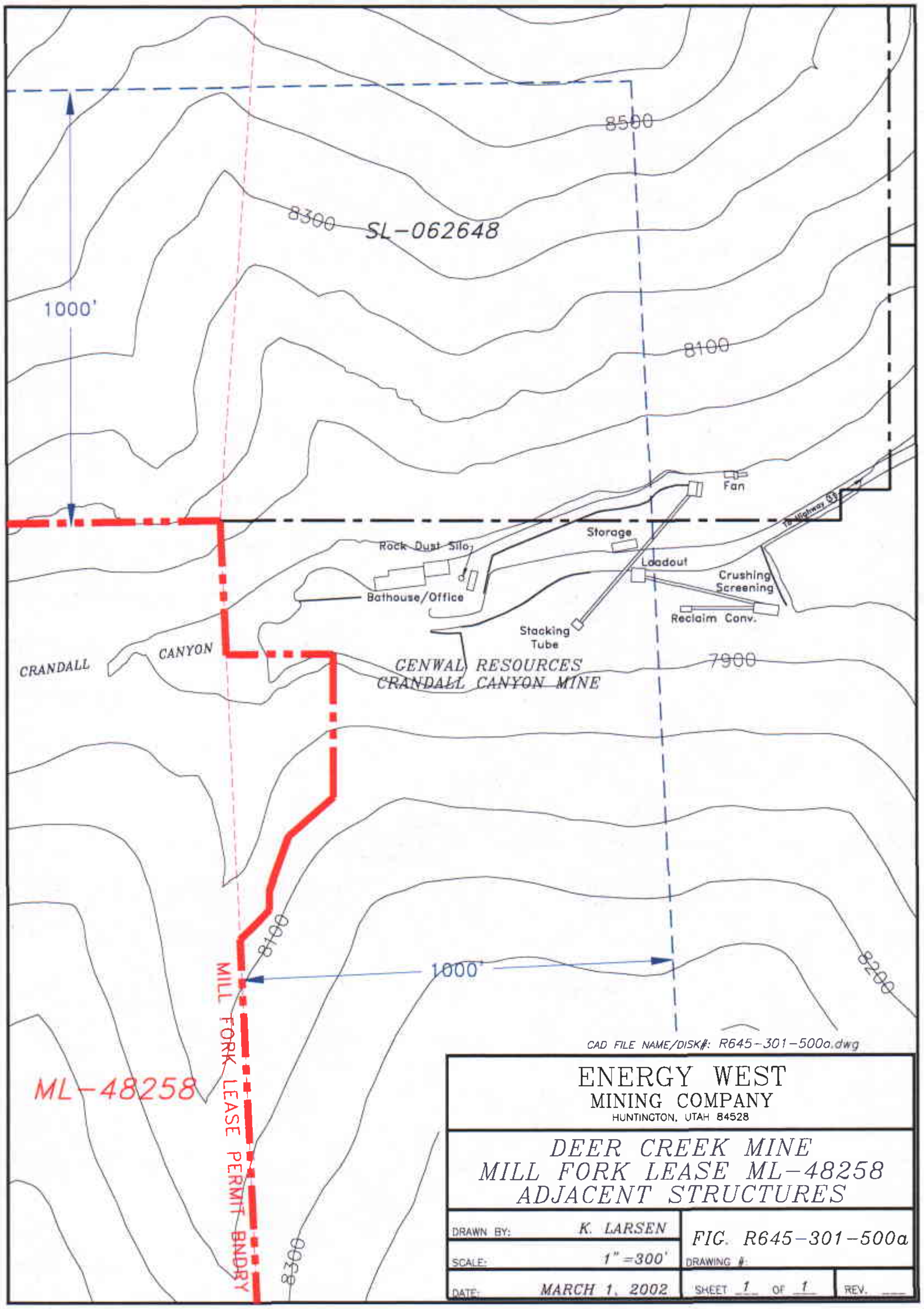
In addition to the Left Fork facilities, PacifiCorp permitted a new facility in Rilda Canyon during 2005, refer to Volume 11 for complete details related to the Rilda Canyon area.

An off-site support facility of the mine is the Deer Creek Waste Rock Storage Facility located northeast of the mine site, near State Highway 31. See Volume 10 of the MRP for more details of the Deer Creek Waste Rock Site. Additional information about all support facilities at the Deer Creek Mine is included in Section 526 of this document.

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7th East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. Prior to any surface disturbance, Energy West will secure all necessary permits.

R645-301-521.121. Location of Buildings

Volume 5, maps 3-9 series (drawings DS202E, DS1812E and CE-10883-EM) and Volume 11 - Engineering Section identify the location of all buildings and structures related to the Deer Creek Mine including Rilda Canyon. The Genwal Coal Mine is located within 1000 feet of the Mill Fork permit area. Figure R645-301-500a identifies the location of all buildings within 1000 feet of the permit area, with the identification of the current use of the buildings.


8500
8300
SL-062648
1000'
8100
Fan
To Highway 31
Storage
Rock Dust Silo
Loadout
Crushing
Screening
Bathouse/Office
Reclaim Conv.
Stacking
Tube
CRANDALL
CANYON
GENWAL RESOURCES
CRANDALL CANYON MINE
7900
8100
1000'
8200
MILL FORK LEASE PERMIT BNDRY
ML-48258
8300
CAD FILE NAME/DISK#: R645-301-500a.dwg
ENERGY WEST
MINING COMPANY
HUNTINGTON, UTAH 84528
DEER CREEK MINE
MILL FORK LEASE ML-48258
ADJACENT STRUCTURES
DRAWN BY: K. LARSEN
FIG. R645-301-500a
SCALE: 1" =300'
DRAWING #:
DATE: MARCH 1, 2002
SHEET 1 OF 1
REV.

R645-301-521.130. Landowners and Right-of-Entry

The landowners of record, both surface and subsurface, included in or contiguous to the permit area are shown on Map MFS1838D and described in the General Section - R645-301-112.

PacifiCorp applied for and received approval for a lease modification of 65.7 acres which connects Federal Coal Lease U- 06039 to the Mill Fork State Lease ML-48258 and grants legal right of entry to the Mill Fork Area.

R645-301-521.140. Mine Maps and Permit Area Maps

Maps MFS1838D, MFU1837D (General Section), MFU18410D and MFU1841D (Engineering Section) shows the existing leases of the permit and the Mill Fork Area along with the boundaries of all areas proposed to be affected over the estimated total life of the coal mining and reclamation operations.

R645-301-521.141. Boundaries of Areas Affected by Mining.

As documented in R645-301-525: Annual Subsidence Survey Procedures, the effects of significant subsidence are assumed to be coincident with the outline of the planned mine workings. Therefore, significant subsidence will not cross outside of the permit boundary. Map MFS1866D projects the affected area boundary based on two methods; 1) angle-of-draw, and 2) actual subsidence case studies from the East Mountain area. As depicted on map MFS1866D, the angle-of-draw method projects potential affected areas beyond the northern permit boundary. Based on historical case studies of actual subsidence, (refer to Figure R645-301-500E and Annual Subsidence Reports), the affected boundary will not exceed the permit boundary. If subsidence occurs outside the permit boundary based on annual subsidence surveys, PacifiCorp commits to amending the permit boundary to include the affected area.

R645-301-521.142. Maps of Planned Subsidence Areas.

Areas in which planned subsidence techniques (as discussed in R645-301-525, SUBSIDENCE CONTROL PLAN and Mining Methods and Subsidence) are to be used are shown on maps MFU1840D (Hiawatha Seam Mine Plan) and MFU1841D (Blind Canyon Mine Plan). These maps show the extent of the areas to be subsided and the sequence in which they will be subsided. As discussed in R645-301.521.141, map MFS1866D shows the extent of projected subsidence (affected area) based on two methods; 1) angle-of-draw, and 2) actual subsidence case studies from the East Mountain area.

R645-301-521.150. Land Surface Configuration Maps

Topographic maps used to depict surface contours with the permit area are shown in Map MFS1866D.

R645-301-521.170/180. Transportation/Support Facilities Maps

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7^{th} East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. Prior to any surface disturbance, Energy West will secure all necessary permits.

R645-301-522. COAL RECOVERY

This section includes a description of the mine plan and measures to be used to maximize the use and conservation of the coal resource. The description attempts to show that coal mining and reclamation operations are conducted to maximize the utilization and conservation of the coal, while utilizing the best technology currently available to maintain environmental integrity. This decreases the likelihood of re-affecting the land in the future through coal mining and reclamation operations.

The Mill Fork Area is governed by SITLA, BLM and DOGM for conservation and royalty payments of the coal scheduled to be mined. Mining plans must be approved by SITLA in cooperation with the BLM for the Mill Fork State Lease and the BLM for UTU-84285 before mining can occur within these areas. A Plan of Operations has been approved and is on file with SITLA to ensure the diligent development and extraction of all minable coal, including the Mill Fork State Lease and UTU-84285.

The lower Blackhawk Formation of the Wasatch Plateau contains two minable seams in this general area - the Blind Canyon (upper) and Hiawatha (lower) coal seams. Interpretation of the surface drilling information indicates that both seams are minable over 50% of the Mill Fork Area. Thus, multiple seam mining will be extensively practiced where the Blind Canyon seam will be mined first and the Hiawatha seam extracted afterwards. This situation requires prudent mine planning and practices to optimize safe mining and resource recovery. Based on previous experience at the Cottonwood and Deer Creek operations with multiseam mining, all main entries are columnized as closely as possible to the upper seam mains and all development gate entries proposed in the lower seam are staggered into the gob of the panel extracted above them by at least 50'. Ongoing exploration including select additional surface holes as well as interseam drilling (approximately 2000' distances along gates) during the mining of the Blind Canyon seam is required to define minable thickness limits and potential quality.

Another major consideration to the overall coal recovery of this area is deep overburden. The area of the Blind Canyon minable seam greater than 2000' of overburden is 40% and in the

Hiawatha minable area accounts for 51%. The maximum overburden exceeds 2600'. This plays a significant part in the layout of the mine plan and a major determinant in the potential reserve recovery. The present layout shows primarily three panels in a series, a barrier and then three more panels for the minimization of potential face stress that may result in face and tailgate bouncing.

The operator will mine, generally to the top rock in all development entries to maintain integrity of the top against abutment pressures exerted by the longwall retreat. Most development entries will be no more than 8 ½' high or seam height to improve safety by limiting the exposure of the miners to high, unstable ribs. If the seam is greater than 8 ½' , bottom coal will be left in the development entries. The physical limitations of the longwall equipment and safety considerations will determine the resultant retreat reserve recovery. Main or submain entries will be developed for long term stability in 3 to 6 entry configuration with pillars ranging from 80' x 80' to 100' x 120' (centers) in size. Longwall development gates will be developed on a two entry yield pillar configuration with a maximum pillar dimension of 50' x 100' centers. This type of layout has been proven in the Deer Creek and Wilberg/Cottonwood/ Trail Mountain mines since the early 1980's and proven very successful in both enhanced safety and reserve recovery.

Although maximum economic recovery is an important design criteria, other considerations must be looked at, especially the ability to mine maximum or minimum thickness or protective coal barriers which must be left in place to ensure the integrity of the mine entries associated with the active underground workings and to protect personnel and the environment. These categories where coal reserves will not be recovered are addressed as follows:

(1) Property Boundary Barriers: All external property boundary lines are protected by a 50 foot (minimum) solid coal "buffer" barrier.

(2) Protective Main Entry Barriers: Protective main entry barriers are designed to protect long term mine entries from excessive abutment pressures of the retreating longwall. Design of these barriers are based on (i) intended duration of use, (ii) depth of cover in the area, (iii) geologic conditions present, and (iv) historical performance of similar sized barriers in similar conditions.

(3) Bleeder Entry Barriers: Bleeder entry barriers are designed to ensure the long term stability of the longwall panel bleeder system. Design of these barriers is based on (i) intended duration of use, (ii) depth of cover in the area, (iii) geologic conditions present, and (iv) historical performance of similar sized barriers in similar conditions. Evaluation of localized conditions at the time of development, in conjunction with the preceding design parameters, will be on-going to determine final barrier sizing so that bleeder entry stability and coal recovery may be optimized.

(4) Subsidence Protective Barriers: No second mining will take place within the following areas:

- Joes Valley Fault: a 22 degree angle of draw from the intersection of the Joes Valley fault on the western boundary of the lease.
-
- Mill Fork Access Development Mains: no second mining will take place under the main entries of the Mill Fork access development.

These are protective barriers for the long term integrity of their respective areas.

(5) Minimum Mining Height: Areas where the coal thickness is less than 7', in particular for longwall development and retreat. Mining below this height is not feasible under current economic conditions and existing equipment complement.

(6) Maximum Mining Height: In panels where the coal height exceeds the effective mining height of the mining equipment, including longwall equipment, either top or bottom coal will be left.

(7) Barriers Between Series of Longwall Panels: Solid coal barriers will be left between particular series of panels to minimize overriding side abutment pressures.

It is expected that recovery rates of approximately 85% can be obtained within the proposed longwall panel areas. The overall minable reserve recovery for the Mill Fork permit area of the Deer Creek Mine is estimated at approximately 60%.

The Deer Creek mining plan is based on the geologic information of the area obtained from outcrops, drilling, and previous mining by the operator. For geologic information of this area, refer to R645-301-600 Geologic Section of this volume.

Table 500-1 provides the approximate number of acres affected by mining in five-year increments for the Mill Fork permit area. In areas of seam overlap, only the first mining in the area is considered in the calculation of acreage. Subsequent mining in the other seam is not considered since the area has already been affected.

Table. 500-1

Area Affected by Mining (acres)

(Based on March 2005 Mine Plan)

Year	Affected Area (acres)
2003-2007	798
2008- 2012	998
2013- 2017	664
2018 - 2022	97

Total Affected Area = 2,557 acres

R645-301-523. MINING METHODS

Continuous Mining Units (Main Entry and Longwall Section Gateroad Development): The principal purpose of the continuous mining units within the Mill Fork Area of the Deer Creek Mine is underground mine development (i.e. section development of mainline entries, longwall section gateroad development, and longwall section setup/bleeder entry development; along with development of mine water holding sumps, rock storage rooms, etc.).

Figure R645-301-500b illustrates the basic configuration of a typical five-entry mains, consisting of (nominal) 20 feet wide entries and crosscuts driven on standard 80 feet x 100 feet entry centers. The pillars created measure a (nominal) 60 feet wide x 80 feet long; a size which has been developed for sufficient support of the main entries and overlying strata. Figure R645-301-500c also illustrates the basic configuration of a typical two-entry longwall panel development, consisting of (nominal) 20 feet wide entries and crosscuts driven on (nominal) 50 feet x 100 feet entry centers. With the retreating longwall mining system, all panel development work is accomplished by continuous mining units prior to longwall installation

Continuous miners will provide the development openings for air, men and materials handling, and other utility services. The support and maintenance of these openings will be according to the approved MSHA Ventilation and Roof Control Plans. The contribution of the continuous miner units to the total production accounts for 15-20% of the total recoverable reserve and will vary from year to year with one to three units operating depending on the development window being maintained ahead of the longwall.

Longwall Mining System:

The predominant mining method to be used in the Mill Fork Area of the Deer Creek Mine will be *Longwall Retreat Mining*. This method, as practiced by PacifiCorp, presents the safest and most efficient underground resource recovery mining method available. About 80-85% of the production will result from the single operating longwall which is planned for use in the Mill Fork Area of the Deer Creek Mine.

As referenced above, the two-entry gateroad system is developed with (nominal) 20 feet wide entries and crosscuts driven on (nominal) 50 feet x 100 feet entry centers. This type of "yield pillar" configuration is designed so that the gateroad pillar 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 by allowing the pillar to significantly crush and minimize the load transferred to the next panel or in the multiseam configuration to eliminate a large barrier to be formed which the lower seam would have to cross under. Figure R645-301-500c illustrates the basic configuration of a retreating longwall system. After gateroad entries are driven to the extent of the longwall panel length, on both sides of the longwall panel, setup and bleeder entries are driven to connect the gateroads. A solid coal barrier is left between the setup and bleeder entries, size based on; (1) intended duration of use, (2) depth of cover in the area, (3) geologic conditions present, and (4) historical performance of similar sized barriers in similar conditions.

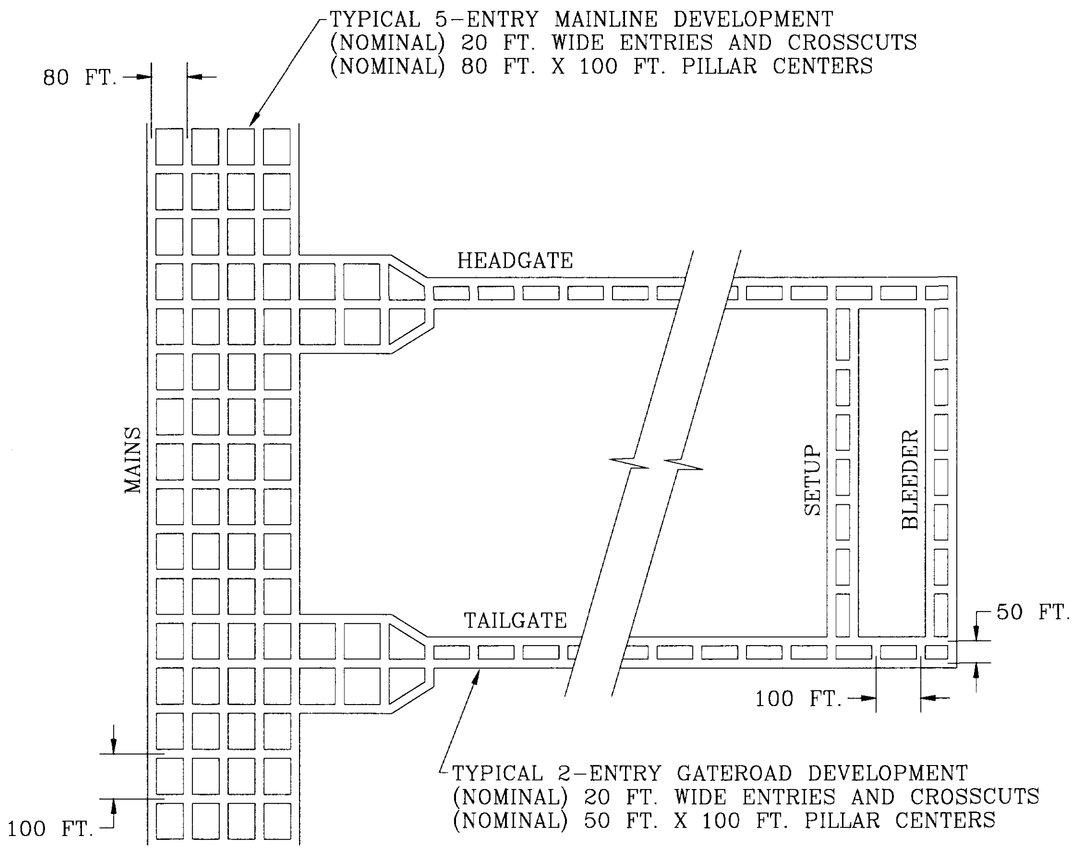


FIGURE R645-301-500b
TYPICAL MAIN ENTRY AND PANEL DEVELOPMENT
FOR THE MILL FORK AREA OF THE DEER CREEK MINE

CAD FILE NAME/DISK#: FIGURE R645-301-500b.DWG

ENERGY WEST MINING COMPANY HUNTINGTON, UTAH 84528	
DEER CREEK MINE *MILL FORK AREA* *LONGWALL PANEL RETREAT*	
DRAWN BY: *K. LARSEN*	*FIG. R645-301-500b*
SCALE: *NONE*	DRAWING #:
DATE: *APRIL 16, 2002*	SHEET *1* OF *1* REV. ___

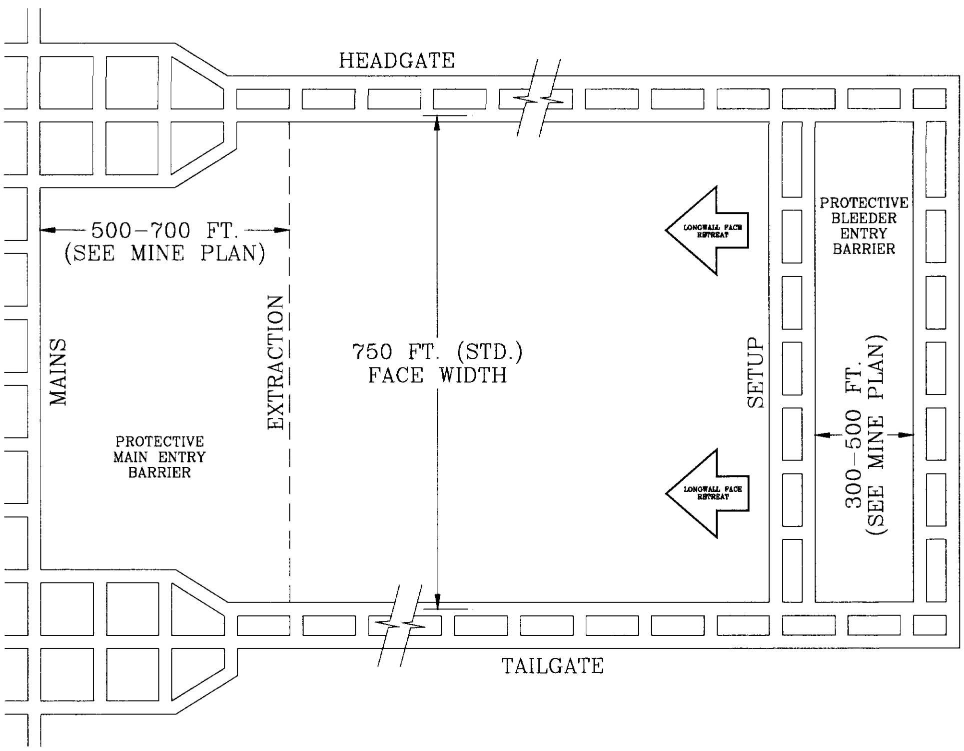


FIGURE R645-301-500c
TYPICAL LONGWALL PANEL RETREAT
FOR THE MILL FORK AREA OF THE DEER CREEK MINE

CAD FILE NAME/DISK#: FIGURE R645-301-500c.DWG

ENERGY WEST
MINING COMPANY
HUNTINGTON, UTAH 84528

DEER CREEK MINE
MILL FORK AREA
LONGWALL PANEL RETREAT

DRAWN BY: K. LARSEN	FIG. R645-301-500c		
SCALE: NONE	DRAWING #:		
DATE: APRIL 16, 2002	SHEET 1 OF 1	REV. ___	

Mine Layout

The mine layout of the Deer Creek Mine for the Mill Fork Area is illustrated on Maps MFU1840D and MFU1841D. The drawings show an arrangement of longwall panels and development sections interconnected by systems of main and sub-main entries. This arrangement is predicated on geographical dedication of reserves, regulatory mining restrictions, available coal quality, and geologic information.

The planned mine development sequence accommodates longwall panels as the primary means of efficiently extracting the reserves. This will ensure the best possible means of maximizing reserve recovery while maintaining consistent coal quality and ground control.

Longwall face width, depending on the geologic parameters of the coal deposit, varies from 500 feet to 780 feet wide. Standard face width is 750 feet center to center (from center-line of head-gate belt entry to center-line of tailgate entry), or 730 feet coal block width. Once installed in the setup entry, the longwall begins retreat mining (from the setup entry "outby" toward the main line entries). A protective barrier is left between the mined out longwall panel (extraction face) and the main line entries that is sized to insure long term main line entry stability.

Panels are designed within the mining area, bounded by natural and imposed limits, with varying degrees of confidence as to final location and extent. Faults may vary somewhat from currently assumed locations. Geologic limitations such as seam splits, channel scours, spars, stratigraphic thinning, burned coal areas, etc. may affect resource recovery by varying the mining limits by hundreds of feet as information becomes available and as mining recovery economics and practicality are further refined. Regulatory mining restrictions, such as escarpment protection barriers and perennial stream buffer zones further confine mining extent. Geotechnical restrictions, largely associated to deep overburden and massive geology may definitely reduce the amount of coal recovered as fewer panels may be able to be mined in a series or safety concerns with potential "bouncing or bursting " conditions persist.

Geotechnical Considerations to Mine Layout

The mine layout of the Deer Creek Mine for the Mill Fork permit area is illustrated on Maps MFU1840D and MFU1841D. The mine layout for this area is designed to be able to mine a large multi-seam area under deep cover by the safest manner and optimize reserve recovery. It is accessed from the North Rilda area in the Hiawatha Seam and crossing the Lease Modification No. 3 area into the Mill Fork Area with a six entry mains development which allows for crossing in a thicker seam. The layout and long term development plan for the Mill Fork Area is centered around optimum placement of the mains, panels and barriers. The mains are developed on the eastern perimeter of the 7' coal isopach which allows also for the shallowest cover for long term integrity. The mains on one side also allow for extended longwall panel lengths and decrease the number of frontal barriers left for longwall panels. The number of panels in a series has been generally kept to three to minimize the resultant increasing stresses created in the deep cover with side abutment contributions.

From the multi-seam consideration, the Blind Canyon (80' to 140' interburden) would be accessed as soon as possible from the Hiawatha Mains by means of rock slopes and a coal transfer shaft so that extraction of the upper seam will take place first. As the Hiawatha seam is developed, its mains also are on the eastern extent of the 7' coal isopach and panel lengths are maximized. The gate entry developments are developed under the gob of the Blind Canyon panels, offset a minimum of 50' from the gate developments of the Blind Canyon. This allows for a more stable development in the Hiawatha seam and higher stresses which may result from remnant pillars above may be absorbed on the longwall face below. Also, the barriers that are shown between the series of panels in the Hiawatha are outside or larger than the barriers left in the Blind Canyon. This is to insure that no high stress barrier will have to be "split" by the lower seam developments. Also, all frontal barriers or barriers between series of panels is established at a minimum of 500' which historically in deep cover in this region is required.

Mine Production and Equipment

It is expected that an average production rate of 1,000 tons/machine shift for continuous miners and 9,500 tons/machine shift for longwalls will be the production rate in the Mill Fork permit area. Table 500-2 lists the anticipated annual and total production of coal from the Mill Fork permit area. This translates into two miner sections and one longwall section operating 2 shifts/day, 190 days/year in order to achieve the required coal output at full production. These production shifts are 10 hour shifts normally producing Monday through Thursday, with supplemental production and necessary construction performed by assigned workers on the weekend crews (Friday through Sunday).

Table 500-2

Mill Fork Permit Area Anticipated and Total Production

(Based on March 2005 Mine Plan)

Year	Tons	Year	Tons
2003	34,567.08 (actual)	2012	3,802,447
2004	561,769.84 (actual)	2013	3,734,935
2005	77,273.42 (actual Jan. & Feb.) 2,358,135 Projected Total 2,435,408	2014	3,514,229
2006	3,937,024	2015	3,759,786
2007	3,731,671	2016	3,761,643
2008	3,691,566	2017	3,631,342
2009	3,902,3394,260,357	2018	3,705,936
2010	3,548,291	2019	3,563,862
2011	3,663,544	2020	3,388,821
		2021	44,232

Total Tons = 58,413,413

All in-mine coal haulage is by belt conveyor. Of the total entries in the main entry system, at least one entry is dedicated specifically to the belt conveyor. All mine personnel and materials are transported underground by diesel equipment. Table 5 (Volume 2, Part 3) lists the major ancillary equipment used in Deer Creek Mine.

The extracted coal is sized in the Deer Creek coal handling facility and conveyed to the PacifiCorp - Huntington Power Plant, approximately two miles away. A portion of the coal is also trucked from the Huntington Plant coal yard and transported via truck to supplement the fuel requirements at the Carbon and Hunter Power Plants.

R645-301-524. BLASTING AND EXPLOSIVES

The Deer Creek Mine is a developed and producing underground mine and there is no anticipated need for any blasting activities incident to the underground mining activities. However, if circumstances develop that require surface blasting activities, a plan will be initiated in accordance with DOGM regulations in R645-301-524.

R645-301-525. SUBSIDENCE CONTROL PLAN

This section describes in detail the operator's plan to ensure minimal environmental impacts from mine-induced subsidence. The Engineering Section - Operation Plan plus the Geology Section (R645-301-600) present the detailed data on which the analytical approach for the subsidence control plan is based. The following subsections describe the principal factors involved in controlling subsidence impacts resulting from the proposed mining operations.

Subsidence Damage Probability Survey (Pre-Subsidence Survey)

Multiple surveys have been conducted on the portion of the surface of East Mountain that could possibly be affected by the full extraction or second mining of coal from the Mill Fork Area. The U.S.D.A. Forest Service (the exclusive surface management agency) has extensively addressed pre-subsidence issues in the Environmental Assessment for the Mill Fork Lease Tract, LBA #11.

It has already been determined that there are renewable resources present in the area in the forms of springs, water seeps, grazing land, timber, and wildlife. Also present in the permit area are unimproved roads, trails, a gas well and pipelines, power transmission lines, and some portions of the Castlegate Sandstone escarpment (see Pre-Subsidence Survey Map [Map MFS1839D - Refer to Confidential and Private Volume Deer Creek tab Volume 12 R645-301-500 Engineering]).

Known springs and seeps that are located within the Mill Fork Area second mining areas are shown on the Pre-Subsidence Survey Map (Map MFS1839D, Refer to Confidential and Private Volume Deer Creek tab Volume 12 R645-301-500 Engineering). Volume 9 Hydrologic Section of the MRP, Appendix A, contains a listing of sampling sites and a monitoring schedule. Most of the streams within the permit area are ephemeral and/or intermittent. The streams that flow into Mill Fork Canyon are fed by springs that emanate primarily in the North Horn Formation within the permit boundary. Portions of the headwaters of the drainage basins that feed Crandall and Rilda canyons are within the Mill Fork Area. Second mining, i.e. longwall extraction or room & pillar mining, of the Mill Fork Area will not occur beneath the main stream channels of these canyons. First mining development of access mains from Deer Creek Mine to the Mill Fork Area will occur to the north of the Right Fork of Rilda Canyon.

The entire permit surface area is utilized for grazing of sheep and cattle during the summer season. Experience from the existing PacifiCorp permit areas has shown that the effects of subsidence on grazing and grazing lands are minimal (refer to R645-301-300: Biology and/or Supplemental Volume 1, Lease Relinquishment).

All existing timber resources on the Mill Fork permit area are administered by the U.S.D.A. Forest Service. Experience on the existing PacifiCorp permit areas over the last 25 years has shown that subsidence does not affect timber resources or access to timber resources (refer to R645-301-300: Biology and/or Supplemental Volume 1, Lease Relinquishment.

Wildlife resources in the permit area are explained in detail in the Wildlife section of this permit application. Experience on the existing PacifiCorp permit areas over the last 25 years has shown that the effects of subsidence on wildlife resources are minimal (refer to R645-301-300: Biology and/or Supplemental Volume 1, Lease Relinquishment.

Only two roads (administered by the U.S.D.A. Forest Service) cross the permit area. These are the Flat Canyon Road, #145, and the East Mountain Road, #244. The Flat Canyon road serves as the access road to the gas well Federal #23-32 and to the top of the north end of East Mountain, and has been graveled and graded. No portion of the Flat Canyon road will be undermined. The East Mountain road, #244, is an unimproved dirt track that winds along the top of the main ridge. This road traverses the main second-mining areas of the Mill Fork Area. The road ends in the north half of Section 11, T.16 S., R.6E, and continues to the north as a pack trail. Several smaller roads and tracks branch off from this main road, but are minor in nature.

Two numbered foot and horse trails are present. The Mill Fork Canyon trail (#391) starts at the top of East Mountain, follows the Mill Fork canyon bottom to the switchback on the main Mill Fork Canyon road (outside the permit boundary). The reclaimed road that follows the top of the ridge between Mill Fork and Crandall canyons (#086) was first constructed during the 1960's as a fire-fighting access road, and later used by ARCO Coal Company to drill several exploration core holes along the ridge. ARCO Coal Company reclaimed the road in 1982. A foot / horse trail follows the track of the old road. These trails should not be affected by subsidence.

A single gas well, own and operated by Merit Energy, is located within the permit area (identified as Federal #23-32), near the center of Section 23, T.16 S., R.6E. This is a producing well, with an attached transmission pipeline. A gas transmission pipeline extends from this well south along forest road #244 for about 2,000 feet, then exits the permit area to the south. The well is near the southern extent of the mine plan. PacifiCorp and Merit Energy entered into an agreement to establish a working relationship regarding multiple mineral development to insure the maximum utilization of the coal and oil and gas estates in certain lands in Emery County, Utah all in the interest of the conservation and full utilization of natural resources.

As stated in the agreement, "Merit is the owner and operator of a producing gas well in the Area of Interest identified as Well No. 32-23. The well was drilled in 1989. PacifiCorp is conducting active coal mining operations in the Area of Interest in the immediate vicinity of Well No. 32-23 by and through Interwest Mining Company, a wholly owned subsidiary, as its managing agent, and Energy West Mining Company, another wholly owned subsidiary, as mine operator. These mining operations are in the Deer Creek Mine in the 12^{th} West longwall panel, off of the 7^{th} North Mains. It is anticipated that the full extraction of PacifiCorp's 12th West longwall panel could potentially cause a subsidence impact on Well No. 32-23. The parties wish to enter into a proactive agreement to establish the working relationship among the parties as this multiple mineral development activity takes place so as to insure the safe and effective compatible usage of both the coal and the oil and gas estates and to achieve maximum economic recovery of these natural resources". The multiple mineral development agreement was signed by all parties (PacifiCorp, Merit Energy, Division of Oil, Gas & Mining and SITLA) and became effective on August 12, 2005. This agreement achieves the purpose and intents of Utah Administrative Code R649-3-27.2 such that a cooperative agreement exists between Merit and PacifiCorp which allows multiple mineral development.

Energy West will report of the subsidence monitoring related to Well No. 32-23 in the Annual Subsidence Reports.

Another gas pipeline segment is buried along forest road #017 in the southwest corner of the permit area. This pipeline will not be undermined.

Two power transmission lines are present within the permit area. The largest is the Utah Power 345 KV line that crosses the southwest corner of the permit area in Section 22, T.16S., R.6 E.. The "Plan of Operations" approved in November 2002 included mining adjacent to the powerline over the western end of the 11th West - 12th West Hiawatha longwall panel. Development mining in 11th and 12th West intercepted an extensive split in the Hiawatha seam which limited western development. Based on an revised mine plan, mining will not affect the 345 KV line.

A second transmission line (25 KV) carries electricity from the lower portion of Mill Fork Canyon over the top of Mill Fork Ridge, and down into Crandall Canyon, to the Genwal Mine. This line crosses the small portion of the permit area that projects eastward (NW ¼ NW ¼ Section 8, T.16S. R.7 E.). This transmission line will not be undermined.

Genwal Coal Company maintains a radio repeater at the Mill Fork summit in Section 7, T.16S. R.7 E.. This repeater will not be undermined.

The Castlegate Sandstone outcrop and escarpment are exposed in several portions of the permit area (see the Pre-Subsidence Survey Map, MFS-1839D, PacifiCorp Private and Confidential Volume Deer Creek tab, Volume 12 R645-301-500 Engineering). Some of the outcrops to be undermined by second mining are shown in sections 1 and 12, T.16. S., R.6 E., and sections 6 and 7 of T. 16 S., R. 7 E. Subsidence of the Castlegate Sandstone escarpment has caused occasional cliff failures and rock falls in previous mining areas such as Newberry Canyon and Corncob Wash (Cottonwood Mine), Trail Mountain (Trail Mountain Mine 3rd East Longwall), and Rilda Canyon (Deer Creek Mine 8th West, 7th East and 9th East Longwalls). The Castlegate Sandstone is also exposed in Upper Joes Valley along the western edge of the permit area. Cliff outcrops of the Castlegate Sandstone are small and infrequent on the Mill Fork permit area. Based on the current mine plan no cliff exposures of the Castlegate Sandstone on the Joes Valley side will be undermined by second mining. The Castlegate Sandstone exposures on the Joes Valley side of the permit area are mostly protected by the 22° angle-of-draw buffer zone to prevent second mining under the Joes Valley Fault. The 22° angle-of-draw buffer zone is a requirement (Stipulation #19) of the Environmental Assessment of the Mill Fork Lease Tract, LBA #11, prepared by the U.S.D.A. Forest Service, in which stipulations for leasing the tract were published. According to the E.A., only small failures of the Castlegate Sandstone are to be expected as a result of mine subsidence. Most of the exposed Castlegate outcrops within the Mill Fork Area will not be undermined by second mining.

No other structures, man-made or otherwise, are present on the Mill Fork Area that could be damaged by mine-induced subsidence.

Subsidence Angle of Draw Calculation:

The use in subsidence – related calculations of a 15 degree angle of draw (to the outside limit, or zero ground movement, refer to section below entitled Annual Subsidence Survey Procedures for the projected affected area) is an industry/agency accepted standard used for delineation of surface influence protection from mining areas considered for full extraction mining. Mining experience at Energy West's Deer Creek, Cottonwood, and Trail Mountain mines has provided a sound, scientific basis for using the 15° angle of draw mentioned above (refer to Annual Subsidence Reports of the Deer Creek MRP).

The angle of draw of subsidence produced by full-extraction mining can be influenced by many factors. These include the size and shape of the area mined, number of seams mined, thickness of the coal extracted, depth of overburden, overburden composition, bedding and jointing characteristics of the overburden, fractures or faults in the overburden, adjacent mine workings, and adjacent areas of burned coal and clinker.

Based on data collected by the U.S. Bureau of Mines and over twenty years of subsidence data collection on East and Trail Mountains, the angle of draw in typical mining conditions is found to be between 0 and 15 degrees from vertical. In some limited areas, the angle of draw is greater than 15 degrees, but in every case, the angle is greater due to the influence of one of the other factors mentioned below.

Faults can influence the angle of draw. If mining occurs adjacent to an existing fault, the area of subsidence will follow the natural plane of weakness formed by the fault. In this case, the angle of draw will be the same as the dip of the fault.

Prehistoric burning of near-outcrop coal creates a partially collapsed rubble or "clinker" zone above the burned out coal, susceptible to further collapse under additional stress. If mine workings extend to an area of burned coal experience has shown that the overburden stresses above the mined area can be transferred to the adjacent burned coal and clinkers which may cause the clinkered areas to collapse or fail. In this case, the angle of draw may appear to be very shallow as the area of subsidence will encompass the mined area plus the clinker collapse area. The failure of the susceptible clinkered areas is the source of subsidence outside the normal area of influence.

For planning purposes, any barrier of protection left in the mine to protect surface features should use a 15 degree angle of draw unless one of the factors mentioned above is known to exist in the immediate area.

Mining Methods and Subsidence

Subsidence at the surface is minimized when mining areas are simple in shape, and mining extraction is complete and consistent within those areas. The operator intends to minimize surface effects of subsidence by using, wherever practical, the longwall mining method and mining the coal deposits as completely as possible. Approximately eighty percent (80%) of the recoverable coal reserve will be mined by the longwall method, the remaining area will be mined by continuous miner units.

The longwall mining method allows almost total extraction of the coal and induces caving of the immediate and upper roof strata. As the coal seam is extracted, the overlying strata cave rapidly. The caving process has been shown to propagate to within 100 feet of the surface in less than two weeks after mining. This was determined by a cooperative study conducted by the U.S. Bureau of Mines using Time Domain Reflectometry (TDR). In this study, a coaxial cable was cemented within a drill hole positioned near the center of the 14th West longwall panel in the Cottonwood Mine. As the caving of the strata occurred, the cable would shear or be stretched. The depth of the shears and stretches were identified with instruments on the surface.

The data collected from this study is contained in Volume 3, Appendix IV of the Deer Creek MRP. Surface subsidence has been observed within two months of the coal extraction. In most areas, the subsidence will stabilize within 2 years of mining.

It is the operators intent to arrange longwall mining areas in large enough blocks of longwall panels as present mining technology or equipment allows in order to minimize the perimeter areas which would be on the sloping edges of the subsidence troughs. The "chain" pillars of support for the longwall gate roads have been designed on the yielding pillar principle so that they will yield to destruction and not impede subsidence within the blocks of panels.

The size of the support coal pillars used in main entries for both the Blind Canyon and Hiawatha seams to ensure long term stability has been determined by basic calculation for the deepest expected cover (from prior mining practice in the area) and USBM studies. Experience has also shown that, in multi-seam mining circumstances, columnizing main entry development pillars in both seams is essential for long term main entry stability.

Full extraction areas, by definition, are planned and can control subsidence in areas. It is anticipated that the planned subsidence will result in a generally uniform lowering of the surface lands in broad areas, thereby limiting the extent of material damage to those lands and causing no appreciable change to present land uses and renewable resources. Subsidence prediction work has shown that the expected maximum planned and controlled subsidence will vary from zero to fifteen (0-15) feet, assuming that the total cumulative extraction from the two seams will not exceed twenty (20) feet.

Subsidence Monitoring Plan

The establishment of a subsidence monitoring plan is a requirement of the Stipulations section (No.7) of the Environmental Assessment for the Mill Fork Lease Tract, LBA #11, Page A-2 by the U.S.D.A. Forest Service.

The operator initially adopted a twofold approach to subsidence monitoring:

1) aerial photogrammetry,
2) on-the-ground monumentation.

After seven years of comparing the two types of surveys it was determined that both methods 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 State of Utah

Division of Oil, Gas & Mining (DOGM), the operator discontinued on-the-ground monumentation and now collects subsidence data solely by aerial photogrammetry.

The subsidence monitoring program, conducted since 1980, has produced data which not only document the amount of subsidence that has occurred but also allows the operator to predict the amount of subsidence that is likely to occur when mining in new areas. The detail of the data collected in years past is not included herein. This report is submitted annually to the BLM, USFS, and the Utah Division of Oil, Gas, & Mining.

Aerial Photogrammetry

PacifiCorp's subsidence monitoring program is primarily based on aerial photogrammetry. PacifiCorp has been using aerial photogammetry - based subsidence modeling since 1980. This method has proven to be the best way to collect subsidence data on East Mountain. A baseline photogrammetric survey was conducted in 1980 that included over 21,000 elevations measured on approximate 200-foot spacing grid. In flat areas with limited vegetation, the elevations can be read from the photographs with a precision of one-half foot. In steeper areas, where cliffs are present, the resolution is not as good, and inaccuracies of greater than ten feet can occur. In steeper areas, photogrammetric monitoring can, and has been, augmented by conventional survey data.

Annual Subsidence Survey Procedures

Aerial photographs of the entire Mill Fork permit area will be used in conjunction with 51 widely spaced survey control points on the ground (see Map MFS1857D, Flight Paths with Survey Control) to produce a digital elevation model of the ground surface in successive years from which a surface subsidence map is generated for each year. The ground control points are marked and surveyed using conventional survey methods, then flagged so that they can be seen in photographs taken from the air. Approximately 100 aerial photographs of the permit area will be taken along 7 flight lines that traverse the permit area from north to south. Overlapping portions of photographs taken from successive viewpoints along the flight lines produce stereoscopic views of the ground surface. These 93 views of overlapping photograph pairs are called "models" in the photogrammetric process. Elevations of the ground surface over the entire permit area are then calculated using a computer-aided stereoplotter, and verified using the 51 known survey points. Ground elevations are calculated for a grid of approximately 200-foot centers, optimized for terrain. The baseline data, including surveying and flagging ground control points, acquiring the aerial photographs, and generating the surface grid and map, for the Mill Fork Area were collected in 2000 (refer to MFS1857D Mill Fork Lease ML-48258 Subsidence Survey: Flight Lines with Survey Control) . These elevations will then be compared to elevations measured from the photographs taken annually in each summer. Using this method, ninety percent of the points measured will be accurate to within plus or minus one-half foot.

PacifiCorp participated with the governmental agency task force which included representatives from the Bureau of Land Management, Forest Service and the Division of Oil, Gas and Mining, to develop *"Memorandum of Understanding for Processing of Requested to Relinquish Federal Coal Leases (10-MOU-97-001)"*. This document established "Standards for Relinquishment Consideration" including the amount of accepted variation in annual subsidence data. As stated in the MOU, the area will be considered stable, if the cumulative subsidence during the period (3 years) has been 1 foot or less under normal circumstances. Based on this agreement, subsidence measurements and areas and subsidence areas shown on PacifiCorp's annual subsidence maps show areas of total measurable subsidence greater than two feet. PacifiCorp's experience on East Mountain since 1980 has shown that the areas of minimum detectable subsidence, i.e., one foot or more, very rarely extend outside of the outline of the total mine workings, even in areas where more than one seam has been mined. Figure R645-301-500d compares the predicted verus actual subsidence for the Deer Creek Mine (data from cooperative study conducted by the United States Bureau of Mines and PacifiCorp). The angle of draw for subsidence used in future mining areas should be 0°, or the outline of the planned mine workings in areas unaffected by faulting or near surface burned coal. Figure R645-301-500e depicts actual subsidence measured at the Deer Creek Mine north of the Roans Canyon Fault system (additional case studies can be observed in the Annual Subsidence Reports.

The applicant or applicants contractor will maintain survey control aerial targets within the permit boundary necessary to allow the interpretation of coordinate points on photos within $\pm$0.5 foot. Following this procedure the operator will conduct annually an aerial photo survey of all areas which have been undermined. The operator will continue monitoring all areas undermined until the operator and DOGM agree that the subsidence in a given area has become stable and no further monitoring is necessary. The findings of the survey will continue to be reported to DOGM annually in a summary report.

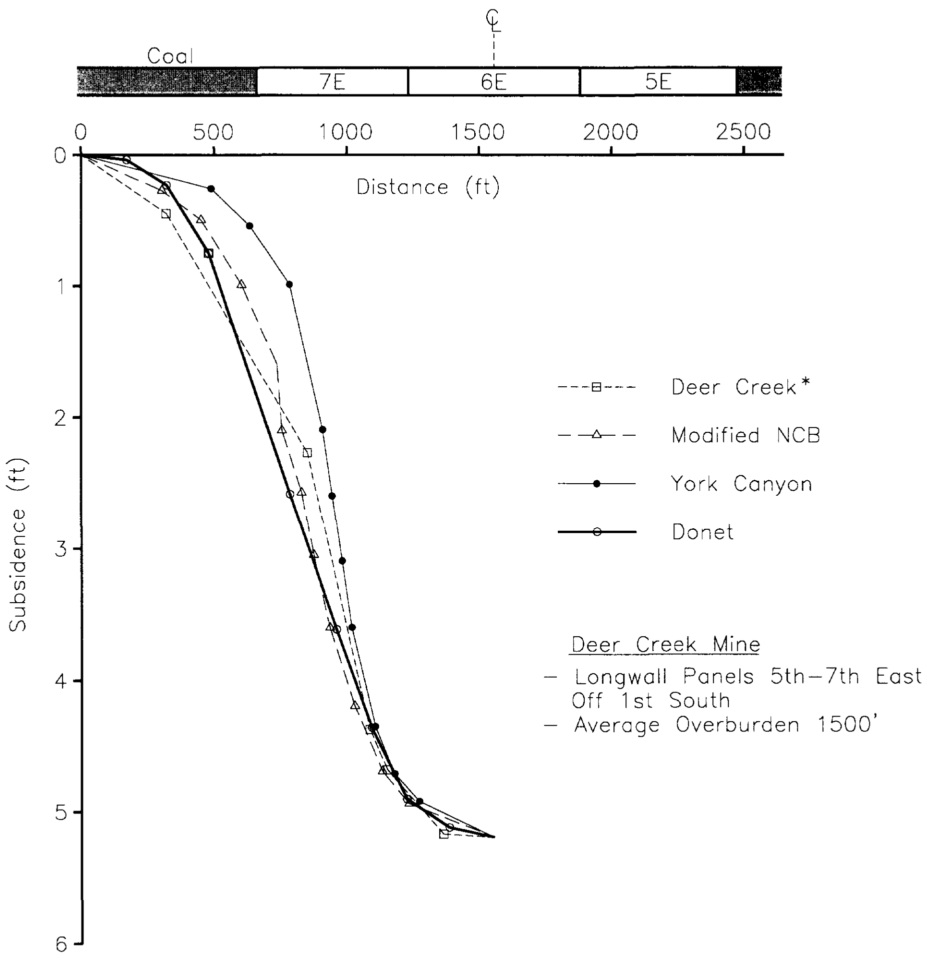
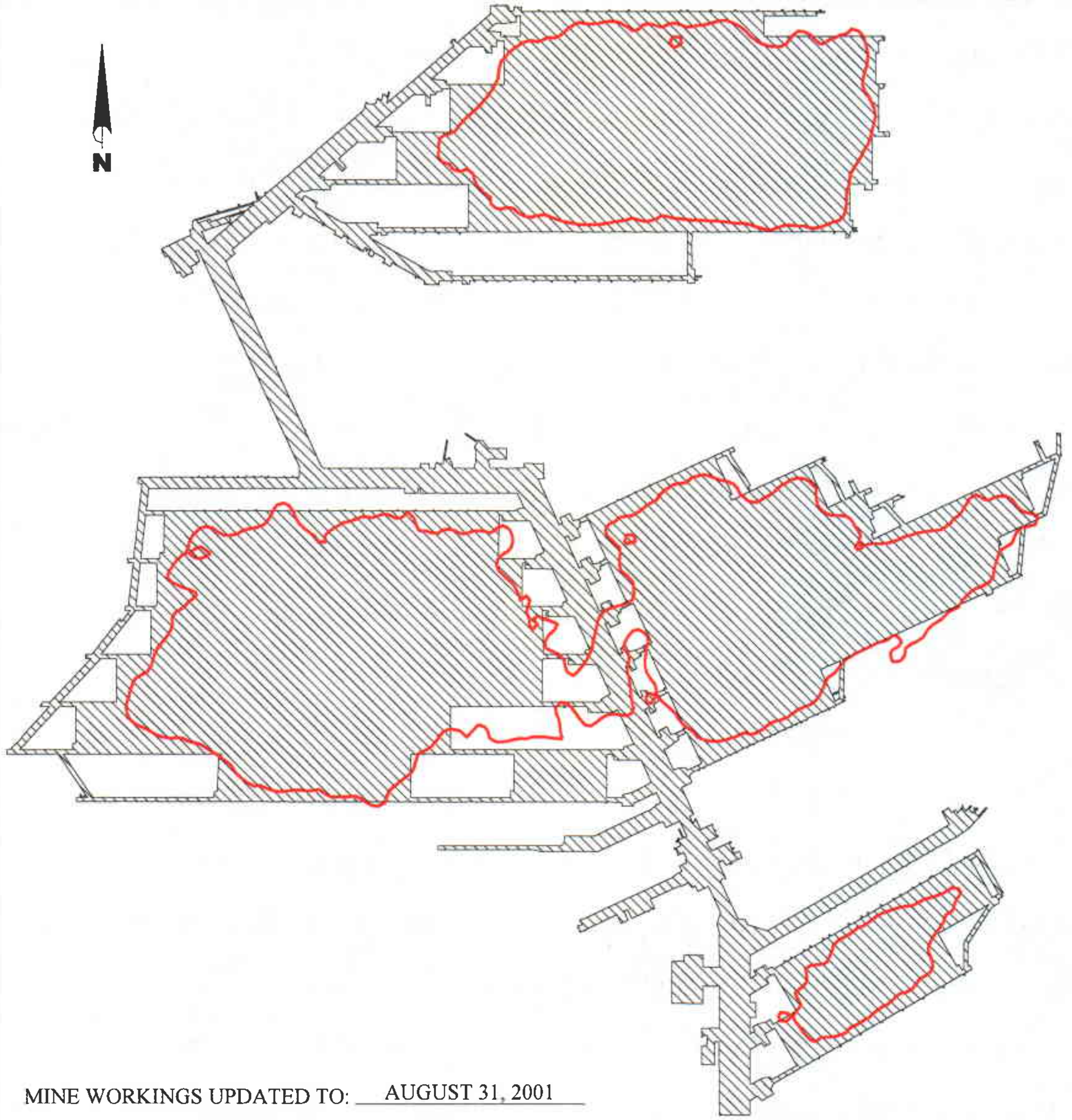


FIGURE R645-301-500d
MEASURED AND PREDICTED SUBSIDENCE
FOR THE MILL FORK AREA OF THE DEER CREEK MINE

CAD FILE NAME/DISK#: FIGURE R645-301-500d.DWG

*Reference
- United States Bureau of Mines Case Study 1985
- Maleki, Hamid, Subsidence Characteristics in U.S. Coal Mines, 1999

ENERGY WEST MINING COMPANY HUNTINGTON, UTAH 84528	
DEER CREEK MINE MILL FORK AREA MEASURED AND PREDICTED SUBSIDENCE	
DRAWN BY: K. LARSEN	FIG. R645-301-500d
SCALE: NONE	DRAWING #:
DATE: APRIL 16, 2002	SHEET 1 OF 1 REV. ___



MINE WORKINGS UPDATED TO: AUGUST 31, 2001

CAD FILE NAME/DISK#: 500 Engineering\FIGURE R645-301-500e.DWG

EXTENT OF MEASURED SUBSIDENCE
(1 FT. CONTOUR LINE)
FOR ADDITIONAL CASE STUDIES
REFER TO ANNUAL SUBSIDENCE
REPORTS

ENERGY WEST
MINING COMPANY
HUNTINGTON, UTAH 84528

DEER CREEK MINE
NORTHERN AREA
ACTUAL AFFECTED BOUNDARY

DRAWN BY: K. LARSEN	FIG. R645-301-500e	
SCALE: 1" =2400'	DRAWING #:	
DATE: NOVEMBER 29, 2002	SHEET 1 OF 1	REV.

Special Monitoring - Castlegate Cliff Escarpment

Under the currently proposed mine plan for the Blind Canyon and Hiawatha seams, the amount of Castlegate Sandstone outcrop area that would be mined is only a fraction of the total Castlegate Sandstone outcrop area. Segments of the Castlegate Sandstone outcrop to be undermined by full extraction mining are discussed below (see also Map MF-1839D, Refer to Confidential and Private Volume Deer Creek tab, Volume 12 R645-301-500 Engineering). Approximately 3,700 linear feet of outcrop along the north slope of the right fork of Mill Fork canyon will be undermined by a single seam. Of this, about 375 feet are concealed by vegetation and soil, 1,840 feet are steep or rocky slopes, and about 1,490 feet are cliff exposures. Of this, approximately about 2,500 feet of outcrop will be undermined by second mining. Except for about 1,490 feet of cliff exposures, the remaining portion of the outcrop is rocky slopes.

The Castlegate Sandstone formation exposures in the Mill Fork Area contain fewer cliffs than areas to the south and east. This is due mainly to increased vegetative cover, especially on north-facing slopes. Due to the limited cliff exposures of the Castlegate Sandstone, the limited amount of Castlegate Sandstone exposures to be undermined, and the remoteness of these outcrops, no special monitoring or mine layout protection measures are planned for the escarpment in this area. The exact amount of Castlegate outcrops to be undermined by Blind Canyon and Hiawatha seam panels on the north side of the right fork of Mill Fork Canyon is unknown at this point as the exact layout of the panels has not been determined. The layout of these panels will be finalized after the surface exploration drilling program of summer 2006 is conducted. As there are no roads or structures down the fall line from these outcrops, no safety hazard is created.

Mitigation of Subsidence Damage Effects

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 similar presubsidence uses.

In order to restore any land affected by operations to a condition capable of supporting the current and postmining land uses stated herein, the operator will replace water (including State Appropriated Water Supplies: refer to R645-301-700.530 and Hydrologic Table MFHT-2) determined to have been lost or adversely affected as a result of operator'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 postmining land uses as stated herein. For a complete discussion including a list of State Appropriated Water Supplies within and adjacent to the Mill Fork permit area refer to R645-301-731.530 and Hydrologic Table MFHT-2.

During the course of regular monitoring activities required by the permit, or as the operator otherwise acquires knowledge, the operator will advise DOGM and the surface land management agency of the loss or adverse occurrence discussed above, within ten working days of having determined that it has occurred. Within ten working days after DOGM notifies operator in writing that it has determined that the water loss is the result of the operator's mining operation, the operator will meet with DOGM 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 DOGM, the plan shall be implemented. The operator reserves the right to appeal

DOGM'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).

Should any structure such as roads, (FDR-244), power line and related facilities, be adversely impacted as a result of subsidence directly related to the operation of the Deer Creek Mine, (including the Mill Fork State Lease ML-48258/UTU-84285), PacifiCorp will repair or replace the structure. PacifiCorp will inspect FDR-244 annually for damage and will repair any damages at the expense of PacifiCorp. The annual inspection will include review for tension cracks and buckling, followed by restoration of the road surface as necessary. PacifiCorp will notify the Forest Service if any inspection identifies any subsidence related feature which requires restoration.

Section Corners and Monuments

PacifiCorp commits to comply with Special Lease Stipulation #16 which states "The Lessee, at the conclusion of the mining operation, or at other times as surface disturbance related to mining may occur, will replace all damaged, disturbed or displaced corner monuments (section corners, ¼ corners, etc.), their accessories and appendages (witness trees, bearing trees, etc.), or restore them to their original condition and location, or at other locations that meet the requirements of the rectangular surveying system. This work shall be conducted at the expense of the Lessee, by a professional land surveyor registered in the State of Utah, and to the standards and guidelines found in the Manual of Surveying Instructions, United States Department of the Interior.

Subsidence Control

The operator 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 preceding subsidence control plan.

Lease Boundary Subsidence Barrier

The northern boundary of this lease adjoins leases currently being mined by Genwal Coal Company. Genwal's current mining and future mining will be within 100 feet of the northern permit boundary along its entire length. BLM has previously recommended that Pacificorp leave a 50-foot barrier between mine workings and permit boundaries. Pacificorps current mine plan uses a 100-foot barrier along the lease / permit area boundary in the Blind Canyon (upper) seam, which is planned to be mined first, as a precaution against overlapping the underlying Genwal workings in the Hiawatha seam which are known to cross the permit boundary line in at least one area. In the Hiawatha seam, a 400 - foot barrier will be left as a side abutment barrier to isolate Pacificorps longwall panels on the south side of the permit boundary from extracted Genwal longwall panels on the north side of the boundary.

As stated in R645-301-525: Annual Subsidence Survey Procedures, the effects of significant subsidence are assumed to be coincident with the outline of the planned mine workings. Therefore, significant subsidence will not cross outside of the permit boundary. Map MFS1866D projects the affected area boundary based on two methods; 1) angle-of-draw, and 2) actual subsidence case studies from the East Mountain area. As depicted on map MFS1866D, the angle-of-draw method projects potential affected areas beyond the northern permit boundary. Based on historical case studies of actual subsidence, (refer to Figure R645-301-500E and

Annual Subsidence Reports), the affected boundary will not exceed the permit boundary. If subsidence occurs outside the permit boundary based on annual subsidence surveys, PacifiCorp commits to amending the the permit boundary to include the affected area.

Based on the current knowledge of the coal reserves on the south and east sides of the permit application area, no second mining will occur close enough to these permit boundaries to warrant a boundary protection barrier. As mentioned in the PROBABLE HYDROLOGIC CONSEQUENCES DETERMINATION section, (728: Hydrologic Balance - Surface Water System), the drainages conveying runoff away from the permit areas are streams in Rilda, Mill Fork, and Crandall canyons. Second mining, i.e. longwall extraction, of the Mill Fork area will be limited to the main ridge of East Mountain, underlying the headwaters of these canyons and subsidence will not occur beneath the stream channels of these canyons. Riparian zones that might exist along the canyons that form the headwaters of these streams are in areas of more than 600 feet of cover, where subsidence effects will not cause damage.

Joes Valley Fault Subsidence Barrier

Along the western boundary of the permit application area, the U.S.D.A. Forest service has stipulated a 22° angle of draw barrier to protect the Joes Valley Fault from mine-induced subsidence effects. This barrier also prevents subsidence – related effects from crossing the permit area boundary to the west. For completed discussion related to the location of the Joes Valley Fault, refer to R645-301-620 Structural Features: Geology Chronology of the Depiction of the Joes Valley Fault in Various Publications. The width of this barrier was calculated as follows: Using field reconnaissance, topographic maps, and low-altitude aerial photographs, the trace of the Joes Valley fault was drawn on the base map. At several locations along the trace of the fault, the elevation of the fault trace was interpolated from the surface elevation contours. The elevation difference between the fault trace and the projected elevation of the lowest seam to be mined (the Hiawatha) was calculated. This elevation was multiplied by the tangent of the proposed angle of draw (22°) to determine the width of the barrier at each calculation point. This width was then drawn eastward perpendicular to the fault trace to determine the eastward extent of the barrier. A cross-sectional view of this barrier is shown on Map MFU1829D, Geologic Cross - Sections.

Public Notice

The operator 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 SITLA, BLM and DOGM or permission is granted by the adjacent surface agencies. At least six months prior to mining, or within that period if approved by the Division, the underground mine operator will mail a notification to the water conservancy district, if any, in which the mine is located and to all owners and occupants of surface property and structures above the underground workings. The notification will include, at a minimum, identification of specific areas in which mining will take place, dates that specific areas will be undermined, and the location or locations where the operator's subsidence control plan may be examined. PacifiCorp complied this requirement on December 9, 2002. The entire surface area of the Mill Fork permit area is administrated by the Forest Service. PacifiCorp considers the permit application process to be the prior notification.

R645-301-526. MINE FACILITIES

Introduction

Coal production from the Mill Fork Area will be transported by an underground conveyor belt system to the Deer Creek Mine facility. The Deer Creek Mine facility is located on a 20 acre site at the junction of Deer Creek Canyon and Elk Canyon (refer to Volume 5, maps 3-9 and 3-9A). The site is characterized by moderate vegetation and rugged, steep terrain. Surface facilities include the following: sediment pond, embankment fills, coal surge bin, transfer tower, breaker station, crusher station, coal weigh bin, truck load-out, facility conveyors, overland conveyor, parking lot, parking garage, office-bathhouse, warehouse-shop, materials storage area, access and service roads, mine ventilation fan, power supply and substation, water treatment system, high pressure pumphouse, water storage tank, sewer treatment system, and drainage system (refer Volume 5, Maps 3-9 and 3-9A).

There are also support facilities located in the Left Fork of Rilda Canyon, a tributary of Huntington Canyon. The facilities pad and access road of this area occupy approximately 2.01 acres of Manti-La Sal National Forest land in the NW1/4, NW1/4, SE1/4 of Section 29, T16S, R7E, SLM (refer to Volume 5, Maps 3-9). These facilities include an access road and a pad area which supports two portals, a substation, power line, fan, water storage tank, and pumphouse.

In addition to the Left Fork facilities, PacifiCorp permitted a new facility in Rilda Canyon during 2005, refer to Volume 11 for complete details related to the Rilda Canyon area.

All facility plans are on file at PacifiCorp-Energy West Mining Company, 31 North Main Street, Huntington, Utah 84528. They are available for public inspection.

With the exception of roads and conveyors, a narrative explaining the construction, use, maintenance, and removal of the previously named facilities can be found in Volume 2, Part 3 of the MRP.

R645-301-527. TRANSPORTATION FACILITIES

As indicated earlier, all disturbance to the Mill Fork permit area will be through underground mining activities. No additional transportation facilities are currently planned. For complete discussion on Transportation Facilities associated with the Deer Creek Mine refer to Volume 2, Part 3.

R645-301-528. HANDLING AND DISPOSAL OF COAL, OVERBURDEN, EXCESS SPOIL, AND COAL MINE WASTE

The Deer Creek Volume 2, Part 3 includes a narrative explaining the construction, modification, use, maintenance, and removal of coal, overburden, excess spoil, and coal mine waste.

R645-301-529. MANAGEMENT OF MINE OPENINGS

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7th East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. Prior to any surface disturbance, Energy West will secure all necessary permits.

For complete discussion on the sealing of existing mine openings, refer to Volume 2, Part 4 and Volume 11 R645-301-500 Engineering.

R645-301-530. OPERATIONAL DESIGN CRITERIA AND PLANS

The Deer Creek MRP includes a general plan for each sediment pond, water impoundment, and coal processing waste bank, dam or embankment within the permit area (see Volume 2, Part 3). No additional sediment ponds, impoundments, coal processing waste piles, dams or embankments are planned for the Mill Fork Area.

R645-301-532. SEDIMENT CONTROL

No surface facilities, sediment control, or other disturbance is planned for the Mill Fork Area. For complete discussion on sediment control facilities at the Deer Creek Mine, refer to Volume 2 Part 3 and Volume 11 R645-301-700 Hydrology.

R645-301-533. IMPOUNDMENTS

No impoundments are planned for the Mill Fork Area.

R645-301-536. COAL MINE WASTE

No additional waste rock disposal sites are planned for development of the Mill Fork Area. The current sites and standards are listed in the Deer Creek MRP.

R645-301-534. ROADS

No new roads are planned for the Mill Fork Area. For a discussion on the access road for the Deer Creek Mine, refer to Volume 2, Part 3 and Volume 11 R645-301-500 Engineering of the MRP.

R645-301-535. SPOIL

For a discussion on spoil of the Deer Creek Mine, refer to Volume 2, Part 3 of the MRP.

R645-301-536. COAL MINE WASTE

Underground development waste, coal processing waste, and excess spoil will continue to be disposed of in accordance with plans approved by DOGM and MSHA. There are no plans to return coal processing wastes to the underground workings at the Deer Creek Mine.

R645-301-540. RECLAMATION PLAN

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7th East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. Prior to any surface disturbance, Energy West will secure all necessary permits.

A reclamation plan for the Deer Creek Mine is described in Volume 2, Part 4 and Volume 11 R645-301-500 Engineering of the MRP. This plan includes narrative, maps, designs and plans for the mine.

R645-301-541.2 Surface Coal Mining and Reclamation Activities

All underground openings, equipment, structures, or other facilities not required for monitoring, unless approved by the Division as suitable for the postmining land use or environmental monitoring, will be removed and the affected land reclaimed.

In addition to reclamation related to "Surface Coal Mining and Reclamation Activities", PacifiCorp commits to comply with Utah State Lease For Coal ML-48258 lease stipulation 14. EQUIPMENT: RESTORATION 14.1 Equipment which states "Lessee may abandon underground improvements, equipment of any type, stockpiles and dumps in place if such abandonment is in compliance with applicable law, and further provided that Lessee provides Lessor with financial or other assurances sufficient in Lessor's reasonable discretion to protect Lessor from future environmental liability with respect to such abandonment or any any associated hazardous waste spills or releases. Lessee shall identify and locate on the mine map the location of all equipment abandoned on the Lease Premises. PacifiCorp has developed a policy and commits to notifying the regulatory agencies prior to equipment abandonment and mine sealing. Notification to the agencies includes; the location and type of equipment, reason for abandonment, and an invitation to conduct a site visit to review the situation.

R645-301-600 GEOLOGY SECTION

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Doelling, H.H., 1972, Wasatch Plateau Coal Fields, *in* Doelling, H.H. (ed.), Central Utah Coal Fields; Sevier-Sanpete, Wasatch Plateau, Book Cliffs and Emery, Utah Geological and Mineralogical Survey Monograph Series No. 3, Salt Lake City, Utah.

R645-301-600 GEOLOGY SECTION

R645-301-610. INTRODUCTION

This part of the application provides a detailed description of the geology of the coal resources, surrounding strata, and surface features within the Mill Fork permit area (State Lease ML-48258/UTU-84285) and surrounding areas.

Since 1971, detailed data on the geology of the coal deposits within the permit and surrounding area have been collected, compiled, and analyzed by PacifiCorp and several government agencies. Information collected by PacifiCorp is the result of exploratory drilling, field investigations, geologic mapping, field sampling, aerial photography, and mapping of underground mine workings.

PacifiCorp has also used numerous geologic reference works by previous authors and agencies specifically written about the coal deposits of this area for the preparation of this section.

R645-301-611. GENERAL REQUIREMENTS

The geology within and adjacent to the Mill Fork permit area is discussed in Sections R645-301-621 through R645-301-627.

R645-301-611.200. Proposed operations as given under R645-301-630

Proposed mining operations are discussed in section R645-301-630, including mine layout and sequencing.

645-301-612. CERTIFICATION

All maps and drawings within R645-301-600 have been certified by a registered professional engineer.

645-301-620. ENVIRONMENTAL DESCRIPTIONS

The Mill Fork permit area, consists of the Mill Fork State Lease, approximately 5,563 acres and adjacent Federal Coal Lease UTU-84285, approximately 213.57 acres of coal lands located in the Wasatch Plateau coal field of central Utah (See Figure 1, Introduction). The Mill Fork permit area is located entirely within Emery County.

The Wasatch Plateau is one of several high plateaus in central Utah located along the western boundary of the Colorado Plateau geological province. The geology of this region is characterized by flat-lying sedimentary rocks, ranging in age from Paleozoic to Recent, with simple geologic structures such as gentle folds and mostly normal faulting. This thick "layercake" of sedimentary rocks has been deeply dissected by erosion. The Mill Fork permit area consists of the surface and subsurface coal resources that underlie the north end of East Mountain, one of several high, flat north-south ridges that make up the Wasatch Plateau. The headwaters of Mill Fork Canyon and Crandall Canyon cut into East Mountain on the eastern side of the lease. The steep escarpment of the Joes Valley fault forms the western boundary of the lease. Elevations range from 7,500 feet in the lowest areas to over 10,000 feet at the tops of the plateaus, resulting in a broad diversity of climatic conditions and flora and fauna over the permit area. Annual rainfall in the region ranges from about 10 inches per year in the lower canyon bottoms to over 30 inches per year in high elevation areas. The dry climate of this area promotes erosion by inhibiting plant growth at lower elevations and on south-facing slopes.

A. REGIONAL GEOLOGY

The Energy West Mining Company mines and permit areas are located in the central portion of the Wasatch Plateau Coal Field in Emery County, Utah. Generally, this area is a series of high, flat-topped mesas flanked by heavily vegetated slopes which extend downward to precipitous cliffs. Below these cliffs steep slopes gradually flatten out into a broad flat valley (Castle Valley) below. Topographic relief of up to 5,000 feet can be measured from the top of the plateau to Castle Valley below. Horizontal coal seams occur within the strata of the Wasatch Plateau, about halfway between the valley floor and the top. The following discussion summarizes the stratigraphy and structural geology of the region and within the Energy West Mining Company permit area.

Figure GF-1
Stratigraphy of East Mountain
(After Doelling, 1972)

Period	Epoch/Age	Stratigraphic Unit		Thickness, feet	Description
QUAT.	Holocene (Recent)		Alluvium	0 - 200'	Valley fills, poorly sorted clay to boulders
TERTIARY	Paleocene	Wasatch Group	Flagstaff Limestone	100 - 200	Fossiliferous lacustrine limestone, gray
			North Horn Formation	500 - 1500	Variegated mudstones and clays, occasional sandstones & limestones, forms hummocky terrain.
CRETACEOUS	Maastrichtian	Mesaverde Group	Upper Price River Formation	600 - 800	Coarse-grained sandstones, occasional conglomerates, interbedded mudstones
	Campanian		Castlegate Sandstone (lower Price River Formation)	200 - 400	Coarse grained sandstone, occasional conglomerate lenses, tan color, massive cliff-former
			Blackhawk Formation	600 - 800	Interbedded mudstones, siltstones, and sandstones, bottom 150 feet contains coal seams and rider seams.
			Star Point Sandstone: Spring Canyon tongue Storrs tongue Panther tongue	200 - 400	Sandstone, gray-white, 3 main units inter-tongue with underlying Masuk Shale, tops of units occasionally bleached white, indicating overlying coal seams.
	Santonian	Mancos Shale	Masuk Shale Member	1,000 - 1,300	Shale, gray, soft, slope former
			Emery Sandstone	50 - 800	Sandstone, yellow-gray, cliff-former. May be associated with coal seams. Subsurface only in Mill Fork Lease.
	Coniacian		Blue Gate Shale Member	1,500 - 2,400	Shale, blue-gray, nodular, irregularly bedded, forms badlands. Subsurface only in Mill Fork Lease.
	Turonian		Ferrron Sandstone Member	50 - 950	Sandstone, yellow-gray, intertongues with Mancos shale, associated with important coal beds of Emery coal field, source of coal bed methane.

The regional geology of the Colorado Plateau in which the Wasatch Plateau coal field is situated is fairly simple. Sedimentary rocks have been accumulating in this region since Permian time (see Figure GF-1). A broad, high, flat region that encompasses southeastern Utah, southwestern Colorado, northwestern New Mexico, and northern Arizona, the Colorado Plateau has been an area of relative stability while mountain-building episodes have occurred in surrounding regions. The thick accumulations of sedimentary rocks in this region are being deeply dissected by erosion, leaving the most recent coal reserves in the higher plateaus, where they are now being mined. The Energy West permit area covers portions of East Mountain and Trail Mountain, which are separated by Cottonwood Canyon, a deep, partially glaciated valley.

During late Cretaceous (Campanian) time, from 75 – 85 million years ago, the Wasatch Plateau region lay at the edge of the Western Interior Cretaceous Seaway, with the sea to the southeast and a range of mountains (the Sevier Orogeny) to the northwest. Streams from these mountains brought eroded sediments southeast to the sea. Stagnant areas between these stream and river channels contained swamps in which peat accumulated. These stream channel and coal swamp deposits are now called the Blackhawk formation, a member of the Mesaverde Group of Cretaceous formations. During Campanian time, the sea advanced and receded several times, leading to the formation of several stacked coal seams within the Blackhawk sediments. The coal seams present in the Energy West permit area are named from lowest (oldest) to highest (youngest) the Hiawatha, Cottonwood, and Blind Canyon Seams. The Hiawatha and Blind Canyon seams are separated by 30 – 100 feet of interburden.

B. REGIONAL GEOLOGY SEDIMENTARY FORMATIONS

Numerous sedimentary rock formations are exposed in the Wasatch Plateau both above and below the coal bearing Blackhawk formation. Mining and construction activities affect a number of these, and the composition, arrangement, and physical characteristics of these formations greatly affect the mining and hydrologic characteristics of the area.

The geologic formations exposed in the Energy West permit area range from Upper Cretaceous (100 million years old) to Tertiary and Recent in age (see Figures MFU-1823D and GF-1). These formations, in ascending order from oldest to youngest, are the Masuk Shale member of the Mancos Shale, the Star Point Sandstone, the Blackhawk Formation, the Castlegate Sandstone, the Upper Price River Formation (all Cretaceous), and the North Horn Formation, and the Flagstaff Limestone (Tertiary). The coal deposits are restricted to the lower portion of the Blackhawk Formation, about 2,500 feet below the top of the Plateau. Recent geologic deposits include numerous stream terrace gravels along streams and rivers, glacial till deposits in the upper reaches of Cottonwood Canyon, and alluvial and colluvial fills in all of the significant drainages.

The Masuk Shale is the upper-most marine member of the Mancos Shale and consists of light to medium gray marine mudstones. This formation weathers readily, forming gray slopes that are often covered by debris and little or no vegetative cover. The Masuk shale is several hundred feet in thickness, and is the lowest and oldest of the geologic units exposed in the permit area. This formation is generally devoid of groundwater.

Overlying and intertonguing with the Masuk Shale is the Star Point Sandstone, a beach-front sandstone. In the East Mountain area the Star Point Sandstone ususally consists of three prominent massive cliff-forming beach-front sandstones totaling about 400 feet in thickness. These sandstone "tongues" are named from bottom to top: the Panther, the Storrs, and the Spring Canyon. In between the three tongues are beds of the Masuk Shale. The intertonguing of the Star Point and Masuk shale represents three transgression / regression episodes along the shoreline of the Cretaceous Interior seaway. The upper contact of the Star Point Sandstone is usually abrupt and readily identifiable on outcrops. Even though the Star Point Sandstone underlies almost the entire permit area, the low permeability and lack of recharge limit its usefulness as a water producing aquifer. The Star Point Sandstone occasionally exhibits aquifer characteristics in localized areas. These are isolated occurrences where regional faults have created secondary permeability and have been intersected by major canyons with perennial streams. An example of this type of occurrence is Little Bear spring located in Huntington Canyon.

The Blackhawk Formation consists of alternating mudstones, siltstones, sandstones, and coal. Although coal beds are generally found throughout the Blackhawk Formation, the thickest economically mineable seams are restricted to the lower 150 feet of the formation. The sandstones contained within the Blackhawk Formation are mostly fluvial stream channel deposits and increase in number in the upper portions of the formation. Fluvial sandstone channels that are in contact with the top of the coal seams occasionally cut into the coal (due to the erosion of peat by stream erosion during deposition) and create thinned coal zones called "scours." Many of the tabular sandstones and sandstone channels contain perched water, mostly in fractures, joints, and bedding planes. The permeability of these sandstones is relatively low. Mudstones surrounding these channels usually function as aquicludes. The total thickness of the Blackhawk Formation in the East Mountain area is about 750 feet. The Blackhawk Formation usually forms a broad, consistent slope between the Star Point Sandstone cliffs below and the Castlegate Sandstone cliffs above.

The Castlegate Sandstone is the lower member of the Price River Formation. The Castlegate Sandstone sits on top of the Blackhawk Formation and forms a prominent 300-foot cliff in highly eroded areas of the southern outcrops of the permit area (the southern end of the Cottonwood and Trail Mountain mines), steep blocky slopes in moderately eroded areas (Rilda Canyon), and occasional blocky outcrops in forested or heavily vegetated areas (Mill Fork Canyon). The Castlegate Sandstone consists of about 200 to 400 feet of coarse-grained, arkosic, light tan fluvial sandstones; pebble conglomerates; and minor layers of mudstone.

The Upper Price River Formation, which overlies the Castlegate Sandstone, is about 600 to 800 feet thick and forms slopes which extend upward from the Castlegate Sandstone escarpment. The Upper Price River Formation is comprised predominantly of fine to coarse- grained sandstone but commonly contains mudstone beds between the point bar deposits. Although some mudstones are present, fine-grained, poorly sorted (occasionally conglomeratic) sandstones dominate the Upper Price River Formation.

The North Horn Formation is about 500 to 1000 feet thick in the East Mountain area. The North Horn Formation spans the Cretaceous-Tertiary boundary (65 million years ago). Mudstones and claystones dominate the rock types present and are generally gray to light brown in color, although black, pink, purple and greenish colors have been seen. The lower two thirds (upper Cretaceous in age) of the formation is generally highly bentonitic mudstone. Localized, lenticular sandstone channels are present throughout the formation. The sandstone beds are more common near the upper and lower contacts of the formation. The North Horn formation, because of the soft rock types present, is prone to slumping. Widespread areas of slumping and hummocky terrain are present in North Horn outcrops.

The Flagstaff Limestone is the youngest (Paleocene) and highest formation exposed in the permit area and consists of dense, white to light gray lacustrine limestone with abundant fossil shells. Resistant to erosion, remnants of 100 to 150 feet of this formation remain, forming caps on the highest plateaus.

Between the time of sediment accumulation and erosion, the sedimentary rocks of the Wasatch plateau were intruded by widely scattered igneous dikes. The approximate age of these dikes ranges from 8 to 24 million years. Though more common in the northern parts of the Wasatch Plateau, several dikes are known to exist within the Genwal Mine, just to the north of the northern permit boundary. These dikes are only a few feet or inches wide, and are traceable for only a few hundred feet. The extent and continuity of these dikes at depth is unknown, and the effects on mining, if any, are unknown at this time.

Stream terrace gravels have been deposited along the major rivers and valley floors at various historic erosional levels, and lay unconformably on top of the Masuk shale. These terrace gravels are extensively used locally for construction gravels. Some are partially cemented together by caliche – type calcareous cement. None of these terrace gravels occur at or above the coal mining levels. None of these gravels contain groundwater.

Glacial-till deposits are present in the upper half of Cottonwood Canyon. The classic 'U"- shaped valley and presence of a terminal moraine show that this valley contained a small glacier during the last Pleistocene ice age (10,000 to 12,000 years ago). The depth of this till ranges from 80 to 150 feet thick at the valley floor. The groundwater characteristics of this till and the groundwater hydrology of Cottonwood Canyon are being closely monitored by Energy West Mining Company.

Most of the main drainages and side canyons in the permit area contain alluvial fill as a valley floor material. The depth of this fill material can be up to 100 feet in some of the major stream valleys. Seasonal streams, ground water, and various springs are present in these alluvial fills. The groundwater and surface water hydrology of these alluvial materials are closely studied and monitored by Energy West Mining Company.

C. STRUCTURAL FEATURES:

Several important structural features, the Straight Canyon Syncline, Flat Canyon Anticline and Huntington Anticline, the Roans Canyon Fault Graben, Mill Fork Fault Graben, Left Fork Fault Graben, Pleasant Valley Fault, and the Deer Creek Fault, have been identified adjacent to and within the Mill Fork permit area (see Map MFU-1823D, Geologic Formations Map).

Folding:

Strata in the Mill Fork area are gently folded in two broad structural features. The Flat Canyon Anticline crosses the southeastern portion of the permit area. This anticline trends southwest to northeast, and plunges to the southwest. Dips in the anticline range from two to six degrees with the south limb dipping the steepest.

To the north, the north limb of the Flat Canyon Anticline becomes the south limb of the Crandall Canyon Syncline, a flat-bottomed syncline. This syncline also trends southwest to northeast. Dips on the northwest side are much steeper than on the southeast side.

Faulting:

The only known fault within the Mill Fork permit area is the Joes Valley Fault, which forms the western limit of the coal reserves in this permit area. The Joes Valley Fault is the largest and most prominent of several north south trending fault zones within the

Wasatch Plateau coal field. Displacement of the fault is approximately 1,500 feet, downthrown on the western side. The fault creates a continuous north-south escarpment on the east side of Joes Valley. Several side canyons are cut into this escarpment on the western side of the permit area, all of which drain into Joes Valley. The fault zone itself is not visible along this escarpment, but the fault has been intercepted underground in the Genwal mine to the north. Where the fault has been intercepted in the Genwal mine workings, a drag fold is present, indicated by a gentle downward folding of the strata along the fault zone, extending for a few hundred feet to the east of the fault. The following section describes the depiction of the Joes Valley Fault in various publication through time.

Chronology of the Depiction of the Joes Valley Fault in Various Publications

Introduction:

The Joes Valley Fault forms the eastern boundary of the Joes Valley Graben, a fault – formed valley that stretches from the vicinity of Scofield, Utah on the northern end , to Interstate 70 in the south near Fremont Junction, a distance of about 50 miles. It is a highly visible and well-known geologic feature, immediately recognizable on geologic maps and in aerial and space photography. It is a normal fault, with a displacement of about 1,500 feet, downthrown to the west.

The Joes Valley Fault is significant to Energy West because it forms the western physical boundary of two of Energy West's mining areas, the Mill Fork, and the Trail Mountain mining area. It also formed the western boundary of the adjacent Genwal Mine property to the north. The western boundary of the Mill Fork State Lease and Genwal western leases were configured roughly along the surface trace of the fault before the tract was leased.

For the purposes of leasing and mining, it is important to know where this fault is located both on the surface and at the level of the coal seams that are being mined (coal seam depth in the fault intercept area ranges from about 700 feet up to 1,200 feet). Mining near the fault zone could potentially have impacts on surface subsidence and hydrology. Mining near or at the fault at depth could have detrimental effects on mining (water inflows, bad ground conditions) and on mine planning. As this is a normal fault, a steep dip to the west is expected, with a fault intercept at depth some distance to the west of the surface trace.

As Energy West's Deer Creek Mine workings approached the fault from the east in late 2005, it became an important issue to locate the fault as closely as possible both on the surface (Section 15, T. 16 S, R. 6 E.) and underground so that Energy West could apply for an extension or addition (Lease By Application) to ML-48258 to optimize reserve recovery in the area of the fault. The location of the surface trace of the fault became an important issue in the LBA process.

Mapping History:

Refer to the Joes Valley Fault locations in figure GF-2, which shows the various interpretations of the fault location over time for Section 15, T. 16 S, R. 6 E. The original surface fault trace used in Energy West's maps was taken from a map in Doellings (1972) report on the coal reserves of the Wasatch Plateau. In Doellings report, the fault is shown on two maps – a reproduced map from a 1955 edition of the A.A.P.G. Bulletin #39, showing the fault on a non-topographic structure map and a 15-minute USGS topographic map (publication date 1923), with the surface fault trace drawn on based on topography. Both of these maps show the fault trending from south-southwest to north-northeast, along the base of East Mountain.

In 1996, the Joes Valley Fault was encountered underground in the west mains development of the Genwal Mine. Ground conditions at the fault zone were relatively good, with little sympathetic faulting or fracturing, and only damp conditions at the fault intercept. Genwal Mine went on to develop bleeder entries, setup faces, and longwall panels in close proximity to the fault zone for several years (1997 – 2002) after the initial intercept. Genwal mined adjacent to the fault trace for approximately 1.5 miles, mapping in the process the trend of the fault zone and its relationship to the surface trace. Additional sympathetic faults to the east of the main fault zone caused problems for Genwal's northernmost developments. To this date, no known subsidence or fault-related ground movements have occurred above Genwal's extensive mining near the fault.

In 1997, as the Mill Fork State Lease was being prepared for the leasing process, another map depicting the surface trace of the fault was prepared by the USDA Forest Service for the Environmental Analysis for Lease by Application #11 (Mill Fork Lease Tract). This map shows the surface fault trace angling due north in Section 15, a slightly different interpretation than in the existing literature.

In 2001, as Energy West was preparing permitting documents for the Mill Fork State Lease, a map of all known geologic features in the Mill Fork area was constructed for inclusion in the permit application (Geologic Formations Map MFU-1823D). The Joes Valley fault on this map was based on Doelling's interpretation of the fault location, interpretation of recent aerial photographs of the area, and on surface elevation contours that were generated by digitizing a USGS 7.5 minute quadrangle map (publication date

1979). The contours of the 7.5 minute map are more modern and more accurate than those of Doelling's 15-minute contour map.

In 2005, Energy West obtained an integrated set of surface mapping products for the Mill Fork Lease area that consisted of 20-foot surface elevation contours generated by stereo aerial imagery, and a set of ortho-photo images also generated by the stereo aerial photographs, but spliced together and adjusted to exactly match the surface contours and surveyed surface control points. This data set allows aerial photographic interpretations of objects on the surface to be transferred directly and accurately on to contour maps. Using these tools, the surface fault trace was mapped directly from the ortho-photo images, on which the fault trace is clearly visible, directly to Energy West's mine and surface maps. The fault trace on this map is in a slightly different location than on previous maps, being slightly to the west from the previous interpretation of 2001.

While the Joes Valley Fault trace is clearly visible on aerial photographs and from the air, the fault plane itself is not visible in Joes Valley, refer to figure GF-3. It is either obscured by recent sediments, or vegetation, or both. As a result, the fault itself cannot be located, surveyed or measured directly on the ground surface. Tools that Energy West has used to better locate the surface fault trace have been topography and topographic expressions of the fault trace, aerial photography, aerial reconnaissance, and ground resistivity and induced polarization surveys across the fault trace.

Energy West Mining Activities:

In late 2005 and 2006, underground mining in the Mill Fork State Lease reached the area of the Joes Valley fault in Section 15. 14^{th} West continuous miner section reached a stopping point (based on the Mill Fork State Lease boundary, not the fault) in November,

2005. From this point at crosscut #70, a horizontal core hole was drilled due west toward the fault. Based on the surface trace of the fault then in use on Energy West's map (the 2001 interpretation), the fault should have been encountered at about 500 feet, if the fault plane was vertical. The hole was drilled to about 490 feet before mine logistics issues forced the removal of the drill from the area. No evidence of faulting or fault-related fracturing was observed in the core samples. This hole did show that the fault at depth was at least as far west as was shown on the map at that point in time, and that the dip of the fault was probably inclined to the west, making the underground intercept farther west than the surface intercept.

In April, 2006, the 15th West continuous miner section also reached the projected vicinity of the Joes Valley Fault. By this time, the new 2005 interpretation of the Joes Valley Fault surface trace was in use by Energy West. Using horizontal directional rotary drilling, the fault was located in two places to the northwest of the advancing faces. The fault was identified by rock intercepts in the horizontal holes, and by fault-related materials (sand and water) flowing from the fault zone. These fault intercepts placed the fault plane at depth about 110 feet west of the new surface trace interpretation. The 15th West Section of the mine was advanced to within 140 feet of the fault without seeing any traces of faults or related fractures, refer to figures GF-3 and GF-4. From 15th West, 14th West section (which had stopped about 650 feet short of the new subsurface projection of the fault) was extended 450 feet closer to the fault.

The nearest known faulting outside of the permit area is the Mill Fork fault graben. The Mill Fork fault graben passes to the southeast of the permit area (see Map MFU-1823D, Geologic Formations Map). This fault graben was crossed in ARCO's Huntington Canyon #4 Mine in Mill Fork Canyon and has a displacement of about twenty five (25) feet on the each side. The trend of this fault zone is approximately N 40° E. Based on projections from maps of #4 Mine, this graben should pass by the southeast corner of the permit area, between the Mill Fork State Lease and the existing Deer Creek Mine. Where it crosses the northern end of East Mountain, the fault has been mapped to have a displacement of thirty (30) feet down on the northwest side. Deer Creek mine workings have not intercepted this fault zone and exploration drilling in the right fork of Rilda canyon does not show any displacement, indicating that the displacement of the fault zone is too small to measure with exploration drilling, or that it has disappeared in this area. This fault zone does not appear in any surface outcrops.

R645-301-622 CROSS-SECTIONS, MAPS, AND PLANS

Map MFU-1823D, the Geologic Formations Map shows the locations and elevations on the surface of all exploration drillholes and test wells within the permit area. Thirty-five (35) coal exploration holes and one gas well have been drilled within the permit area to date (August 2005). In 1975 Utah Geologic and Mineral Survey (UGMS) drilled DH-2. Five (5) holes were drilled by the USGS in the early 1980s: CLB-1, CLB-2, CLB-3A, SLB-1, and SLB-3. Two (2) holes were drilled by ARCO Coal Company in 1981: HC-2 and HC-3. PacifiCorp has drilled twenty-seven (27) holes to date within the lease (EM-169 through EM-195). The single gas well on the property, Federal 32-23, was drilled in 1987, by Meridian Oil and Gas Co.

R645-301-621.200. Nature, Depth, and Thickness of the Coal Seams to Be Mined

Mining operations at PacifiCorp's mines have historically mined the two major seams present in the area, the Blind Canyon (upper) and the Hiawatha (lower) seams. The coal-bearing portion of the Blackhawk formation is the lower half of the formation, with the Hiawatha seam at or just above the interface between the Blackhawk formation and the Star Point Sandstone below.

Both the Hiawatha and Blind Canyon coals are ranked as High-Volatile Bituminous 'B' low sulfur coals.

The coal reserves in the Mill Fork permit area and remaining reserves at Deer Creek are in both the Hiawatha and Blind Canyon seams. The Hiawatha and Blind Canyon seams are close together, usually within 80 vertical feet. The depths of both seams, therefore, are similar in those areas where both seams are present. Overburden depths (Maps MFS 1824D & MFS 1825D) range from 0 feet, where both seams outcrop at the surface, up to about 2,600 feet under the Flagstaff Limestone "caps" on East and Trail mountains. The overburden strata consist of those formations already listed in section R645-301-621:

- Flagstaff Limestone
- North Horn Formation
- Upper Price River Formation
- Castlegate Sandstone
- Blackhawk Formation

Localized rider coal seams are fairly common above both seams, occurring from 1 foot to 20 feet or more above the Hiawatha and Blind Canyon seams. None of these rider seams have been named or mined.

In this region of the Wasatch Plateau, the Hiawatha seam is the lowest coal seam present. In much of the mining area currently permitted by PacifiCorp, the Hiawatha seam rests directly on the Star Point Sandstone, a massive, medium-grained, brownish-gray sandstone, which makes a very good mine floor. In some areas, there are between 0 and 15 feet of interbedded softer mudstones and siltstones between the Hiawatha and the Star Point Sandstone.

Thickness of the coal seams is variable, ranging from as little as 0 feet up to 19 feet in the Blind Canyon and from 0 feet up to 19 feet in the Hiawatha. Coal thickness is dependent on two main factors – the amount of peat originally deposited in the Cretaceous swamps, which varies from region to region, and the amount of scouring or erosion of the peat that took place after the peat was deposited but before lithification of the sedimentary sequence. More coal was deposited in the center of the swamp areas than around the edges, where distributary stream channels either prevented deposition, or scoured away the peat already deposited.

At some point in time during peat swamp development, the environment of deposition changed and each successive peat swamp was overrun by sediments, mainly mudstones and sandstones. Stream beds that passed directly over the previously deposited peats eroded sinuous channels of various depths into the peat and left behind sand-filled "scours," which cut varying amounts of top coal from the original thickness. The sudden losses of coal height that occur under these localized scours have impacts on coal mining operations that range from mild to disastrous.

Regional variations in coal thickness in the Blind Canyon and Hiawatha seams have been documented to varying degrees by mining activities and exploration drilling funded by government agencies and industry. Regional thickness trends of these seams are fairly well known, but the localized thickness variations caused by channeling are not as well known due to the localized nature of channeling. The Mill Fork region does not contain many exploratory drillholes because of its remoteness, and only general statements can be made based on this drilling as to the thickness trends in either seam.

R645-301-621.300. All Coal Crop Lines of the Coal to Be Mined

Coal outcrop and projected outcrop lines are shown on Map MFU 1823D. Coal outcrop lines are inferred where the outcrops are concealed by alluvium or colluvium. There are no significant coal outcrops within the Mill Fork permit area, due to the depth of burial in this area, however, significant outcrops of both seams occur just to the east of the lease boundary in Crandall and Mill Fork canyons.

Strike and dip of the coal seams are shown on Map MFU-1827D and MFU-1828D. The strike of the coal seams varies as the coal beds and surrounding strata are folded by the different structures (Flat Canyon Anticline and Crandall Canyon Syncline) mentioned in the section on structures above. The dip of the coal beds in this area is usually gentle, with dips rarely exceeding 4 or 5 degrees.

R645-301-621.400. Location and Depth of Gas and Oil Wells

Locations of all known oil and gas wells in and around the permit area are shown on Map MFU-1823D. One gas well, Merit Energy Co. East Mountain Unit 32-23, a producing well, is located within the permit boundary in Section 23, T. 16 S., R. 6 E. Total depth of this hole is 7,476', and the hole is completed in the Ferron Sandstone.

R645-301-623 ENVIRONMENTAL GEOLOGIC INFORMATION

R645-301-623.100. Acid- and Toxic-Forming Strata

Extensive sampling and testing of overburden strata, coal , and surrounding rocks has shown that there are almost no materials present that are potentially acid- or toxic- forming media. Almost all samples show slight alkalinity. Yearly sampling of in-mine roof, coal, and floor materials continue to confirm these results. Detailed analyses are presented in Appendix C.

R645-301-623.200 Reclamation Potential

Access to the Mill Fork permit area will be via a set of underground main entries from the existing Deer Creek mine workings. Other than possible future breakout locations for ventilation, there will be no surface facilities or disturbance within the permit boundary. If future breakouts become necessary, they will be permitted in a separate application. Reclamation, if necessary, will be performed in accordance with R645-301 and R645-302.

R645-301-623.300. Subsidence Control Plan

For the purposes of this section and the proposed operations in the Mill Fork area, a subsidence control plan has been developed. Refer to R645-301-500. Engineering for plan details.

Surface subsidence of all of the Energy West permit areas has been carefully surveyed, monitored and documented for almost 20 years. Subsidence is monitored by yearly comparison of new vs. old aerial photography using sophisticated photogrammetric measuring techniques, and is tied to known surveyed control points on the ground. Overflights by helicopter of all mined areas are conducted at least annually to inspect the ground surface. A Subsidence Monitoring Report is published annually, and submitted to various regulatory agencies.

If obvious subsidence - induced cracks appear at the surface, they are reported immediately to the surface-controlling agency and mitigation procedures are implemented if deemed necessary.

R645-301-624 GEOLOGIC INFORMATION

Numerous sedimentary rock formations are exposed in the Mill Fork permit area on East Mountain both above and below the coal bearing Blackhawk formation. The composition, arrangement, and physical characteristics of these formations greatly affect the mining and hydrologic characteristics of the area.

The geologic formations exposed in the Mill Fork permit area range from Upper Cretaceous (100 million years old) to Tertiary and Recent in age (see Figure GF1). These formations, in ascending order from oldest to youngest, are the Masuk Shale member of the Mancos Shale, the Star Point Sandstone, the Blackhawk Formation, the Castlegate Sandstone, the Upper Price River Formation, and the lower part of the North Horn Formation (all Cretaceous), the upper part of the North Horn Formation, and Flagstaff Limestone (Tertiary). Recent geologic deposits include numerous stream terrace gravels along streams and rivers, glacial till deposits in the upper reaches of Cottonwood Canyon, and alluvial and colluvial fills in all of the significant drainages and in Joes Valley.

Vertical relief across the exposures of these formations is about 3,000 feet within the permit area. Overburden thickness above the lowest coal seam to be mined (the Hiawatha seam) ranges from about 200 feet up to about 2,600 feet.

This sedimentary sequence has been structurally modified over time only slightly. Two gentle fold structures, the Flat Canyon anticline and the Crandall canyon syncline, cross the permit area. Dips of the beds are generally very gentle, less than 5 degrees.

Faulting is present within the permit area. On the western side of the permit area, the Joes Valley fault forms the boundary of a major structural graben, called Joes Valley, which cuts off mineable coal reserves to the west. The displacement of this fault is at least 1,500 feet, down thrown on the western side. No other faulting is known to exist within the permit area.

Jointing of the sedimentary formations of the area is a significant and important feature. Jointing of the rocks surrounding the coal seams affects mine orientation and planning, as well as the hydrologic characteristics of the rocks. Joints in the area trend predominantly north – south to N 10° E (parallel to the Joes Valley Fault), with a few secondary sets at other orientations.

Surface and groundwater hydrology has been extensively studied within the permit area and adjacent areas. Surface water originates from melting snow, with a significant runoff season every year. Yearly precipitation has varied widely over the past 20 years, resulting in fluctuations of surface water flows and surface spring discharges.

Alluvial fills in the bottoms of Mill Fork and Crandall canyons have been shown to transport significant quantities of sub-surface water downstream. The streams in the right and left forks of Mill Fork canyon are intermittent, rising out of the alluvium, flowing, and sinking back into the alluvium multiple times as the water moves down-gradient toward Huntington Canyon.

Surface water flowing down the unnamed drainages into Joes valley behaves similarly to the waters moving down Mill Fork Canyon. The small streams in these canyons sink into and re-emerge from the alluvium in the canyon bottoms numerous times. As the streams cross the fault and emerge into Joes Valley, the water disappears into the alluvial fan material that has accumulated at the mouth of each canyon. Farther out in the valley, water emerges from underneath the alluvial fan material, forming a swampy area that parallels the fault trend.

Subsurface water, including water that is intercepted in mine workings, is usually encountered in ancient, perched aquifers. These perched aquifers are usually tabular or stream channel sandstones, which have moderate porosity, but low permeability. Water also is encountered perched in the open joint systems within these rocks. Subsurface water has also been encountered in some isolated incidents in fault zones and structural synclines, notably the Roans Canyon fault zone and Straight Canyon syncline, about 5 miles south of the permit area.

Extensive research has shown that the surface and underground hydrologic systems are not hydraulically connected. No impact to surface hydrologic systems is anticipated within the permit area. Some perched water will be encountered underground during mining activities within the permit area. The location and quantity of water encountered underground will depend on the types of rocks, joint patterns and geologic structures that are present.

R645-301-624.200. Overburden Removal

Since all mining and access related to the Mill Fork area will be underground, no portion of the permit area will be exposed to or adversely impacted by mining. Analyses of overburden materials are presented in Appendix C and in Table G-1 of the Deer Creek / Cottonwood / Des-Bee-Dove Geologic Section, Volume 8.

R645-301-624.230. Chemical Analyses of the Coal Seam for Acid- and Toxic- Forming Materials

Chemical analyses for the Blind Canyon and Hiawatha coal seams within the permit area are available from drill cores from Energy West drill holes EM-169 through EM-179, EM-182, EM-184 and EM-185, and ARCO drill holes HC-2 and HC-3. Coal core samples taken from Mill Fork Lease drill holes are tabulated in R645-300- Appendix A.

Sulfur forms data for the Blind Canyon and Hiawatha coal seams within the permit area are available from drill cores from ARCO drill holes HC-2 and HC-3. These results are tabulated below:

SULFUR FORMS		
	Blind Canyon Seam	Hiawatha Seam
Pyritic	0.03	0.09
Sulfate	0.00	0.00
Organic	0.47	0.43
Total	**0.50**	**0.52**

R645-301-624.310. Drill Hole Logs

R645-300 Appendix B contains a tabulation of all drill hole logs within the permit area. Drillhole DH-2 (UGMS, 1975) is reproduced as a typical drill log in this appendix. All drill hole logs are available for review at Energy West Mining's main office in Huntington, including the proprietary holes completed by PacifiCorp.

R645-301-624.320. Chemical Analyses for Acid- or Toxic- Forming Materials

R645-300 Appendix C contains a table of analyses for acid- and toxic- forming or alkalinity-producing materials above and below the coal seams to be mined.

R645-301-624.330. Pyritic and Total Sulfur Chemical Analyses

A table of sulfur forms analyses for the Blind Canyon and Hiawatha seams is presented in the R645-301-624-230.

R645-301-627 DESCRIPTION OF OVERBURDEN

Overburden above the lowest seam to be mined (the Hiawatha Seam) is shown on Map MFU-1829D, Geologic Cross-Sections and Figure GF-1. The overburden above the coal seams to be mined includes the Blackhawk formation, the Castlegate Sandstone, the Upper Price River formation, the North Horn formation and the Flagstaff Limestone.

The Blackhawk formation consists of interbedded fluvial mudstones, siltstones, sandstones and coals. The vertical makeup of this formation is highly variable. Generally, the Blackhawk is sandier toward the top, and shalier toward the bottom. The mineable coal seams are usually within the bottom 300 feet of the formation, along with numerous rider seams and carbonaceous mudstones. This formation usually forms a long, steep slope (about 40 degrees) with frequent outcrops of large channel sandstones. The Blackhawk formation ranges from 600 to 800 feet thick in the permit area.

The Castlegate Sandstone, which comprises the lower half of the Price River formation, is a prominent cliff-forming sandstone, which forms cliffs or steep blocky outcrops which are visible nearly everywhere in the permit area. The Castlegate is a massive, coarse grained, occasionally conglomeratic or arkosic sandstone. The prominent North – South joint set is usually clearly visible in outcrops of the Castlegate. The Castlegate Sandstone averages about 300 feet thick in the permit area.

The Upper Price River formation consists of interbedded coarse-grained sandstones that resemble those of the Castlegate Sandstone, but are softer, and interbedded with occasional mudstones. The Upper Price River formation forms a steep slope above the Castlegate Sandstone cliffs. The thickness of the Upper Price River formation is difficult to determine, due to its gradational contact with the overlying North Horn formation, but is probably about 600 feet thick in the Mill Fork permit area.

The contact between the Upper Price River formation and the North Horn formation is difficult to discern on East Mountain, but is generally picked as the change in slope from the steeper outcrops of the Upper Price River formation below to the gentler and more rolling slopes of the North Horn formation above.

The North Horn formation is a softer formation which forms the rolling, slumping, hummocky terrain near the top of East Mountain. The North Horn consists mostly of interbedded shales and clays, with occasional sandstone and fresh water limestone beds. The North Horn formation has a characteristic orange to reddish purple color. Outcrops of the North Horn formation are rare, and usually seen on very steep eroded slopes or in landslide areas. The North Horn formation is about 800 – 1,000 feet thick in the permit area.

The Flagstaff Limestone forms isolated "caps" on the highest peaks of East Mountain. The Flagstaff Limestone is a fresh water lacustrine limestone which is about 100 to 200 feet thick. This limestone is hard and resistant.

In terms of potential subsidence, this combination of hard and soft formations has a beneficial effect. The Castlegate Sandstone is generally considered a barrier to subsidence. It is so thick and massive that in some places such as Trail Mountain, the Castlegate essentially prevents subsidence cracking from reaching the surface. No surface cracks have been detected on Trail

Mountain. The softer formations above the Castlegate have a tendency to move and settle without major cracking due to their softer nature.

Most of the surface cracking in the Deer Creek mine area has occurred in shallow cover areas of Blackhawk Formation exposures, or along the edges of groups of longwall panels.

Because the Castlegate Sandstone is a prominent cliff-former, subsidence damage to the formations overlying the mines is concentrated in the Castlegate. This damage takes place when undermining causes vertical and overhanging cliff faces and balanced rocks to fail. Cliff failures of this type have been isolated to Newberry Canyon and Corncob Wash above the Cottonwood mine, and a section of cliff above the Trail Mountain Mine, and represent a fraction of the total amount of Castlegate Sandstone cliffs undermined. Minor rock falls above the Deer Creek Mine on the south side of Rilda Canyon have also been documented. Energy West is currently involved in an extensive study of the effects of subsidence on the Castlegate sandstone cliffs on the north side of Rilda Canyon. The results of this study will determine the effectiveness of the empirical model developed and used to predict the likelihood of cliff failure.

The Castlegate Sandstone outcrop within the permit area exhibits prominent cliffs and points, especially in the head of Mill Fork Canyon. Some of these will probably be susceptible to subsidence damage. Most of the prominent Castlegate Sandstone cliffs, however, occur above areas where the coal seams are too thin to be considered mineable. Undermining of the Castlegate on the Joes Valley side of the permit area is prevented by the angle-of -draw buffer zone to keep mining away from the Joes Valley Fault.

R645-301-630 OPERATION PLAN

The permit area contains areas of mineable coal in both the Blind Canyon and Hiawatha seams. At present, the operation plan is to drive mains in the Hiawatha seam from the northwest corner of the Deer Creek mine northwest into the Mill Fork area then drive mains from south to north, bisecting the lease. Longwall panels in the southern Hiawatha reserves area will be developed as the mains are driven northward.

The Blind Canyon seam is mineable in the north half of the lease. When the Hiawatha seam mains pass under the mineable Blind Canyon reserves, slopes will be driven upward into the Blind Canyon seam. Blind Canyon seam development will take place with mains bisecting the reserve from south to north, and east-west longwall panels on either side of the mains. When the Blind Canyon reserves are extracted, development of the Hiawatha reserves that underly the Blind Canyon mineable area will then be developed and extracted.

R645-301-631 CASING AND SEALING OF BOREHOLES

Each coal exploration permit application will include a description of the methods used to backfill, plug, case, cap, seal or otherwise manage exploration holes or boreholes to prevent acid or toxic drainage from entering water resources, minimize disturbance to the livestock, fish and wildlife, and machinery in the permit and adjacent area. Each exploration hole or borehole that is uncovered or exposed by coal mining and reclamation operations within the permit area will be permanently closed, unless approved for water monitoring or otherwise managed in a manner approved by the Division. Use of an exploration borehole as a water monitoring or water well must meet the provisions of R645-301-731. The requirements of R645-301-731.400 do not apply to boreholes drilled for the purposes of blasting.

Exploration boreholes are plugged after use by filling the hole from total depth to the surface with type II portland cement/abandonite. If circulation cannot be maintained within the borehole, enough cement/abandonite to fill the borehole completely is pumped to the bottom of the hole, then the remainder of the hole is filled with bentonite chips or pellets to within the top 5' of the hole, and a cement surface plug containing a permanent hole identification marker is placed in the top of the hole. This hole plugging method is approved by the B.L.M. and D.O.G.M., and is used on all present and future exploration boreholes.

If an exploration borehole is to be converted to a water monitoring well, the water well regulations of the State of Utah are used to construct the well completion.

R645-301-632 SUBSIDENCE MONITORING

All mining within the permit area will be underneath the uninhabited East Mountain area. No dwellings or building structures will be undermined. A single gas well, own and operated by Merit Energy, is located within the permit area (identified as Federal #23-32), near the center of Section 23, T.16 S., R.6E. The well is near the southern extent of the mine plan. A gas transmission pipeline extends from this well south along forest road #244 for about 2,000 feet, then exits the permit area to the south. No mining is planned under the pipeline. Another gas pipeline segment is buried along forest road #017 in the southwest corner of the permit area. This pipeline will not be undermined. PacifiCorp and Merit Energy entered into an agreement to establish a working relationship regarding multiple mineral development to insure the maximum utilization of the coal and oil and gas estates in certain lands in Emery County, Utah all in the interest of the conservation and full utilization of natural resources.

As stated in the agreement, "Merit is the owner and operator of a producing gas well in the Area of Interest identified as Well No. 32-23. The well was drilled in 1989. PacifiCorp is conducting active coal mining operations in the Area of Interest in the immediate vicinity of Well No. 32-23 by and through Interwest Mining Company, a wholly owned subsidiary, as its managing agent, and Energy West Mining Company, another wholly owned subsidiary, as mine operator. These mining operations are in the Deer Creek Mine in the 12th West longwall panel, off of the 7th North Mains. It is anticipated that the full extraction of PacifiCorp's 12th West longwall panel could potentially cause a subsidence impact on Well No. 32-23. The parties wish to enter into a proactive agreement to establish the working relationship among the parties as this multiple mineral development activity takes place so as to insure the safe and effective compatible usage of both the coal and the oil and gas estates and to achieve maximum economic recovery of these natural resources". The multiple mineral development agreement was signed by all parties (PacifiCorp, Merit Energy, Division of Oil, Gas & Mining and SITLA) and became effective on August 12, 2005. This agreement achieves the purpose and intents of Utah Administrative Code R649-3-27.2 such that a cooperative agreement exists between Merit and PacifiCorp which allows multiple mineral development.

Energy West will report of the subsidence monitoring related to Well No. 32-23 in the Annual Subsidence Reports.

Two power transmission lines are present within the permit area. The largest is the Utah Power 345 KV line that crosses the southwest corner of the permit area in Section 22, T.16S., R.6 E.. The "Plan of Operations" approved in November 2002 included mining adjacent to the powerline over the western end of the 11th West - 12th West Hiawatha longwall panel. Development mining in 11th and 12th West intercepted an extensive split in the Hiawatha seam which limited western development. Based on an revised mine plan, mining will not affect the 345 KV line. This transmission line is owned and operated by Utah Power, a subsidiary of PacifiCorp. A second transmission line (25 KV) carries electricity from the lower portion of Mill Fork Canyon over the top of Mill Fork Ridge, and down into Crandall Canyon, to the Genwal Mine. This line crosses the small portion of the permit area that projects eastward (NW ¼ NW ¼ Section 8, T.16S. R.7 E.). This transmission line will not be undermined. Genwal Coal Company maintains a radio repeater at the Mill Fork summit in Section 7, T.16S. R.7 E.. This repeater will not be undermined.

The only roads that will be undermined are the unimproved dirt trails that provide access to the top of the ridge. Subsidence damage to these roads is expected to be minimal, based on previous experience at the existing mines mentioned above.

The method used to detect and document subsidence on East Mountain divides the land surface into separate study areas based on the second-mining areas in the mine plan. These areas are then studied using photogrammetric comparisons of each successive year of mining progress. The photogrammetry is tied to known survey baseline points that are flagged each year.

R645-301-641 SEALING OF BOREHOLES

All exploration boreholes are sealed upon completion using the following method. The borehole is sealed with cemented/abandonite from bottom to top through the drill pipe or other pipe lowered into the hole. As much cement/abandonite is used to fill the hole, or if the hole does not fill, enough cement/abandonite to fill the hole plus 10% is pumped through the pipe into the hole. If the hole does not fill to the surface, the remainder of the hole is filled with bentonite chips to within 5' of the surface. A cement surface plug is placed in the hole, and a brass marker with the hole number and year is placed on top of the cement, two feet below surface grade.

R645-301-700 HYDROLOGIC SECTION

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R645-301-700 HYDROLOGIC SECTION

R645-301-710 INTRODUCTION

This application provides a detailed description of the hydrology, including groundwater and surface water quality and quantity, of the land within the Mill Fork State Lease/UTU-84285 and adjacent areas (refer to Figure MFHF-1). The Mill Fork Lease (ML-48258), consists of approximately 5,563 acres located northwest of the existing Deer Creek Mine workings.

Detailed data on the hydrology of the land within the permit and surrounding area have been collected, compiled, and analyzed by PacifiCorp, hydrologic consultants and several government agencies. Information collected by PacifiCorp is the result of exploratory drilling, field investigations, geologic mapping, aerial photography, spring surveys, groundwater tests, monitoring of numerous wells and stream stations, climatological monitoring, and investigations by independent consultants.

PacifiCorp has a policy of close cooperation with many agencies and has invited, encouraged, and permitted numerous agencies to conduct investigations and experiments within and adjacent to the permit area. The resulting information produced by these investigations is quite extensive and has been utilized throughout this application.

R645-301-711 GENERAL REQUIREMENTS

711.100 **Existing hydrologic resources as given under R645-301-720**

711.200 **Proposed operations and potential impacts to the hydrologic balance as given under R645-301-730**

711.300 **The methods and calculations utilized to achieve compliance with hydrologic design criteria and plans given under R645-301-740**

711.400 **Applicable hydrologic performance standards as given under R645-301-750**

711.500 **Reclamation activities as given under R645-301-750**

R645-301-712 CERTIFICATION

All cross sections, maps, and plans required by R645-301-722 as appropriate and R645-301-731.700 will be prepared and certified according to R645-301-512.

R645-301-713 INSPECTION

No impoundments are planned for the Mill Fork Area.

R645-301-720 ENVIRONMENTAL DESCRIPTION

R645-301-721 GENERAL REQUIREMENTS

The existing pre-mining hydrologic resource of the East Mountain - Mill Fork Area are subdivided into the following sections.

A. Existing Groundwater Resources

1. Regional and Permit Area Groundwater Hydrology
2. Regional and Permit Area Geology
3. Regional and Permit Area Groundwater Characteristics
4. Springs and Seeps
5. Groundwater Quality
6. Chemical Evolution of Groundwater
7. Solute and Isotope Chemistry
8. Active and In-Active Groundwater Zones
9. Mine Dewatering
10. Groundwater Rights and Users
11. North Emery Water Uses Association (NEWUA)
12. Castle Valley Special Service District (CVSSD)
    Little Bear Springs

B. Existing Surface Resources

1. Regional and Permit Area Surface Water Hydrology
2. Surface Water Quality
3. Soil Loss and Sediment Yield

A. EXISTING GROUNDWATER RESOURCES

1. Regional Groundwater Hydrology

The characteristics and usefulness of a groundwater resource are dependent upon the geology of the water bearing strata and on the geology and hydrology of the recharge area. Groundwater movement and storage characteristics are dependent on the characteristics of the substratum. To facilitate an understanding of groundwater of the Mill Fork Area, a discussion of pertinent regional geologic features is presented below.

2. Regional Geology

The Mill Fork Area is located in the central portion of the Wasatch Plateau Coal Field in Emery County, Utah. Generally, this area is a flat-topped mesa surrounded by heavily vegetated slopes which extend to precipitous cliffs dropping steeply to the valley below. Relief of up to 5,000 feet is measured from Castle Valley lowland to the plateau above. The following discussion summarizes the structural geology and stratigraphy of the region and the permit areas located within the Mill Fork Area.

The regional geology of the Colorado Plateau in which the Wasatch Plateau coal field is situated is fairly simple. Sedimentary rocks have been accumulating in this region since Permian time. A broad, high, flat region that encompasses southeastern Utah, southwestern Colorado, northwestern New Mexico, and northern Arizona, the Colorado Plateau has been an area of relative stability while mountain-building episodes have occurred in surrounding regions. The thick accumulations of sedimentary rocks in this region are being deeply dissected by erosion, leaving the most recent coal reserves in the higher plateaus, where they are now being mined. The Energy West permit area covers portions of East Mountain and Trail Mountain, which are separated by Cottonwood Canyon, a deep, partially glaciated valley.

The geologic formations exposed in the Energy West permit area range from Upper Cretaceous (100 million years old) to Tertiary and Recent in age. These formations, in ascending order from oldest to youngest, are the Masuk Shale member of the Mancos Shale, the Star Point Sandstone, the Blackhawk Formation, the Castlegate Sandstone, the Upper Price River Formation (all Cretaceous), and the North Horn Formation, and the Flagstaff Limestone (Tertiary). The coal deposits are restricted to the lower portion of the Blackhawk Formation, about 2,500 feet below the top of the

Plateau. Recent geologic deposits include numerous stream terrace gravels along streams and rivers, glacial till deposits in the upper reaches of Cottonwood Canyon, and alluvial and colluvial fills in all of the significant drainages.

The Masuk Shale is the upper member of the Mancos Shale and consists of light to medium gray marine mudstones. The marine Masuk Member of the Mancos Shale was deposited in an open marine environment (Mayo and Peterson, 2001). The member is a highly erodeable calcareous, gypsiferous, and carbonaceous dark gray colored shale. It is continuously exposed along the eastern edge of the Wasatch Plateau, but is not exposed in the Mill Fork permit area. The Masuk member is approximately 1,300 feet thick. Westward thinning wedges of the Masuk interfinger with tongues of the Star Point Sandstone. Usually this formation weathers readily, forming slopes which are often covered by debris. It is generally devoid of water.

Overlying and intertonguing with the Masuk Shale is the Star Point Sandstone. In the East Mountain area the Star Point Sandstone consists of three or more massive sandstones totaling about 400 feet in thickness.

The Star Point Sandstone forms massive cliffs where exposed at the surface. The sandstone was deposited as seaward thinning (east), marine, shoreface blanket sands that are laterally continuous (Mayo and Peterson, 2001). Landward (west), these sandstones terminate abruptly into the mud- and organic-rich backshore facies (Van Wagoner and others, 1990). Because many of the organic-rich facies are now mineable quality coal, locally the Star Point Sandstone has immediate contact with coal seams. Elsewhere sandstone bodies of the Star Point Sandstone are overlain and underlain by lower shoreface and open marine shales of the Mancos Formation. What this means is that the marine shoreface sandstones are three dimensionally encased by low-permeability marine shales and fine-grained carbonaceous backshore coal-bearing facies (Mayo and Peterson, 2001).

The Star Point Sandstone thins eastward and merges with the underlying Masuk Member of the Mancos Shale. Three prominent tongues of the Star Point Sandstone interfinger with the Mancos Shale. These three sandstone members, from top to bottom, are the Spring Canyon, Storrs, and Panther Sandstones (refer to Figure 6, Mayo & Associates report in Appendix B). In the Mill Fork permit area area, the Spring Canyon tongue is approximately 100 feet thick, lies about 80 feet above the Storrs tongue, and consists of massive, fine- to medium-grained sandstone. The Storrs tongue lies about 120 feet above the Panther tongue and consists of 50 feet of soft, friable sandstone. The basal Panther tongue is approximately 100 feet thick and consists of massive, crossbedded delta front sandstones Mayo and Peterson, 2001).

Even though the Star Point Formation exists throughout the entire East 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 caused by the mudstone layers of the North Horn and Blackhawk formations, will be discussed in detail in the section entitled REGIONAL GROUNDWATER CHARACTERISTICS. Locally, the Star Point 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 consists of alternating mudstones, siltstones, sandstones, and coal. Although coal is generally found throughout the Blackhawk Formation, the economic seams are restricted to the lower 150 feet of the formation. The total thickness of the Blackhawk Formation in the East Mountain area is about 750 feet.

The upper portion of the Blackhawk Formation was deposited in an alluvial-plain/suspended-load fluvial channel environment (Mayo and Peterson, 2001). In these delta and flood-plain environments layers of mud are more abundant than channel sands. Sandstone channels are generally isolated from each other both laterally and vertically by mud-rich overbank and interfluvial rocks (Galloway, 1977). The upper portion of the Blackhawk Formation also contains some thin carbonaceous shale layers and thin coal seams that are not of economic interest.

The lower portion of the Blackhawk Formation contains the mineable coal deposits and consists of more thinly bedded sandstone and shale layers (Johnson, 1978). The coal-bearing units of the lower Blackhawk Formation overlie and are laterally juxtaposed to marine shoreface sandstones of the Blackhawk Formation and Star Point Sandstone (Mayo and Peterson, 2001). On a large scale, these sandstone bodies are laterally continuous but terminate abruptly into the mud- and organic-rich backshore faces in a landward direction (Van Wagoner and others, 1990). However, individual rock layers are lenticular and discontinuous, with abundant shaley interbeds. The fine to medium grained sandstones occur as thin- to massively-bedded paleochannel deposits. The paleochannels increase in frequency, thickness, and lateral extent upward in the formation. There is also a vertical repetition of erosional scours within the upper sandstones (Marley, 1979).

The Castlegate Sandstone, the lower member of the Price River Formation, generally caps the escarpment which surrounds the eastern limit of the property. The Castlegate Sandstone consists of approximately 250 to 350 feet of coarse-grained, light gray, fluvial sandstones; pebble conglomerates; and subordinate zones of mudstones.

The formation was deposited from bed-load fluvial channel systems (Appendix B Figure 8; Chan and Pfaff, 1991). The Castlegate Sandstone is made up of coarse-grained, often conglomeratic, fluvial sandstone. Thin interbeds of siltstone and claystone occur in lower portion the formation. Sandstone dominates over mudstone and individual sand channels may be thin, wide, or interpenetrating. Although the primary porosity is high, the existence of mudstone drapes and pervasive carbonate and silica cement greatly reduces the overall porosity (Mayo and Peterson, 2001, Appendix B).

The Upper Price River Formation, which overlies the Castlegate Sandstone, is about 350 feet thick and forms steep slopes which extend upward from the Castlegate Sandstone.

The Price River Formation was deposited from mixed-load fluvial channel systems that have sandstone/mudstone ratios intermediate between bed-load and suspended-load channel systems (Mayo and Peterson, 2001, Appendix B). Sandstones and mudstones occur in about equal proportions. Point bars that develop in this type of system are larger than those in suspended-load channel systems. Mudstone drapes created during low flow stages of the active fluvial system separate the sandstones from each other both horizontally and vertically (Mayo and Peterson, 2001, Appendix B).

The North Horn Formation forms the cap rock for much of East and Trail mountains where the Flagstaff Limestone has been eroded away. Mudstones dominate the rock types present and are generally gray, light brown, to purple in color. Localized, lenticular sandstone channels are present throughout the formation. The sandstone beds are more common near the upper and lower contacts of the formation. The North Horn Formation is approximately 850 to 1,000 feet thick in the Mill Fork area.

The North Horn Formation was deposited in an alluvial-plain/suspended-load fluvial channel environment (Mayo and Peterson, 2001, Appendix B). In such environments layers of mud are more abundant than sands, which occur in sandstone channels. The sandstone channels are generally isolated from each other, both laterally and vertically, by mud-rich overbank and interfluvial rocks (refer to reference list in Appendix B: Galloway, 1977). In the study area the formation consists primarily of shale with discontinuous sandstone channels, minor lenses of limestone, and conglomerate. Highly bentonitic mudstones, which swell when wetted, are common in the lower two-thirds of the formation.

The Flagstaff Limestone caps the uppermost portions of East Mountain is the youngest formation exposed in the Mill Fork permit area. It typically forms small exposures on top of the plateau (refer to Geologic Section, Geologic Formation Map). A thickness of 105 feet was measured on Trail Mountain immediately south of the study area (refer to reference list in Appendix B: Davis and Doelling, 1977). Maximum thickness in the Mill Fork permit area is approximately 80-100 feet.

The Flagstaff Limestone consists of carbonates, marls, and some thin sandstone stringers deposited in lacustrine, marginal lacustrine, and alluvial plain depositional environments (refer to reference list in Appendix B: Garner and Morris, 1996). It primarily consists of light- to medium-gray colored limestone containing abundant secondary fractures produced during uplift and subaerial exposure (Mayo and Peterson, 2001, Appendix B).

3. Regional Groundwater Characteristics

Waters entering the groundwater system are mostly from snow melt. The amount of water which enters the groundwater system is highly variable from one site to another. The low surface relief on the top of East Mountain encourages the infiltration of melting snow. Conversely, the many areas with steep slopes have a much more limited infiltration opportunity. All of the geologic formations which surface in the area have relatively low permeability which further reduces the amount of water entering the groundwater system. Probably less than five percent of the annual precipitation recharges the groundwater supply (Price and Arnow, 1974; U. S. Geological Survey, 1979).

Geology controls the movement of groundwater. Because of the low permeability of the consolidated sedimentary rocks in the East Mountain area, groundwater movement is primarily "through fractures, through openings between beds, and, in the case of the Flagstaff Limestone, through solution openings" (Danielson et al., 1981, p. 25).

The majority of the groundwater which infiltrates the Flagstaff Limestone flows down vertical fractures which intersect sandstone channel systems in the North Horn Formation. The majority of the groundwater reaching this point intersects the surface in springs located in the North Horn Formation. Very little recharge intersects the Price River Formation and Castlegate Sandstone; consequently, they are not water saturated where intersected in the numerous drill holes penetrating those units. The remaining water then flows downdip (to the southeast) from the northern reaches of East Mountain until it discharges in the form of springs.

Data have been collected from numerous coal exploration drill holes, from within the adjacent mine workings, from surface drainages, and from the springs in the area. The data have identified two separate isolated aquifer systems on the East Mountain property; the first is localized perched water tables in the North Horn and the Price River formations, and the second is a combination of localized perched water tables in the Blackhawk Formation and the Star Point Sandstone which exhibits some limited potential as a regional aquifer. Stratigraphy is the main controlling factor restricting groundwater movement and development of regional and perched aquifer systems within the East Mountain property. The following is a description of the various formations and how they influence the groundwater systems. The description is in descending order, which parallels the general groundwater flow (refer to Figure MFHF3).

a. Flagstaff Limestone

This formation displays a strong joint pattern which permits good groundwater movement both vertically and horizontally through the formation. Exposures of the Flagstaff Limestone is limited to a narrow north-south trending ridge located in the western half of the Mill Fork permit area.

b. North Horn Formation

This formation is comprised of a variety of rock types which range from highly calcareous sandstone to mudstone. Its permeability is variable.

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 Upper Price River Formation or Castlegate Sandstone below (bentonitic mudstone will be discussed in detail in the PHC.) 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 depth of the aquifers in the North Horn Formation is 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 East Mountain gives PacifiCorp the ability to assess any effects that mining might have on the North Horn Formation perched aquifers.

With the data available it is not possible to compile a piezometric map of the waterbearing strata in the North Horn Formation because the channels are discontinuous and not interconnected.

c. Upper Price River Formation

The Upper Price River Formation is comprised predominantly of sandstone but commonly contains mudstone beds between the point bar deposits. It is generally devoid of water because it lacks adequate recharge.

d. Castlegate Sandstone

The formation is thought to be fairly permeable but, where it has been intersected by drill holes, has never been found to be water saturated. It is often dry or slightly damp in some zones. It is devoid of significant water because it lacks adequate recharge.

e. Blackhawk Formation

The Blackhawk Formation contains only perched or limited aquifers which exist within the strata overlying the coal seams and the upper portion of the Star Point Sandstone Formation. The perched aquifers exist as fluvial channels (ancient river systems) which overlie and scour into the underlying strata (refer to Volume 9 Hydrologic Section Maps HM2 and HM3 for examples of mapped channels systems within the adjacent Cottonwood and Deer Creek mines). Channel systems were part of a deltaic depositional setting active during and after the coal forming peat accumulation. The largest influx of water encountered during the mining process occurs beneath the fluvial channels. The sandstone channels are mainly composed of a fine to medium grained sand with similar characteristics to the Star Point Sandstone Formation. The semi-permeable and porous nature of the channels allows an effective route for water transport. Other constituents of the Blackhawk Formation (i.e., non-permeable mudstone, carbonaceous mudstone, coal seams, and interbedded mudstones/siltstones and sandstones) generally act as aquicludes which impede vertical groundwater flow to the lower stratigraphic units. In areas other than where faulting and fracturing have created secondary permeability, the migration of water from the perched aquifers-sandstone channel systems of the Blackhawk Formation to the Star Point Sandstone Formation is limited. Extensive mining in the Cottonwood/Wilberg complex, which produces coal from the Hiawatha seam, is stratigraphically located on top of the upper member of the Star Point Formation Sandstone. Only minor quantities of groundwater have been produced from the Star Point Sandstone Formation. The coal seams of the Blackhawk Formation are effective in impeding vertical groundwater movement. In many areas in the adjacent mines where roof coal was left in place because of abundant thickness or as an additional effort to support the immediate roof, production of groundwater occurred only when roof support was installed or when a roof failure occurred exposing the overlying sandstone channel systems. Listed below are hydrologic characteristics of individual rock types reported by the USGS, Open File 84067.

Lithology: Sh, shale; Slt, siltstone; Ss, sandstone; f, fine grained; m, medium grained.
Hydraulic conductivity: I, impermeable to water even at a pressure of 5,000 pounds per square inch.

Geologic unit	Lithology	Depth below land surface (feet)	Porosity (percent)	Hydraulic conductivity (feet per day) Horizontal	Hydraulic conductivity (feet per day) Vertical
Blackhawk Formation	Ss, f	1,521	14	$1.5x10^{-2}$	$3.7x10^{-3}$
	Slt	1,545	3	$9.3x10^{-8}$	$1.2x10^{-7}$
	Sh	1,786	2	I	I
	Ss, f	1,792	14	$1.1x10^{-2}$	$3.9x10^{-3}$
	Sh	2,170	4	$1.1x10^{-8}$	---
	Slt	2,265	2	$2.0x10^{-7}$	$2.2x10^{-6}$
Star Point Sandstone	Ss, m	2,466	17	$3.1x10^{-2}$	$1.1x10^{-2}$
	Ss, m	2,493	11	$1.5x10^{-2}$	$6.6x10^{-3}$

In the adjacent Cottonwood and Deer Creek mines, the majority of the water flowing into the mines comes from within the limited fluvial channel aquifers; however, water is also transmitted into the mine workings by way of faults, joints or fractures, and in-mine drill holes. Historical monitoring locations in the Deer Creek Mine are shown on Map HM2, in the Wilberg/Cottonwood Mine on Map HM3 (refer to Volume 9 Hydrologic Section). Many locations within the mines have been monitored in the past, but a limited number of accessible long term water monitoring locations now exists because most water-producing areas of the mines are dewatered and stop flowing shortly after initial mining in the area.

In several locations in the Deer Creek and Wilberg/Cottonwood mines, such as retreated longwall panels, water is being produced but cannot be measured because the workings are inaccessible. The water entering these areas flows into numerous low areas in the mine which act as temporary sumps. The water is then pumped to the main sump located near the mine portal. Because the pumping system in the mine is ever changing (i.e., portable pumps being moved to various locations within the mine as the need arises), it is not possible to collect meaningful data from specific areas of the mine that can be compared with data collected from years or even months past.

Based on data from the adjacent mines, several observations have been made concerning the Blackhawk water-bearing strata. The sandstone, which is semi-permeable and porous, affords an effective route of water transport; while relatively impervious shale in the Blackhawk Formation prevents significant downward movement of the percolating water. Of the water-producing areas, those closest to the active mining face exhibit the greatest flows. As mining advances the area adjacent to the active face continues to be excessively wet, and previously mined wet areas experience a decrease in flow. It appears that the water source is being dewatered since mined out areas of the mine do not continue to produce water indefinitely. The water source must be either of limited extent, e.g., a perched aquifer, or have a limited recharge capacity. In an attempt to quantitatively evaluate saturated sandstone channels, a dripping channel in the 6th West area of the Deer Creek Mine was investigated (site 6W X 20; Figure 10, refer to Mayo & Associates report, Volume 9 Hydrologic Section: Hydrologic Support Information No. 11). The channel, located near a minor fault with very limited displacement, has the dimensions of >2,000 feet in length, 150 feet in width and a maximum thickness of 25 feet. An array of uphole monitoring wells was installed across the width of the channel. The wells were 15 to 25 feet deep and were open along their entire depth. Each well was equipped with a shutoff valve and pressure gauge. The idea was to conduct a pump test by letting selected wells gravity drain and simultaneously measuring pressure change in nearby wells. Because a maximum of about 2 psi was recorded in the well (i.e. (5 feet of water) we were unable to conduct the test. What the well did demonstrate was that the sandstone channel was not fully saturated and it was a perched, unconfined groundwater system.

Although much of the water transfer within the Blackhawk Formation is through fractures or faults, data indicate that recharge to the Blackhawk is limited because of the above confining formations and many of the fractures become sealed by swelling bentonitic clays which stop or limit the water transfer, confirmation of which exists along the numerous faults and fractures over the area. A measurable flow of water along a fault existed at only one location in the Wilberg/Cottonwood Mine - along the Pleasant Valley Fault in Main West, Wilberg. This location produced an estimated average flow of 5 gpm from the time it was encountered to 1980 when the flow stopped. The fractures sealed readily because of the ability of the shaley layers to swell and decompose to form an impervious clay, preventing significant downward percolation, collection, or conveyance of water along faults in the Blackhawk Formation.

Significant quantities of groundwater were also encountered in the Deer Creek Mine, 4th South area, where development entries intersected fractures/faults associated with the Roans Canyon Fault system. As with other areas where groundwater has been intercepted, the flow from the 4th South/2nd Right area has decreased rapidly, from approximately 2000 gpm in March 1990 to approximately 120 gpm in December 1990. Exploratory drilling was utilized in the development entries to locate and map the extent of the water producing fracture. The water producing zone was isolated utilizing an inflatable packer and a pressure gauge was installed to monitor the head differential. Pressure readings recorded were similar to those of Roans Canyon Fault crossing at 3rd North, with readings varying from 80-90 pounds per inch. This calculates out to approximately 200 feet of head. The amount of overburden in the area where the water producing fracture was encountered is approximately 1800-2000 feet. In reviewing the dewatering curve and the initial head differential, groundwater produced from the interception of the water producing fracture was a function of storage and recharge to the fault is limited. To monitor the potential impact of mine dewatering, PacifiCorp installed a series of wells in both the Deer Creek and Cottonwood/Wilberg mines (refer to Volume 9 Hydrologic Section Maps HM-2 and HM-3). These wells were incorporated in the hydrologic monitoring program in 1989. Well development information was detailed in the 1989 Annual Hydrologic Monitoring Report and in Volume 9 - Hydrologic Support Information). Only the wells in the Deer Creek Mine along the axis of the Straight Canyon Syncline revealed a change which could possibly be related to mine dewatering. In addition to the in-mine monitoring PacifiCorp installed a series of surface wells to monitor the potential impacts in Cottonwood Canyon located to the south of Mill Fork and in Rilda Canyon located to the east of Mill Fork. To evaluate the effects on the surface springs and surface drainage systems PacifiCorp maintains an extensive monitoring program. Data collected will be reported annually in the Hydrologic Monitoring reports.

Long-term water producing areas do exist within the current mine workings. Four types of occurrences have been recognized and will be monitored by the applicant (refer to Volume 9 Hydrologic Section: Figure HF4) and include 1) structural rolls with overlying fluvial channels, 2) Pleasant Valley and Roans Canyon Fault systems, 3) fractures and joints (lineaments), and 4) surface and inmine drill holes.

f. Star Point Sandstone

The Star Point Sandstone overlies and intertongues with the Masuk Shale. The formation is approximately 350 to 400 feet in thickness and consists of at least three upward coarsening sandstone units. Mudstone units of the Masuk Shale are present above the lower two sandstone members of the Star Point Sandstone due to the interfingering nature of the contact between the two units.

The Star Point Sandstone, which immediately underlies the Hiawatha Coal Seam, exhibits some characteristics of an aquifer but experiences little recharge. Studies conducted by the USGS indicate that the Star Point Sandstone is of low permeability, thus limiting its usefulness as a water-producing aquifer. Most of the water discharge from the Star Point Sandstone is where it has been intersected by the major canyons in the plateau or where faulting has caused secondary permeability. This, plus the fact that the Star Point Sandstone is only slightly to moderately permeable, allows only limited flow of groundwater through the formation. Drill holes completed in the Deer Creek, Wilberg/Cottonwood and Genwal mines have defined the piezometric gradient in the lower Blackhawk/Star Point Sandstone system in isolated areas and confirmed the groundwater flow ~~to~~ conforms with the topographic relief and structural features, i.e., regional dip, Straight Canyon Syncline, and regional faulting (refer to Volume 9, figures HF-5A and HF-5B for gradient information related to Deer Creek and Wilberg/Cottonwood mines and figure MFHF-6 for potentiometric gradient data for the Spring Canyon Member of the Star Point Sandstone for the Mill Fork Area).

The overall pattern of groundwater flow and surface water-groundwater interactions in the Mill Fork permit area and adjacent areas can be described by a fairly simple conceptual model involving both active and inactive groundwater flow regimes (Mayo and Morris, 2000 Appendix B). The model is illustrated in Appendix B Figure 27. Inactive zone groundwater systems contain old groundwater (i.e. 2,000 to 19,000 radiocarbon years, Appendix B Table 5), have very limited hydraulic communication with the surface and with other active groundwater flow systems, and are not influenced by either annual recharge events or short term climatic variability as evidenced by the decline in roof drip rates (Appendix B Figure 15) and lack of fluctuations of in-mine monitoring wells.

Solute chemistry in the Spring Canyon Member is not uniform beneath existing mines suggesting that there is a partitioning of groundwater systems in the member (refer to Appendix B - Mill Fork Hydrologic Investigation). This condition is likely the result of interbedded lower-permeability layers in the Star Point Sandstone which partition individual sandstone bodies. These findings are substantiated by monitoring well data from 6 wells in the Trail and East Mountain areas (Appendix B Section 7.3) and are significant in that they strongly suggest that the Spring Canyon Member does not act as a single regionally continuous aquifer, but rather it supports a series of smaller, discrete groundwater systems.

Water in most of the Blackhawk/Star Point aquifer is confined under pressure between shale and siltstone beds within the aquifer (USGS Lines, Open File Report 84067). Water is released from storage from confined aquifers mainly by compression of the sandstones and less permeable, confining beds as pressure in the aquifer declines. The quantity of water that can be released from storage is dependent on the storage coefficient, which is about $1x10^{-6}$ per foot of thickness for most confined aquifers (USGS Lines, Open File Report 84067). Data collected by PacifiCorp on the Roans Canyon Fault System in 1988, 3rd North fault crossing, confirmed the USGS storage coefficient estimations, with values ranging from $1.6x10^{-4}$ to $7.0x10^{-6}$. Transmissivity values computed for pump tests conducted by the USGS on Trail Mountain on nonfully penetrating wells in the Blackhawk/Star Point aquifer ranged from 0.7 to 100 ft^2/day with a majority of the two results ranging from 1 to 10 ft^2 /day. The computed transmissivity of 100 ft^2 /day was greater than the laboratory data (listed early in this section) and was believed to be due to secondary permeability in the form of fractures. Transmissivity results ranging from 0.7 to 10 ft^2 /day are indicative of the low permeability rock in most of the Cretaceous and Tertiary strata within the Wasatch Plateau.

g. Structural Hydrologic Features

Several important structural features, the Straight Canyon Syncline, Flat Canyon Anticline and Huntington Anticline, the Roans Canyon Fault Graben, Mill Fork Fault Graben, Left Fork Fault

Graben, Pleasant Valley Fault, and the Deer Creek Fault, have been identified adjacent to and within the Mill Fork permit area (refer to Hydrologic Map MFS1830D).

Folding:

Strata in the Mill Fork area are gently folded in two broad structural features. The Flat Canyon Anticline crosses the southeastern portion of the permit area (refer to Hydrologic Map MFS1830D). This anticline trends southwest to northeast, and plunges to the southwest. Dips in the anticline range from two to six degrees with the south limb dipping the steepest.

To the north, the north limb of the Flat Canyon Anticline becomes the south limb of the Crandall Canyon Syncline, a flat-bottomed syncline. This syncline also trends southwest to northeast. Dips on the northwest side are much steeper than on the southeast side.

Faulting:

The only known fault within the Mill Fork permit area is the Joes Valley Fault, which forms the western limit of the coal reserves in this permit area. The Joes Valley Fault is the largest and most prominent of several north south trending fault zones within the Wasatch Plateau coal field. Displacement of the fault is approximately 1,500 feet, downthrown on the western side. The fault creates a continuous north-south escarpment on the east side of Joes Valley. Several side canyons are cut into this escarpment on the western side of the permit area, all of which drain into Joes Valley. The fault zone itself is not visible along this escarpment, but the fault has been intercepted underground in the Genwal mine to the north. Where the fault has been intercepted in the Genwal mine workings, a drag fold is present, indicated by a gentle downward folding of the strata along the fault zone, extending for a few hundred feet to the east of the fault.

The nearest known faulting outside of the permit area is the Mill Fork fault graben. The Mill Fork fault graben passes to the southeast of the permit area (refer to Hydrologic Map MFS1830D). This fault graben was crossed in ARCO's Huntington Canyon #4 Mine in Mill Fork Canyon and has a displacement of about twenty five (25) feet on the each side. The trend of this fault zone is approximately N 40° E. Based on projections from maps of #4 Mine, this graben should pass by the southeast corner of the permit area, between the Mill Fork lease and the existing Deer Creek Mine. Where it crosses the northern end of East Mountain, the fault has been mapped to have a displacement of thirty (30) feet down on the northwest side. Deer Creek mine workings have not intercepted this fault zone and exploration drilling in the right fork of Rilda canyon does not show any displacement, indicating that the displacement of the fault zone is too small to measure with exploration drilling, or that it has disappeared in this area. This fault zone does not appear in any surface outcrops.

h. Alluvial Aquifers

Utah Regulations require that the presence of alluvial valley floors in or adjacent to the mine project area be identified. The regulations define an alluvial valley floor as "unconsolidated streamlaid 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 unconcentrated runoff or slope wash together with talus, or other massmovement accumulations, and wind blown deposits." The 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;
   b. The capability of an area to be flood irrigated, based on streamflow, water yield, soils, water quality, topography, and regional practices; or
   c. Subirrigation of the lands in question, derived from the groundwater system of the valley floor.

Scope: The purpose of this section of the report 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 permit areas. It is divided into three parts. First, a general description of the surface operations and site disturbances associated with the permit areas is presented. Next, discussions of the characteristics of geomorphology and irrigation are presented. Finally, the conclusions of the alluvial valley floor determination are summarized.

Site Description: Surface facilities associated with the permit area will consist of the portal area and associated facilities for Deer Creek Mine.

The climate of the general area is semi-arid to arid and continental. Daily minimum temperatures recorded at the East Mountain weather station in winter range from the average low of -6.3° F to the maximum record low of -15.2° F, and daily maximum temperatures in summer range from the average high of 84.7° F to the maximum record high of 89.3° F.

Temperatures in the region tend to be inversely related to elevation. Average annual precipitation recorded for a 20 year period (1981-00) at the East Mountain weather station averaged 13.59 inches. Approximately fifty percent of the annual precipitation falls during the winter as snow with most of the remainder coming as summer thunderstorms.

Alluvial Valley Floor Characteristics: In this section of the report the various criteria for determining the existence of an alluvial valley floor are examined in relation to the overall permit and adjacent areas.

Geomorphic Criteria: Alluvial deposits in and adjacent to the mine permit area have been mapped and reported in Doelling's "Wasatch Plateau Coal Fields, 1972." The report indicated that alluvia in the area are found solely along Huntington Creek below the Rilda Canyon confluence in the

Huntington drainage system, in the Cottonwood drainage system along lower Cottonwood Creek and at the mouth of the North Fork of Cottonwood Creek, and in the Joe's Valley drainage.

Flood Irrigation: Flood irrigation near the project area is currently (and has historically been) confined to the alluvial areas of Huntington Creek approximately one mile below the confluence of Deer Creek and Huntington Creek. In the Cottonwood drainage system flood irrigation is currently, and historically, confined to the alluvial areas of lower Cottonwood Creek. No flood irrigation has historically been practiced on the narrow alluvium land upstream in the canyons opening to lower Cottonwood and Huntington Canyon creeks. 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.

Water quality of Cottonwood and Huntington creeks is good. A detailed review of the surface water quality has been presented previously in this report and is updated each year in the annual Hydrologic Monitoring Report.

Subirrigation: Some subirrigation of vegetation does occur on the alluvial valley floors. The subirrigated species (mainly cottonwoods and willows) are found along the channels of Cottonwood Creek and in the Joe's Valley drainage above the reservoir and along the channels of Rilda Canyon and Huntington Creek. This suggests that subirrigation is confined to the channel areas where the water table is near the surface.

Alluvial Valley Floor Identification: Based on the foregoing analysis, the narrow canyons associated with the permit area cannot be considered to have an alluvial valley floor due to insufficient alluvium and the very limited area for supporting an agriculturally useful crop. The valley floor of Huntington Creek below the confluence with Deer Creek, however, can be classified as an alluvial valley floor due to the presence of both flood irrigation and limited subirrigation on the alluvium.

Potential Impacts of Alluvial Valley Floors: Very little potential exists for the mine operations to impact the Cottonwood and Huntington Creek alluvial valley floor due to the location of the operations in comparison to the alluvial deposits. All surface disturbances in the portal area will be protected by sediment control facilities and have been designed and constructed according to R645 standards 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 believed that the overall permit area and associated activities will have no significant hydrologic impacts on the alluvial valley floor along Cottonwood and Huntington creeks. Details concerning the monitoring program are outlined in section R645-301-731.

4. Springs And Seeps

Prior to coal leasing, lands administrated by the United States Forest Service require sufficient environmental baseline data to be analyzed during the National Environmental Protection Act (NEPA) analysis process. In preparation for coal leasing through the lease-by-application process, Genwal Resources conducted baseline spring and seep surveys from 1994-1996 (northern portions of the lease were surveyed in 1989-90). Data collected by Genwal Resources was determined by the Forest Service to meet the requirements of the Data Adequacy Standards (refer to Appendix C). Information submitted to the Forest Service included: location, flow and quality (data indicates general trends, date of collection generalized and quality limited to field data). With PacifiCorp's acquisition of the Mill Fork State Coal Lease, a complete re-evaluation of groundwater resources was initiated in 2000 and continued through 2002. Evaluation of the data by revealed similar geologic occurrences to the southern portion of East Mountain, (majority of the groundwater resources discharge from the North Horn Formation in a down-dip configuration), which has been monitored by PacifiCorp for more than twenty years. The water reconnaissance program of the Mill Fork Area was initiated with an aerial survey via helicopter. During the reconnaissance survey, previous baseline survey data was evaluated for field location accuracy. Based upon initial observations, PacifiCorp commenced a field program in 2000 to completely map, field mark and photograph each groundwater source. Previous baseline studies were utilized as a guide of potential groundwater resources. The entire area of the Mill Fork State Lease/UTU-84285 and adjacent area was traversed. During the field reconnaissance process, when water resources were encountered, they were tracked to the source. At the sources, the sites were located utilizing GPS surveying techniques (GPS - equipment: Trimble Asset Survey, differentially corrected, horizontal accuracy sub-meter), digitally photographed, field marked with a brass tag and measurements were taken of flow and temperature (refer to Appendix C). PacifiCorp retained identification system established during the previous surveys, except for the Joes Valley area and Mill Fork Ridge. In these two areas, several springs were labeled with multiple tags of different numbers and separate springs were labeled the same identification. In addition to the field measurements, PacifiCorp collected baseline water quality samples. Not all sites were sampled, collection of water quality samples were restricted to sites where representative samples could be obtained. At selected sites, springs were also sampled for isotopic data. These sites were selected based on geographic location, geologic formation and occurrence (refer to Appendix C).

During the 2000-2002 baseline evaluation a total of 198 springs were identified within and adjacent to the permit area. Each spring site on East Mountain has been studied to determine the geologic circumstances that cause the springs to occur. The mode of occurrence for each spring has been tabulated on the "Springs Geologic Conditions Inventory" sheets located in the compact disk in the Appendix C. The springs on East Mountain originate in several different ways (see Table MFHT-1 and Mill Fork Spring Map MFS1831D); however, many springs share the same mode of occurrence and, in some cases, are related.

The most frequent occurrences of springs are those located about 150 to 350 feet below the top of the North Horn Formation (refer to Figure MFHF-4). Field observations along with drill hole data show a predominance of fluvial siltstone and sandstone at that stratigraphic interval. These sedimentary rocks represent many isolated fluvial systems which are water-bearing. The springs are formed where the fluvial channels intersect the land surface. Because the fluvial channels within this zone are generally not interconnected, the springs are not interrelated but share the same mode of occurrence.

Numerous springs located in the lower portion of the North Horn Formation occur when water flowing through fluvial sandstones which are underlain by a thin zone of impervious mudstone at the base of the North Horn Formation intersect the land surface. Field observations along with drill hole data indicate that impervious mudstone units occur at the upper and lower portion of the North Horn Formation. Even though these individual mudstone layers are discontinuous, the occurrence of this type of strata exists throughout the East Mountain Property. The springs related to this mode of occurrence are not generally interrelated because they are fed by waters flowing through isolated fluvial channel sandstones and siltstones.

Numerous springs are located along and within the Joes Valley Graben. Generally, the springs are located within the North Horn Formation (Bald Mountain Ridge located west of the permit area) along the fault zone and the alluvial valley deposits. Many of the largest springs surveyed for the Mill Fork permit area are located along this fault system west of the Mill Fork permit area. The springs located along this fault zone are generally interrelated.

A few springs are located within both the Flagstaff and Price River formations; however, their occurrence is insignificant in comparison to springs located in the North Horn Formation.

Generally springs with discharges exceeding 50 gpm are associated with faulting where permeability has been increased by fracturing (example: Bald Ridge area). The discharge of the springs varies directly with the amount of precipitation and also varies seasonally. Discharge is greatest during the snow melt period, normally from late April through the month of June. Following periods of groundwater recharge the discharge recedes fairly rapidly at first, then gradually, indicating a double porosity effect. At the end of the water year, the remaining discharge is only twenty to thirty percent (20-30%) of the peak discharge (refer to Tables MFHT-3 and -4 for historical data for the southern portion of East Mountain compared to the Mill Fork Area. Seasonal flow variation collected for the Mill Fork permit area compares directly to the data collected for the southern portion of East Mountain and data collected by Genwal resources to the north. Table MFHT-4 compares the data collected from the southern portion of East Mountain to the Mill Fork Area.

The following table provides a breakdown of spring locations by geologic formation and surface drainage:

MILL FORK PERMIT AREA (Energy West 2000-2002 Surveys) SPRINGS by GEOLOGIC FORMATION and SURFACE DRAINAGE						
Drainage System	***Geologic Formation***					
	Alluvium	***Flagstaff***	***North Horn***	***Upper Price River***	***Castle Gate***	***Blackhawk***
Huntington Drainage						
Crandall Canyon	0	0	0	7	1	0
Mill Fork Canyon	0	0	44	10	1	5
Right Fork of Rilda Canyon	0	1	39	1	0	0
Cottonwood Drainage						
Un-Named Drainages of Joes Valley	35	0	29	19	6	0
Total Number of Springs = 198						

5. Groundwater Quality

Groundwater chemical quality is very good in strata above the Mancos Shale. The USGS reported a range in dissolved solids from 50 to 750 mg/l for samples from 140 springs in the region issuing from the Star Point Sandstone Formation and overlying formations (Danielson et al., 1981). During the Energy West 2000 and 2002 seep and spring surveys, a total of one hundred twenty nine (129) samples were collected with a range of dissolved solids from 207 to 390 mg/l (refer to Appendix C). 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 percolating through the underlying Mancos Shale quickly deteriorate, with total dissolved solids concentrations frequently exceeding 3000 mg/l.

Additional studies by PacifiCorp have confirmed the primary findings of the USGS concerning regional trends in quality. Originally, decreasing quality from north to south was believed to depict the groundwater flow direction, and the quality decreased as a function of the time it traveled through the strata. Although the time travel component is probably an important factor, in 1985 a surface exploration program identified the existence of an area of residual heat from an ancient burn on the outcrop throughout the southern extreme of East Mountain. The high temperature was also explored within the mine and a portion of reserves were lost because of the situation. It is now theorized that the high temperature water dissolved the mineral constituents of the formations, thereby altering the water chemistry. The quality also decreases vertically downward because of the influence of marine sediments along with the trend of decreasing quality from north to south.

An examination of Figure MFHF-5 indicates that a relationship exists between elevation and the total dissolved solids concentration of the springs. The data indicate that concentrations of dissolved materials increase with diminishing elevation for both surface streams and springs. The change in quality is a function of the differences in the chemical character of geologic formations which outcrop at different elevations.

To more closely identify springs which are related, water samples are analyzed to determine the percentage of cations and anions in solution. These percentages have been graphically represented as cation-anion diagrams (refer to Appendix B, Table 2, Figure 22 and Appendix C: Water Quality tab). The purpose of the diagrams is to identify groups of related springs by water chemistry. The diagrams clearly show the similarity of water quality of springs originating in the same geologic formation. Historical data from PacifiCorp's on-going East Mountain Hydrologic Program has demonstrated is that, even though the quality varies slightly from individual sites as well as from different formations, seasonal variations do not exist (refer to Annual Hydrologic Reports for yearly comparisons and Volume 9 Hydrologic Section Hydrologic Support Information No. 11, page 36: paired t-test analysis). Along with the data referenced above, Table MFHT-5 compares the seasonal water quality data collected during 2000-2001 field seasons for the Mill Fork Area. Data collected in 2000-2001 confirms the trends historical in data collected for southern East Mountain, i.e., despite the seasonal variability in discharge rates, the solute concentrations of active region groundwaters do not exhibit significant seasonal variability (refer to Appendix C: Water Quality tab and Table MFHT-5).

PacifiCorp began in-mine quality monitoring in 1977 (Cottonwood/Wilberg and Deer Creek mines). With the collection of numerous samples throughout the extent of the mine workings, the quality has remained relatively constant (see Volume 9 Hydrologic Section Maps HM2 and HM3). As with the springs the quality varies from individual sites, but quality from the individual sites remains constant versus time (see Volume 9 Hydrologic Section Figure HF8).

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 Star Point Sandstone-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.

PacifiCorp contracted Mayo & Associates in 1996 to conduct comprehensive study to characteristize the hydrology and hydrogeology of the East and Trail mountains (refer to Volume 9 - Hydrologic Support Information No.11). The hydrogeology of the PacifiCorp leases were evaluated by analyzing: 1) solute and isotopic composition of surface and groundwaters, 2) surface and groundwater discharge data, 3) piezometric data, and 4) geologic information. The following is list the key points and conclusions from the 1996 study:

Conclusions From the 1996 Mayo & Associates Hydrologic Investigation

1. The δ^2H and $\delta^{18}O$ compositions demonstrate that all groundwaters are of meteoric origin (i.e. snow and rain).
2. Active and inactive groundwater regimes occur in the mine lease area.
3. The active regime includes alluvial groundwater, groundwater in the Flagstaff Formation, and all near surface exposures of the other bedrock formations except, perhaps, the Mancos Shale. The near surface extends about 500 to 1,000 feet into cliff faces. Groundwaters in the active regime contain abundant ^3H and anthropogenic ^{14}C.
4. Comparison of long-term discharge hydrographs with precipitation records demonstrates that active regime groundwaters: 1) are in direct hydraulic communication with the surface, 2) are recharged by modern precipitation, and 3) have large fluctuations in spring discharge rates which can be attributed to seasonal and climatic variability. High-flow/low-flow discharge rates vary as greatly as 600 gpm to nearly dry; however, most high flow rates are less than 50 gpm.
5. Despite the seasonal variability in discharge rates, the solute concentrations of active region groundwaters do not exhibit significant seasonal variability.
6. The inactive regime includes groundwater in sandstone channels in the North Horn, Price River, and Blackhawk Formations which are not in direct hydraulic communication with the surface (i.e. greater than about 500 to 1,000 feet from cliff faces). Mine workings are largely part of the inactive regime. The sandstone channels are vertically and horizontally isolated from

each other and when encountered in mine workings are usually drained quickly. Coal seams are hydraulic barriers to groundwater flow. The blanket sands of the Star Point Sandstone are also largely in the inactive zone. Except where exposed near cliff faces, faults encountered in mine workings are part of the inactive regime. Except near cliff faces, faults are not conduits for vertical hydraulic communication between otherwise hydraulically isolated pockets of groundwater.

7. Inactive region groundwater systems contain old groundwater (i.e. 2,000 to 12,000 years), and are not influenced by annual recharge events or short term climatic variability.

8. In-mine inactive regime groundwaters occur in nearly stagnant, isolated zones which have extremely limited hydraulic communication with other inactive regime groundwaters in the vicinity of mine workings and with near-surface active regime groundwaters as evidenced by the following:

a) Groundwaters discharging into mine openings have ^{14}C ages ranging from 2,000 to 12,000 years

b) Roof drip rates rapidly decline when water is encountered in the mine indicating that the saturated zone above the coal seam is not hydraulically continuous and has a limited vertical and horizontal extent.

c) Unsaturated conditions have been identified in boreholes drilled vertically into sandstone channels located above coal seams.

9. The fact that inactive region groundwaters encountered in mine openings do not have an infinite age means that, at some time, there has been some hydraulic communication with the surface. This communication is extremely limited as illustrated by calculated steady state recharge-discharge rates of faults and sandstone channels in the inactive zone which range from 0.001 to 1.23 gpm.

10. Groundwater in the Star Point Sandstone is part of the inactive regime as evidenced by the 6,000 year ^{14}C age of the sample from well TM-3. In the down dip direction along the axis of the Straight Canyon Syncline, potentiometric pressures in the Spring Canyon

member results in upwelling of groundwater into Hiawatha seam mine openings. Such upwelling may locally reduce the pressure in the Spring Canyon member.

11. Areally extensive groundwater regimes in the lower Blackhawk Formation and Star Point Sandstone do not exist within the lease area. Therefore, it is not meaningful to create piezometric surface maps of these systems.

12. Streamflow is dependent on snow melt, precipitation and thunderstorm activity. There is no apparent hydraulic communication between streamflow and groundwater encountered in mine openings.

13. The groundwater discharging into the Rilda Canyon alluvial collection system is of modern origin and is closely tied to seasonal recharge. This is evidenced by its modern radiocarbon and ^{3}H contents and by the discharge hydrographs. The alluvial groundwater is not related to the groundwater encountered in the mines.

14. The groundwater discharging in Cottonwood Canyon near Cottonwood Spring and Roans Spring discharges from glacial deposits and is of modern origin. The radiocarbon and ^{3}H contents of this water indicate a modern origin. The water in the shallow glacial deposits is not related to the groundwater encountered in the mines.

In addition to the study conducted in 1996, Mayo & Associates were retained in 2000 to investigate hydrologic resources of the Mill Fork permit area and adjacent areas. The purpose of this investigation is to 1) characterize the groundwater and surface water systems in the Mill Fork permit area, and 2) determine the probable hydrologic consequences of underground coal mining to surface waters and groundwaters within the Mill Fork permit area. The hydrology and hydrogeology of the Mill Fork permit area area have been evaluated by analyzing: 1) solute and isotopic compositions of surface waters and groundwaters, 2) surface water and groundwater discharge data, 3) piezometric data, and 4) geologic information (refer to Appendix B for complete details).

6. Chemical Evolution Of Groundwater (excerpt from Mayo & Associates Study - Appendix B)

a. Chemical Reactions

Solute compositions of groundwaters are the result of interactions between groundwater and bedrock lithology and between groundwater and atmospheric and soil gases. The general reactions responsible for the chemical evolution of groundwaters in the vicinity of the study area and inside the coal mines are described below:

Groundwater acquires most of its $CO_{2(g)}$ in the soil zone where the partial pressure of CO_2 greatly exceeds atmospheric levels. This CO_2 combines with water to form carbonic acid according to

$$CO_{2(g)} + H_2O = H_2CO_3 \qquad (1)$$

Carbonic acid dissociates into H^+ and HCO_3^- as

$$H_2CO_3 = HCO_3^- + H^+ \qquad (2)$$

The H^+ ions temporarily decrease the pH of the water but are quickly consumed by the dissolution of carbonate minerals that are abundant in the soil zone and in most aquifers. Carbonate mineral dissolution is represented as

$$2H^+ + \underset{\text{(dolomite)}}{CaMg(CO_3)_2} = Ca^{2+} + Mg^{2+} + 2HCO_3^-, \text{ and} \qquad (3)$$

$$H^+ + \underset{\text{(calcite)}}{CaCO_3} = Ca^{2+} + HCO_3^-. \qquad (4)$$

The net effect of reactions 2 through 4 is to increase the pH and the Ca^{2+}, Mg^{2+}, and HCO_3^- contents of waters. Dissolution of gypsum, which is present in minor amounts in many formations in the region, can elevate the Ca^{2+} and SO_4^{2-} contents in the absence of additional $CO_{2(g)}$ and H^+ according to

$$\underset{\text{(gypsum)}}{CaSO_4 \bullet 2H_2O} = Ca^{2+} + SO_4^{2-} + 2H_2O. \qquad (5)$$

Elevated Na^+ concentrations may result from either the dissolution of halite or from ion exchange on clay particles or on sodium zeolites (Mayo and others, 2000). Halite dissolution will increase the overall solute concentration (i.e. TDS) and will yield equal Na^+ and Cl^- contents when the solute compositions are reported in the meq/l units. Halite is not abundant in the study area. Ion exchange will not directly elevate the overall solute content, but will result in increased Na^+ concentrations with corresponding decreases in Ca^{2+} and/or Mg^{2+} concentrations. Halite dissolution may be represented as

$$NaCl = Na^+ + Cl^-, \qquad (6)$$

and ion exchange may be represented by reactions involving the sodium zeolite analcime,

$$2NaAlSi_2O_6 \bullet H_2O + Ca^{2+} = Ca(AlSi_2O_6)_2 \bullet H_2O + 2Na^+, \qquad (7)$$

$$2NaAlSi_2O_6 \bullet H_2O + Mg^{2+} = Mg(AlSi_2O_6)_2 \bullet H_2O + 2Na^+, \qquad (8)$$

or clay mineral exchange which may be represented as

$$Ca^{2+} + Na\text{-clay} = 2Na^+ + Ca\text{-clay} \qquad (9)$$

$$Mg^{2+} + Na\text{-clay} = 2Na^+ + Mg\text{-clay} \qquad (10)$$

7. Solute Compositions

Stiff (1951) diagrams representing mean solute compositions of groundwater, streams, and springs at the surface are shown in Appendix B Figure 22. Mean solute compositions of each spring and geologic formation are listed in Appendix B Table 2. The solute compositions of groundwaters and surface waters in the study area are shown graphically on a Piper plot in Appendix B Figure 23. Calculated mineral saturation indices are listed in Appendix B Table 3.

a. Streams

(1) Crandall Canyon Drainage

Water quality samples taken below the confluence of the north and south forks of Mill Fork Creek have a mean TDS of about 300 mg/l and are of the Ca^{2+}-Mg^{2+}-HCO_3^- type with lesser amounts of

SO_4^{2-} (Appendix B Table 2). This water includes drainage from the Mill Fork permit area as well as the area to the north.

(2) Mill Fork Canyon Drainage

Water quality samples taken below the confluence of the north and south forks of Crandall Creek have a mean TDS of about 480 mg/l and are of the Ca^{2+}-Mg^{2+}-HCO_3^- type with lesser amounts of SO_4^{2-} (Appendix B Table 2). Most of this water originates in the Mill Fork permit area.

(3) Rilda Canyon Drainage

Water quality samples taken below the confluence of the north and south forks of Rilda Creek have a mean TDS of about 400 mg/l and are of the Ca^{2+}-Mg^{2+}-HCO_3^- type (Appendix B Table 2). This water is mostly drainage from the Mill Fork permit area.

b. Springs

The solute compositions of groundwaters from nearly all of the springs in the Mill Fork permit area are of similar chemical type (Appendix B Table 2). This is seen in the similarity of the shapes of the Stiff diagrams in Appendix B Figure 22, and the clustering of the data points on the Piper plot in Appendix B Figure 18. All of the springs in the Mill Fork permit area, for which chemical analyses are available, are of the Ca^{2+}-Mg^{2+}-HCO_3^- type with variable amounts of SO_4^{2-}. This chemical type is consistent with the dissolution of carbonate minerals in the presence of soil zone $CO_{2(gas)}$ according to equations 1-4 above.

Mineral saturation calculations indicate that most of the springs and streams in the study area are at or above saturation with respect to the carbonate minerals calcite and dolomite (Appendix B Table 3). What this means is that the chemistry of the spring water is near equilibrium with respect to these minerals, and thus there is not a thermodynamic tendency to dissolve additional carbonate minerals if these are encountered in the groundwater system. Waters with saturation indices less than log = -0.1 have a thermodynamic tendency to dissolve the mineral species should they be encountered in the groundwater system and waters with a saturation indices greater than log = 0.1 have a thermodynamic tendency to precipitate the mineral species.

For additional dissolution of carbonate minerals to occur, an influx of CO_2(g) into the groundwater system must occur. Common sources of CO_2(g) in this environment include CO_2 produced by root respiration and organic decay in the soil zone and bacteriological processes resulting in the oxidation of CH_4 (methane). No surface or groundwater in the study area is near saturation with respect to gypsum. What this indicates is that, if gypsum is encountered along a waters flow path, dissolution of the gypsum will occur, resulting in elevated Ca^{2+} and SO_4^{2-} concentrations. Groundwater from the Blackhawk Formation and Star Point Sandstone encountered in nearby mine environments is supersaturated with respect to both calcite and dolomite (Appendix B Table 3) indicating that the water has the thermodynamic tendency to precipitate these minerals.

TDS concentrations of springs in the study area fall in the narrow range of 207 to 390 mg/l. A probability plot of the ordered ranking of the TDS of groundwaters collected during the 2000-2001 spring and seep survey (Appendix B Figure 24) indicate a single population with a normal distribution. The fact that all of the Mill Fork permit area springs discharging from alluvial systems, the North Horn Formation, Price River Formation, Castlegate Sandstone, and Blackhawk Formation have the same chemical character (Appendix B Table 2; Figures 22 and 23) is of particular significance. In other areas in the Wasatch Plateau, bedrock springs commonly have a broader range of TDS and chemical type, which is related to the bedrock formation from which the springs discharge (Danielson and others, 1981; Mayo and Associates, 1997d; Mayo and Morris, 2000).

The mean TDS for each geologic formation ranges from 253 mg/l in the North Horn Formation to 322 mg/l in the Price River Formation. That there is not a greater variability in TDS, or a greater number of groundwater types represented in the springs in the study area implies that there is not a great deal of variation in the soil zone processes or mineralogy of the matrix of the groundwater systems from which these springs emanate. We believe that the lack of variability in groundwater solute chemistry occurs because the groundwater systems that support springs in the area flush large quantities of groundwater through the thick soil zone and shallow fractured bedrock. Over thousands of years, some of the soluble minerals which were once present in the shallow bedrock and in the soil have been leached away. Because these groundwater systems do not come into contact with rocks deeper in the geologic formations (which vary substantially in their soluble mineral contents) there is little variation in the chemical type of groundwater.

Although there is little variability in the chemical type and TDS of groundwater discharging from springs in the Mill Fork permit area, there is considerable variability in the TDS and solute compositions of spring discharge waters and the solute composition of spring discharging from the Blackhawk Formation in the nearby Trail and Cottonwood Mine areas (Appendix B Table 2, Figure 23). We interpret the overall greater TDS and degree of chemical variability in the Blackhawk Formation in the Trail and Cottonwood Mine waters as a result of great precipitation variability in the Trail and Cottonwood Mine areas. Except for Joes Valley Alluvium, Mill Fork permit area groundwaters recharge and discharge from very wet upland areas. Trail and Cottonwood Mine groundwater recharge and discharge from a variety of elevations and recharge domains.

c. In-Mine Groundwater

Because the Mill Fork State Lease was a new lease area that did not have existing underground workings, the solute compositions of in-mine groundwater can only be inferred from compositions of in-mine waters in nearby mines. Extensive in-mine samples of Blackhawk Formation roof drip water are available from Energy West's mines which include Cottonwood, Wilberg, Trail Mountain, and Deer Creek (Appendix B Table 2). A limited number of in-mine samples (Table 2) from the Star Point Sandstone are also available from the Deer Creek and Cottonwood Mines (Mayo and Associates, 1997d) and from public documents for the Crandall Canyon Mine (Mayo and Associates, 1997a).

(1) Blackhawk Formation

In-mine roof drips from the Blackhawk Formation are of the Ca^{2+}- Mg^{2+} -HCO_3^- -SO_4^{2-} type with appreciable amounts of Na^+ (Appendix B Table 2). These groundwaters have elevated TDS contents relative to Blackhawk spring waters in the Mill Fork permit area and are generally chemically dissimilar to springs in the Mill Fork permit area (Appendix B Figure 23). The two spring samples from the Deer Creek and Cottonwood Mine areas (Appendix B Table 2) have similar solute contents as the in-mine samples. Mayo and others (2000) found the elevated TDS in coal mine roof drip water to be the result of a cascading series of chemical reactions involving the oxidation of pyrite which increases the SO_4^{2-} concentration and releases H^+ ions. The H^+ ions are consumed by dissolution of additional carbonate minerals (i.e., calcite and dolomite) elevating the Ca^{2+} and Mg^{2+} contents. In the process acid mine drainage (AMD) is prevented. Ion exchange of Ca^{2+} and Mg^{2+} on the sodium zeolite analcime increases the Na^+ contents. We anticipate similar in-mine processes will occur in the Mill Fork permit area.

(2) Spring Canyon Member

The solute chemical composition of groundwater in the Spring Canyon Member beneath existing mine workings is highly variable (Appendix B Table 4). Conductivities range from 500 to 2,287 µS/cm. Ca^{2+} concentrations range from 5.5 to 64 mg/l and Mg^{2+} concentrations range from 5.1to 41 mg/l. Na^+ concentrations range from 14 to 550.6 mg/l and Cl^- concentrations range form 5.0 to 221.3 mg/l. The large spatial variations in solute chemistry are attributed to the influence of interbedded Mancos Shale tongues which are present in some locations and not in others and are known to contain soluble minerals. The variations in Na^+ are likely the result of the presence or absence of clays with ion exchange capacity. Ion exchange commonly results in elevated Na^+ concentrations at the expense of decreased Ca^{2+} or Mg^{2+} concentrations.

That the solute chemistry in the Spring Canyon Member is not uniform beneath existing mines suggests that there is a partitioning of groundwater systems in the member. This condition is likely the result of interbedded lower-permeability layers in the Star Point Sandstone which partition individual sandstone bodies. These findings are substantiated by monitoring well data from 6 wells in the Trail and East Mountain areas (Appendix B Section 7.3) and are significant in that they strongly suggest that the Spring Canyon Member does not act as a single regionally continuous aquifer, but rather it supports a series of smaller, discrete groundwater systems.

(3) Joes Valley Fault System

Groundwaters in the Joes Valley Fault system and associated synthetic faults and fractures have been observed in the Crandall Canyon Mine. Data from a public domain document (Mayo and Associates, 1997a, c) indicate the water is of the Ca^{2+} -Mg^{2+} -HCO_3^- type. This water type is consistent with the dissolution of carbonate minerals in the presence of soil zone $CO_{2\,(gas)}$. Slightly elevated SO_4^{2-} concentrations are consistent with dissolution of minor amounts of gypsum. The relatively low mean Na^+ concentration (3.7 mg/l; 0.17 meq/l) indicates that appreciable ion exchange has not occurred. Na^+ and Cl^- contents, in meq/l, are essentially the same, indicating halite dissolution as the Na^+ source.

8. δ^2H and $\delta^{18}O$

The δ^2H and $\delta^{18}O$ composition of a water molecule falling as precipitation is determined by the temperature at which nucleation of the water droplet occurs. However, other effects related to the bulk composition of the water vapor phase, such as cloud rainout and orographic effects, also can affect the isotopic composition of precipitation.

The stable isotopic compositions of waters are usually analyzed relative to the Meteoric Water Line (MWL). The MWL is empirically derived from the worldwide plotting locations of coastal zone precipitation and is defined by the equation $\delta^2H = 8\ \delta^{18}O + 10$ ‰ (See Appendix B for further discussion of the MWL). Precipitation that forms under cooler conditions will plot lower (i.e. more negatively) along the MWL than will precipitation that forms under warmer conditions.

Except for unusual conditions such as geothermal heating above abut 100°C, the δ^2H and $\delta^{18}O$ composition of a groundwater is set at the time of recharge and is not affected by subsurface conditions such as groundwater residence time and mineral dissolution and precipitation reactions. In other words, the recharge and flow history of a groundwater can be evaluated independently of the solute content of the water using stable isotopic compositions.

The δ^2H and $\delta^{18}O$ composition of both in-mine groundwaters and groundwaters from springs, streams, and wells in the study area are listed in Appendix B Table 5 and are plotted on Appendix B Figure 25. Laboratory reporting sheets are presented in Appendix B. All groundwaters in the study area plot near the meteoric water line indicating a meteoric recharge origin (i.e. rain and snow).

Based on their stable isotopic compositions, groundwaters from within both the Energy West and Crandall Canyon Mines are readily distinguishable from each other and from springs and creeks in the Mill Fork permit area. These three populations are statistically different from each other at the 95% confidence level. The Mill Fork Spring samples tend to plot more positively relative to the meteoric water line than do the in-mine waters, indicating that the near-surface groundwaters recharged under different climatic conditions. The more negative composition of the in-mine groundwaters is probably the result of paleorecharge during cooler, wetter times. The stable isotopic composition of water seldom changes significantly after infiltration into the groundwater system. What this suggests is that modern groundwater systems in the upland areas overlying the mine area is not the primary source of recharge to the groundwater systems encountered in the mines.

9. Groundwater ages (^3H and ^{14}C)

The concept of groundwater age is difficult to define because water arriving at a well or spring seldom travels via pure piston flow. Instead it is usually a mixture of water molecules that recharged at different locations and at different times, thus water has no unique age. It is therefore best to think of a groundwater "age" as the *mean residence time* of the water sampled at the well or spring.

In this investigation, two unstable isotopes, tritium (^3H) and carbon-14 (^{14}C), have been used to evaluate mean residence times. Tritium is a qualitative tool indicating if groundwater has a component of water that recharged since about 1954. Groundwater that recharged prior to about 1954 will contain essentially no tritium (Appendix B). Carbon-14 provides information regarding the number of years that have elapsed since the groundwater became isolated from soil zone gases and near-surface waters. Like tritium, ^{14}C can indicate if groundwater has a component that recharged since the 1950s. Groundwaters with ^{14}C contents greater than about 50 percent modern carbon (pmc) contain anthropogenic (i.e., human-induced) carbon associated with atmospheric nuclear weapons testing. It is not uncommon for groundwater issuing from a spring or occurring in a well to be a mixture of old (i.e. containing no ^3H) and modern water.

Groundwater ages have been calculated for 27 springs, 14 in-mine locations, and 6 Star Point Sandstone wells (Appendix B Table 5, Figure 26). All spring waters, except for spring 18-4-1 which is located in the southwestern portion of Trail Mountain, contain anthropogenic carbon and appreciable amounts of ^3H and are, therefore, modern. These springs issue from alluvial systems, the North Horn Formation, the Price River Formation, the Castlegate Sandstone, and Blackhawk Formation.

Spring 18-4-1 issues from the Blackhawk Formation-Castlegate Sandstone contact at the down plunge end of the Straight Canyon Syncline (Appendix B Plate 1) and is not in the Mill Fork permit area. The spring water does not contain water that recharged since 1954; however, the water was likely recharged less than a few hundred years ago as is indicated by its ^{14}C content.

Most groundwaters collected inside the Cottonwood/Wilberg and Deer Creek Mines contain essentially no tritium (Appendix B Table 5) and have mean ^{14}C ages ranging from 2,000 to 12,000 years. Roof drip waters associated with faults (i.e., 1.5N X 29, 6W X 20, and MN-ME) contain waters 2,000 to 7,000 years old and are not in hydraulic communication with the surface (Appendix B Table 5). Both roof drip (i.e. Blackhawk Formation) and wells in the Spring Canyon Member of the Star Point Sandstone in the Crandall Canyon Mine generally have groundwater ages of 13,000 – 19,000 years. These waters contain essentially no tritium and thus represent groundwater systems that are essentially hydraulically isolated from modern near surface hydrologic phenomena.

As discussed in Appendix B Section 7.2.3, two in-mine roof drip samples associated with faults, TW-10 (Roans Canyon) in the Deer Creek Mine and 5th West (Joes Valley Fault) in the Crandall Canyon mine, have ^{3}H contents indicating a component of modern recharge.

Two wells completed in the Star Point Sandstone, CCCW-1S and TM-3, have mean groundwater residence times of 1,000 and 6,000 years, respectively. These two wells are both completed in the Spring Canyon tongue and appear to be located on approximately the same flow line. CCCW-1S is up gradient and near the recharge area as evidenced by the young ^{14}C age and the ^{3}H content. TM-3 is down gradient. Assuming that the two wells intercept groundwater along the same flow line, travel times can be calculated using the method described by Mooke (1980):

$$\Delta T = 8270 \ln (a_{k+1}^{14}/a_k^{14}) \quad (11)$$

$$\Delta T = 5{,}300 \text{ years}$$

where:

ΔT = travel time (in years)

a_{k+1}^{14} = ^{14}C activity of up-gradient sample

a_k^{14} = ^{14}C activity of down-gradient sample

Assuming the travel time of 5,300 years and a distance of 4 miles, the calculated flow velocity is approximately 0.25 feet per year.

10. Active and In-active Groundwater Zones

The overall pattern of groundwater flow and surface water-groundwater interactions in the Mill Fork permit area and adjacent areas can be described by a fairly simple conceptual model involving both active and inactive groundwater flow regimes (Mayo and Morris, 2000 Appendix B). The model is illustrated in Appendix B Figure 27.

Active zone groundwater flow systems contain abundant ^3H, have excellent hydraulic communication with the surface, are dependent on annual recharge events, and are affected by short term climatic variability. Tritium and carbon-14 "age" dating of spring waters in the study area demonstrate that all springs, except 18-4-1, issue from active zone groundwater systems and are of modern origin (Appendix B Table 5, Figure 26). Groundwater in the active zone generally circulates shallowly and has short flow paths. Because the springs in the Mill Fork permit area and adjacent areas are not part of large, regional groundwater systems, hydrographs of their discharge rates show both seasonal and climatic fluctuations (Appendix B Figure 12). During drought cycles, it is not uncommon for discharge from some springs in the active zone to completely cease.

The δ^2H and $\delta^{18}O$ compositions of Mill Fork permit area springs relative to in-mine groundwaters demonstrate that the Mill Fork permit area springs are not part of the same groundwater systems that discharge in the mines (Appendix B Figure 25).

The active regime includes alluvial groundwater, all of the Flagstaff Limestone, and the near-surface exposures of all other bedrock formations. The "near surface" extends a few hundred feet vertically into the subsurface, about 500 to 1,000 feet into cliff faces and is controlled by fracturing, weathering, and the surface exposures of fluvial channel sands. Further into the cliff faces the discontinuous character of the channel sands prevents active groundwater flow.

Except for mountain fronts and cliff faces, the coal bearing lower Blackhawk Formation and the Star Point Sandstone are generally not exposed at the surface in the Mill Fork permit area and are not part of the active zone. In Cottonwood Canyon, located south of Mill Fork permit area, the Star Point Sandstone is within a few hundred feet of land surface and is part of the active zone as evidenced by the tritium content, 1.10 TU, in Well CCCW-1S (Appendix B Table 5). Elsewhere Star Point Sandstone samples have groundwater ages of 6,000 to 19,000 years. In the Mill Fork permit area the lower Blackhawk Formation and Star Point Sandstone are not exposed near the land surface, except at cliff faces, and are not in the active zone.

Except for mining operations near cliff faces, the in-mine environment is generally not part of the active zone. However, in-mine groundwater containing tritium (i.e., 1 TU or more, Appendix B Table 5) in TW-10 (Roans Canyon Fault) and 5th West Fault (Joes Valley Fault-Genwal Mine) indicate that locally the inactive zone extends into the mine environment where fracture zones, that are associated with major faulting, are currently under tensional stress. The extension of the active zone into the mine environment along fractures is localized as evidenced by the absences of tritium and old ^{14}C ages in in-mine groundwater collected elsewhere along the fracture zone (Appendix B Table 5).

Inactive zone groundwater systems contain old groundwater (i.e. 2,000 to 19,000 radiocarbon years, Appendix B Table 5), have very limited hydraulic communication with the surface and with other active groundwater flow systems, and are not influenced by either annual recharge events or short term climatic variability as evidenced by the decline in roof drip rates (Appendix B Figure 15). Groundwater in these systems tends to occur in sandstone channels in the North Horn, Price River, and Blackhawk Formations which are not in direct hydraulic communication with the surface (i.e. greater than about 500 to 1,000 feet from cliff faces). These sandstone channels are vertically and horizontally isolated from each other and when encountered in mine workings are usually drained quickly. The blanket sands of the Star Point Sandstone are also largely in the inactive zone.

Except for the immediate vicinity of Joes Valley Fault, we believe that groundwater intercepted in the Mill Fork permit area will be part of the inactive zone and will not be in hydraulic communication with either near surface groundwater or surface water systems. Mining within 200 to 300 feet of Joes Valley Fault is problematic in that the area is under tension and deep groundwater may be part of the active zone.

Two fundamentally different groundwater regimes, active (near surface) and inactive (deep subsurface and in-mine) that occur in the vicinity of the Mill Fork permit area and elsewhere in the Utah Coal District are due to the vertical and horizontal heterogeneity of the bedrock (Appendix B Section 5.3). The rock formations consist primarily of alternating and interpenetrating layers of somewhat permeable sandstone and impermeable shale and mudstone. Individual rock layers are generally not continuous over great horizontal distances. Rather, one rock facies commonly grades horizontally into another facies. Fluvial deposits consisting of sandstone channels, which locally support groundwater systems, typically interpenetrate with shale and mudstone units. Thus, layers of shale or claystone that have very low permeabilities encase individual sandstone layers both horizontally and vertically. Although the permeability of individual sandstone bodies may locally be relatively high, the ability of these rocks to transmit water horizontally over great distances is low because of the discontinuous nature of the sandstones. Due to the pervasiveness of low permeability shales and mudstones, the potential for vertical groundwater flow is minimal.

Because of the limited potential for groundwater to migrate vertically through the stratigraphic section, active zone recharge waters commonly infiltrate only into the soil zone and shallow, fractured bedrock. Most groundwater moves downward through the shallow subsurface until the first impermeable layer is encountered where it migrates laterally and is discharged at the surface as a spring or seep.

11. Regional Groundwater Systems

A report by the U.S. Geological Survey (Lines, 1985) states that there exists a regional aquifer in the lower Blackhawk Formation and Star Point Sandstone in the Wasatch Plateau. Lines also postulates that the regional aquifer is recharged by the downward migration of groundwaters from overlying perched groundwater systems in the North Horn and Price River Formations. This idea is not correct. Groundwaters encountered within mine openings in the lowermost Blackhawk Formation occur primarily within discontinuous sandstone channels. It is not uncommon for some of these channels to be completely dry, while others are partially or completely filled with water. Between these sandstone channels, the surrounding shales and claystones of the Blackhawk Formation are usually dry. The discontinuous nature of the saturated sediments in the lowermost Blackhawk Formation, and the unconfined conditions under which these groundwaters exist do not support the idea of a deep, regional system with groundwater flowing from areas of recharge to areas of discharge.

Additionally, radiocarbon and tritium groundwater age dating indicates that groundwater in the shallow perched groundwater systems are modern (post-1954) and in-mine groundwater in the Blackhawk Formation and Star Point Sandstone are thousands of years old.

We believe that the presence of swelling clays and impermeable shales in the rocks in the unsaturated zone between the overlying perched systems and the Blackhawk Formation effectively prohibit downward vertical migration of waters from the perched systems. Lines (1985) analyzed cores taken from well (D-17-6)27bda-1 and found the hydraulic conductivities of the shales and siltstones to be very low (i.e. 10^{-7} to 10^{-8} ft/day). One shale sample was found to be effectively impermeable even when a hydraulic pressure of 5,000 psi was applied.

Because there are no regionally extensive groundwater regimes in the lower Blackhawk Formation or Star Point Sandstone within the lease area, it is not possible to draw meaningful potentiometric surface maps of these systems.

Lines (1985) also reported that water was likely leaking from the Joes Valley Reservoir downward into the "lower Blackhawk / Star Point aquifer" in Straight Canyon. We believe that this is incorrect. Groundwater collected from well TM-3, which is completed in the Star Point Sandstone in Straight Canyon just below the reservoir, has a radiocarbon age of 6,000 years, while water in Joes Valley Reservoir is of modern origin. Water levels in TM-3 do not respond to seasonal fluctuations in the water level in Joes Valley Reservoir, indicating that there is little or no hydraulic communication between the reservoir and water in the Star Point Sandstone. Groundwater was sampled at UG-3 in the lower Blackhawk Formation in the Trail Mountain Mine. This water has a radiocarbon age of 5,500 years, which is likewise not consistent with water from the reservoir.

12. Summary of 2001 Mayo & Associates Study

In summary, all groundwater encountered in springs monitored in the Mill Fork permit area discharge from active, shallow groundwater systems. No evidence exists that suggests a large, regional-type aquifer occurs in the area. All of the springs analyzed in the study area exhibit large-scale fluctuations in discharge rates in response to the annual snowmelt event. The springs are also sensitive to longer-term variations in climate. Carbon-14 and tritium dating of spring and stream waters indicate that the springs contain anthropogenic (human-induced) carbon and levels of tritium consistent with recharge in the past 50 years. Stable isotopic δ^2H and $\delta^{18}O$ data from springs and streams at the surface indicate that the recharge sources for these groundwater systems are different from those that recharged the groundwater systems encountered in the mine environment.

Almost all groundwater encountered in in-mine environments <u>is not</u> related to shallow, active zone groundwater systems from which springs and streams discharge. ^{14}C dating indicates that groundwater entering the underground workings in most locations is thousands of years old. When groundwater is encountered in the mine, inflow rates commonly decrease rapidly and most inflows eventually dry up completely. This indicates that the groundwater systems encountered in the mine are not part of large regional groundwater systems. There is no relationship between groundwater inflow rates measured in the mine and the annual snowmelt event or long term climatic trends. This demonstrates a lack of hydraulic communication between the groundwater systems encountered in the mine and active zone groundwater systems near the surface.

13. Conclusions from 2001 Mayo & Associates Study

- Groundwaters discharging from springs are part of active zone groundwater systems. Isotopic analysis indicates that groundwater from the active zone is of modern origin (recharged less than 50 years ago). Seasonal variations in discharge rates from active zone springs indicate that flowpath lengths are short and that groundwater travel times from recharge areas to discharge areas are generally less than one year. The abundance of shale and claystone units in the geologic section prohibits significant downward migration of active zone groundwaters into deeper horizons.

- Analysis of the solute chemistry of groundwaters discharging from springs and seeps indicate that depths of circulation in these systems are shallow. The modern groundwater ages of shallow groundwaters in the study area support this conclusion.

- Groundwater encountered in most locations in the mines is many thousands of years old. Groundwater in the Star Point Sandstone ranges from approximately 1,000 to 19,000 years old. Groundwater in the Blackhawk Formation within the mines ranges in age from about 2,000 to 14,000 years, whereas groundwater in the Joes Valley Fault system ranges in age between about 2,500 and 5,000 years. None of these groundwaters have appreciable tritium concentrations, indicating that no recharge has occurred in the past 50 years.

- Groundwater encountered in the northwest corner of the Crandall Canyon Mine discharges from a series of fractures located near the Joes Valley Fault. Tritium data indicate that a component of this water recharged in the past 50 years, whereas ^{14}C data indicate that another component recharged more than 3,500 years ago. This groundwater appears to originate from a sandstone channel in the mine roof.

- More than two-thirds of all non-alluvial springs in the Mill Fork permit area discharge from the North Horn Formation. The abundance of springs in the North Horn Formation is the result of the large area of exposed North Horn in the upland areas where precipitation is greatest, and the presence of the abundant claystone and shale layers which inhibit significant downward migration of precipitation into the formation.

- The fact that Little Bear Spring discharges modern water and has large variations in discharge rates suggests that it is the discharge location of an active zone groundwater system. Because inactive zone groundwater systems in the Star Point Sandstone beneath the mine are tens of thousands of years old and do not exhibit seasonal variations in discharge, these groundwater systems are precluded as potential contributors to the discharge from Little Bear Spring. The very low permeability in the Star Point Sandstone beneath the mine indicates that diffuse flow through the Star Point Sandstone beneath the mine cannot contribute significant groundwater to the discharge from the spring.

- Limited data suggest the possibility that Little Bear Spring may receive significant recharge where the fracture system from which it emanates crosses streams and active zone groundwater systems in drainages south of Little Bear Canyon. The conditions in Mill Fork Canyon seem favorable for recharge to the spring.

14. Mine Dewatering

Water encountered within the Deer Creek and Wilberg/Cottonwood mines (Des-Bee-Dove was a dry mine) has generally been confined to the perched aquifer systems and fractures-faults associated with the Blackhawk Formation as discussed earlier. Water enters the mines through various avenues including roof leakers (drippers) from overlying fluvial sandstone channels, bolt holes, tension cracks in the overlying strata, longwall caved areas, and where fractures or faults have been intersected by the mine workings. Excess water not utilized in the mining operation or for domestic use in the Mill Fork permit area will be either pumped to storage areas or discharged from the Deer Creek Mine under approved UPDES permits (see Volume 9 Hydrologic Section: Appendix B for UPDES permit information). A complete description of the quality and quantity is reported in the annual Hydrologic Monitoring reports and also in the PHC section (R645-301-728).

15. Groundwater Rights And Users

Nine springs have been developed in Huntington Canyon to provide for domestic, industrial, and commercial water needs. Currently, Huntington City utilizes two springs in Huntington Canyon, Big Bear Canyon Spring and Little Bear Canyon Spring. The North Emery Water Users Association also utilizes springs in Huntington Canyon to provide for domestic and industrial water needs in areas outside of Huntington City. The Association is currently utilizing water from three springs in Rilda Canyon as well as from four other springs in the general area (refer to Volume 9 Hydrologic Section: Map HM1).

Some of the springs on East Mountain: Mill Fork Area have been developed for watering livestock by installing troughs, and JV-36 (located approximately 1 mile west of the Mill Fork State Lease) has been developed as a culinary water source for a cabin in the area. See Table MFHT-3 for a summary of the springs within the permit area, their location, and any claims placed on the water they produce.

a. North Emery Water Users Association

Of concern to PacifiCorp is the proximity of proposed mining activities in Rilda Canyon to the Rilda Canyon Springs which currently serve as a culinary water source to the North Emery Water Users Association (NEWUA) serving some 410 connections. Due to the importance of these springs, a separate discussion is provided in Volume 9 Hydrologic Section.

b. Little Bear Spring

A second spring system which has been developed for culinary purposes referred to as Little Bear Spring occurs east of the Mill Fork permit area. Little Bear Spring is a large spring (average flow of approximately 300 gpm) which issues from the lowest member of the Star Point Sandstone (Panther Member) located approximately one and one half (1 ½) miles to the east of the Mill Fork permit area boundary in Section 9, Township 16 South, Range 7 East. The spring was developed in 1960 by Huntington City and is currently maintained by Castle Valley Special Service District (CVSSD). Little Bear Spring provides sixty five (65) percent of the culinary water for the cities of Huntington, Cleveland and Elmo.

As stated in the Mill Fork environmental assessment (EA) competed in 1997, Little Bear Spring flows continuously, with average monthly discharge ranging from two hundred (200) to four hundred forty (440) gpm (CVSSD, 1997). Flow varies seasonally, with a typical increase of twenty (20) to forty (40) percent in response to spring runoff. The lowest average monthly baseflow recently measured was one hundred ninety eight (198) gpm in April 1995 (refer to Appendix C: Little Bear Spring - for historical quality and quantity). Isotopic analyses performed to evaluate the age of water indicated that the spring discharges modern water, and has very similar composition to water in both Crandall and Huntington Creeks (Mayo and Associates, 1997). Further chemical analyses show that water from Little Bear is very similar to surface water in both Little Bear and Huntington Creeks. Water quality in the spring is good, requiring only chlorine treatment before it is suitable for consumptive use.

Based on previous reports and field observations (refer to Little Bear Spring reference list) , the spring emanates from western fault of the Mill Fork graben. The graben is approximately one thousand (1,000) feet wide and trends from the southwest to the northeast at approximately north thirty (30) degrees east. Much of the geologic and hydrologic detail concerning the fault system was derive from the mining history of the Arco #4 mine located in Mill Fork Canyon. Mining in the #4 mine encountered the eastern fault (down thrown approximately thirty (30) feet on the west) of a small graben as entries were driven northwest from the portals in Mill Fork Canyon. Rock slopes were developed through the fault system down to the coal seam level. Mining proceeded across the graben to the western fault up thrown fault (up thrown approximately twenty nine (29) feet on the west). A second set of rock slopes were developed to access coal reserves to the west of the graben. Coal reserves diminished rapidly to the west and the mine was eventually closed and reclaimed. Mining across and within the graben encountered only minor quantities of groundwater and flow of Little Bear Spring was not impacted.

Isotopic sampling of water from Little Bear Spring indicates modern water (Appendix B Table 5), shows marked seasonal discharge variations and responds to short term climatic cycles indicates that it is supported by shallowly circulating groundwater. The groundwater that supports Little Bear Spring is not related to the deep, old groundwater encountered in area coal mines (refer to Appendix B Groundwater Section).

Results of in-mine slug testing of the Star Point Sandstone beneath the Crandall Canyon Mine conducted by Genwal Resources (Mayo and Associates, 1997b) indicate that diffuse, matrix flow of groundwater through the Star Point Sandstone cannot be an important source of recharge to Little Bear Spring. Flow calculations using the hydraulic conductivities obtained from the slug testing and the approximate hydraulic gradient indicate that diffuse flow through the Star Point Sandstone is capable of yielding at most only a few gpm of groundwater discharge, which would represent only a very small percentage of the spring discharge. The ancient age of groundwater encountered in the Star Point Sandstone beneath the Crandall Canyon Mine adjacent to Little Bear Spring (19,000 years; Mayo and Associates, 1997a) supports this conclusion.

Mayo and Associates (Appendix B Reference List Mayo 1997a,b) suggested that Little Bear Spring is primarily recharged from surface water losses and alluvial groundwater losses in Mill Fork Canyon east of the Mill Fork permit area (refer to Little Bear Spring reference list, Mayo & Associates studies June 1999 through November 2001 and AquaTrack Surveys December 1998 through November 2001).

(1) Groundwater Flow Mechanisms

The Mill Fork environmental assessment described three (3) mechanisms controlling flow to Little Bear Spring:

1. Water flowing through the Star Point Sandstone emerges at the spring location. Recharge for the spring is coming from the north and west, possibly supported by the Joes Valley Fault.

2. Recharge to the spring comes from the flow through the Star Point Sandstone from the north and northwest, and surfaces through fractures in the formation.

3. The trend of Huntington Creek follows a series of straight segments that are evident on topographic maps. The portion of Huntington Creek approximately two (2) miles north of the lease tract follows a north-south lineation. It has been suggested the trend of the creek in this area is controlled by a north-south anomaly (possibly an unmapped fault) that runs south, through the northeast portion of the lease area (proposed lease delineation including the Little Bear drainage area) in Little Bear Canyon. Water from Huntington, Crandall Creeks and maybe Little Bear creeks enters this anomaly, and travels through it until it is intercepted by the Mill Fork Graben, where it is redirected to the northeast and emerges where the Mill Fork Graben fault zone intersects Little Bear Canyon. Comparison of the flow hydrographs for the spring and Huntington Creek show a strong correlation,

suggesting that the water from the spring is derived from surface water sources. Spring flow has an apparent time lag of two (2) to four (4) years against flow in Huntington Creek. Additional flow may reach the spring by surface water seeping into the exposed outcrop of the Star Point Sandstone at nearby upgradient locations, or through direct infiltration of precipitation close to the spring source.

Additional studies completed after the publication of the Mill Fork EA (AquaTek, 1998 and 1999) have developed a fourth mechanism controlling flow:

4. Surface water from the upper reaches of Mill Fork Canyon flows down canyon recharging the alluvial deposits is intercepted by the southern extension of the Mill Fork graben, and then flows north along the fault and emerges in Little Bear Canyon. This flow mechanism was confirmed by a study conducted jointly by Mayo & Associates and the Forest Service (Little Bear Spring reference list: Mayo & Associates, November 2001)

As stated in the EA, given the most recent studies that indicate water from Little Bear spring is modern, chemically similar to surface waters in the area, and given the high discharge rates, it appears that the spring is supported by a system of faults and/or fractures that transmit surface water from the north and the south *(AquaTek Studies).* The hydraulic conductivity of the Star Point Sandstone is low, and gives rise to slow groundwater movement. As demonstrated by Hansen, Allen and Luce, assuming a five thousand (5,000) foot capture zone along the Mill Fork graben, a velocity of 0.013 ft/day through the Star Point, and aquifer height of forty five (45) feet, the potential discharge amount through the Star Point for the spring would only be fifteen point two (15.2) gpm. This demonstrates that flow through the Star Point Sandstone itself cannot support the flow emanating from Little Bear spring.

(2) Mill Fork Leasing Process

As stated in the Mill Fork EA, on February 4, 1993, Genwal Resources, Inc. submitted Coal Lease Application UTU-71307 to the Bureau of Land Management (BLM), Utah State Office, to lease Federal Lands in the vicinity of Mill Fork Canyon.

The Mill Fork tract lies within the Huntington Canyon-Gentry Mountain and the Ferron Canyon, Cottonwood-Trail Mountain Multiple-Use Evaluation Areas as described in the Manti-La Sal National Forest Land and Resource Management Plan (Forest Plan). The Forest Plan Environmental Impact Statement (EIS) and Record of Decision makes these areas available for consideration for coal leasing.

The first step in the leasing evaluation process was to delineate a tract. Tract delineation was completed by the BLM on October 2, 1996. Named the Mill Fork Tract, the area encompassed approximately six thousand four hundred forty (6,440) acres.

A no action alternative and three action alternatives were developed to provide a full range of reasonable alternatives that sharply define the significant issues.

A. Alternative 1 - No Action

Forest Service would not consent to, and the BLM would not approve leasing.

B. Alternative 2 - Offer for lease with standard BLM Lease Terms, Conditions and Stipulations

Forest Service would consent to, and the BLM would approve, offering six thousand four hundred forty (6,440) acres, as delineated for competitive leasing. The lease would only have the standard BLM terms, conditions and stipulations that are included on the BLM coal form.

C. Alternative 3 - Offer for lease with application of Special Coal Leasing Stipulations for Protection of Non-Coal Resources

Forest Service would consent to, and the BLM would approve, offering six thousand four hundred forty (6,440) acres, as delineated for competitive leasing. The lease would have the standard BLM terms, conditions and stipulations that are included on the BLM coal form along with eighteen (18) Special Coal Lease Stipulations from Appendix B of the Forest Plan and two (2) additional tract specific stipulations.

D. Alternative 4 - Offer a modified tract for lease with application of Special Coal Lease Stipulations for Protection of Non-Coal Resources

In addition to those activities addressed in Alternative 3, Alternative 4 specifically focuses on concerns identified as water issues. The portion of the lease tract east of the northeast quarter of Section 7 is removed from the leasing offering, to protect the water quality and quantity of Little Bear watershed and spring, reducing the overall tract by eight hundred eighty (880) acres.

Based on the USFS Record of Decision, the BLM offered for lease the Mill Fork Tract excluding the eight hundred eighty (880) acres (total tract approximately five thousand six hundred sixty (5,660) acres). The modified lease excluded the northeastern portion of the lease tract which encompasses the Little Bear Canyon watershed (designated as a Municipal Water Supply [MWS]). Exclusion of the eight hundred eighty (880) acres will protect the Little Bear MWS and minimize potential disruption or degradation to surface and groundwater resources.

On June 6, 2000, Genwal Resources Inc. re-applied for the eight hundred eighty (880) acres which were excluded during the 1997 Environmental Assessment for the Mill Fork Tract. Bureau of Land Management and United States Forest Service evaluated the Lease-By-Application (LBA U-78593) referred to as the South Crandall Canyon Tract and issued the FONSI on February 18, 2003. Genwal Resources acquired the South Crandall coal lease on June 12, 2003.

PacifiCorp cooperated with Huntington City, Elmo City, Cleveland City and CVSSD in developing a comprehensive mitigation plan. The agreement was signed on July, 2004. As part of the agreement, PacifiCorp constructed a water treatment plant in 2005 located near at the existing Huntington City plant in Huntington canyons. The mitigation agreement information is found in Appendix D of Volume 9.

B. EXISTING SURFACE RESOURCES

Presented within this section of the report is the regional hydrologic setting as well as the site specific description of hydrologic surface water characteristics of the permit area.

1. Regional And Permit Area Surface Water Hydrology

The PacifiCorp permit area is located in the headwater region of the San Rafael River Basin. The surface drainage system of the permit area is divided into two major drainages. The southwest portion forms part of the Cottonwood Creek drainage, and the northeast portion contributes to the Huntington Creek drainage (see Hydrologic Map MFS1830D). The Huntington Creek drainage covers approximately seventy percent (70%) of the East Mountain leases held by PacifiCorp; the remaining thirty percent (30%) is within the Cottonwood drainage system.

Huntington and Cottonwood creeks drain about 300 square miles of the Wasatch Plateau in central Utah. Altitude changes rapidly across the Wasatch Plateau with steep canyon sides and high mountain peaks. Altitudes range from 6,000 to 10,700 feet. Average precipitation generally increases with altitude and ranges from ten (10) inches near the town of Huntington to thirty (30) inches in the upper reaches of Huntington and Cottonwood creeks. Most of the precipitation occurs during winter months in the form of snow.

Water use upstream from Castle Valley (the monoclinal valley containing most of the agricultural land) is primarily for stock watering 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 occasionally approaching zero. Transbasin diversions occur throughout the area.

In general, the chemical quality of water in the headwaters of the San Rafael River Basin is excellent, with these watersheds providing most of the domestic water needs to the people below; however, quality rapidly deteriorates downstream as the streams cross shale formations (particularly the Mancos Shale in and adjacent to Castle Valley) and receive irrigation return flows from lands situated on Mancos derived soils (Price and Waddell, 1973). Dissolved solids concentrations range from about 100 to 600 mg/l in the mountain regions and from 600 to 6000 mg/l in Castle Valley.

Huntington Creek above the USGS stream gaging station (0318000) near the town of Huntington drains approximately 190 square miles. Storage reservoirs regulate runoff from fifty four square miles in the upper part of Huntington Creek. The average channel gradient of Huntington Creek above Huntington is about 100 feet per mile (1.9 percent). Danielson et al. (1981) estimate the average annual precipitation on the Huntington Creek drainage to be on the order of twenty six (26) inches. The average discharge at the USGS gage near Huntington is approximately ninety six (96) cubic feet per second (70,000 acre feet per year). The USGS estimates that "during most years, about 65 percent of the annual discharge at the Huntington Creek station (09318000) occurs during the snowmelt period (April-July)" (Danielson et al., 1981, p. 110). While the majority of stream flows are due to snow melt, thunderstorms of high intensity are common in the area during the summer months. The largest annual peak flows have been caused by thunderstorms. Of the measured annual peak flows on Huntington Creek near Huntington, eight annual events have been greater than 1600 cfs (about a 10 year return period), all of which occurred during July, August, or September. The peak discharge of record was 2500 cfs on August 2 or 3, 1930.

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 proportion of area with southern exposure with more gradual slopes than Huntington Creek Basin and 2) possible subsurface movement of water through fractures associated with the 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 (09324500). 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.

Surface drainages within and adjacent to the Mill Fork State Lease\UTU-84285 include portions of Crandall, Mill Fork, Right Fork of Rilda, and un-named tributaries of Indian Creek. Crandall, Mill Fork and the Right Fork of Rilda drain the east slope of East Mountain and generally flow in a east-west direction from the headwaters to Huntington Creek located east of the permit area. Un-named drainages associated with Indian Creek drain the western slope of East Mountain. Indian Creek flows to Lowry Water and then to Joes Valley.

State of Utah designated standards for water quality in the Huntington Canyon and Indian Creek are 1C, 2B, 3A and 4, corresponding to domestic, recreation, cold water fisheries and irrigation beneficial uses.

a. Permit Area Watershed Characteristics

Water sources within the mine plan area include springs and seeps, which were discussed earlier in the Existing Groundwater Resources section of this report. There are no major water bodies located within or immediately adjacent to the mine plan area.

All of the streams within the Mill Fork permit area are ephemeral or intermittent except for a portion of Crandall Creek (see table below). Elevations in the Mill Fork permit area range from approximately 7880 feet in Crandall Canyon to 10,728 feet at Bald Mountain peak. General land slopes in the permit area range from near vertical along the Castlegate Sandstone escarpment to less than four percent. Vegetative cover consists of sagebrush, juniper, and grasses on the south-facing slopes and dense conifer and aspen complexes on the north facing slopes. The following table outlines the stream classifications for the individual drainage systems:

MILL FORK PERMIT AREA DRAINAGE SYSTEM Stream Drainage Area and Classification				
Major Drainage	**Sub-Drainage**	**Drainage Area (acres)**		**Stream Classification**
		Total	**Within Permit**	
*Huntington Creek**	Crandall Creek	4000	1770	Perennial
	Mill Fork Creek	4020	1195	Intermittent
	Right Fork Rilda Canyon	5460	810	Intermittent
Cottonwood Creek	Un-Named Drainages associated with Indian Creek	NA	2047	Ephemeral
* Little Bear Canyon is not included within the boundaries of the lease and will not be included in the analysis. The Mill Fork EA completed in 1997 excluded 880 acres for protection of the Little Bear watershed.				

(1) Huntington Creek Drainage System:

(a) Crandall Creek

Crandall Creek is a perennial stream and is the northern most surface drainage system within the permit area. (Refer to Hydrologic Map: MFS1830D). The drainage area encompasses approximately 4,000 acres of which 1,770 is within the permit area. Surface facilities of the Genwal Resources coal mine are located in Crandall Canyon in Section 5, Township 16 South, Range 7 East. Genwal's coal leases are located generally to the west and north of the Mill Fork permit area. The Crandall Creek drainage system has been extensively undermined by the Crandall Canyon Mine.

According to the United States Geological Survey (USGS), discharge from Crandall Creek ranged from a minimum of 0.24 cubic feet per second (cfs) to 97 cfs from 1979 to 1984 (Danielson, 1981). Based on the unit hydrographs developed for Crandall Canyon, approximately eighty (80) percent of the streamflow occurs between April and July.

Suspended sediment loads in Crandall Canyon were measured in 1978 and 1979 and were found to range between 0.08 to 0.41 tons/day based on flow variations (Danielson 1981). Crandall Creek immediately below the Genwal Mine was designated as a class A1 channel type (steeper than 4% with boulder or bedrock channel) by Raleigh Consultants in a 1992 survey of drainages in the Huntington watershed. Crandall Canyon is extensively monitored by Genwal Resources including ground and surface water resources.

(b) Mill Fork Canyon

Mill Fork Creek is a intermittent stream centrally located within the permit area. (Refer Hydrologic Map MFS1830D). The drainage area encompasses approximately 4,020 acres of which 1,195 is within the permit area. Numerous springs are located in the headwaters of Mill Fork in Sections 11, 12, 13 and 14. Based upon field observations, flow exists upper reaches during base flow conditions from the headwaters in Section 11 to the lower contact of the Castle Gate Formation. From this point the drainage is dry except for short reaches due to the contributions of springs MF-7 and MF-8A. The drainage is again dry below spring MF-8A until the confluence of the two forks in Section 17. Due to the contribution of flow from spring MF-213, flow in the drainage exist below the forks for approximately one quarter mile. Again, the drainage is dry from this point in Section 17 to where the flow reemerges in Section 21 below the reclaimed Beaver Creek #4 Mine. Flow below the mine exists for approximately one half (½) mile. Mining in the Beaver Creek #4 was restricted to the lower portions of the Mill Fork drainage system in Sections 16 and 17 (refer to Hydrologic Map MFS1830D). During the operational and reclamation phase of the #4 Mine, Beaver Creek monitored stream characteristics (quantity and quality) above and below the mine. As part of the North Rilda extension of the Deer Creek Mine, PacifiCorp incorporated these two points within the surface hydrologic monitoring plan in 1996 (refer to Volume 9 and Annual Hydrologic Reports for unit hydrographs of Mill Fork Canyon). At the request of the Forest Service, an additional surface monitoring point (MFU03) was incorporated into PacifiCorp's hydrologic monitoring program during 2002. Surface monitoring point MFU03 is located in Section 17, Township 16 South, Range 6 East, above the projected intersection of the Mill Fork Graben with Mill Fork Creek (refer to hydrologic map MFS1851D).

(c) Right Fork of Rilda Canyon

Right Fork of Rilda Canyon is a intermittent stream located on the southeastern boundary of the Mill Fork permit area (Refer to Hydrologic Map MFS1830D). The drainage area encompasses approximately 5460 acres of which 810 are within the permit area. Numerous springs are located in the headwaters of the Right Fork in Sections 14, 23 and 24. Based upon field observations, flow exists upper reaches during base flow conditions from the headwaters in Section 14 to the confluence to the two forks in Section 29. PacifiCorp has maintained an extensive network of surface and groundwater resources of Rilda Canyon since 1989, including a flume located in the Right Fork of Rilda Canyon in Section 29 (refer to Volume 9 Hydrologic Section and Annual Hydrologic Reports for unit hydrographs of Rilda Canyon).

(2) Cottonwood Creek Drainage System:

(a) Un-Named Tributaries to Indian Creek

The un-named tributaries of Indian Creek which drain the western slope of East Mountain are ephemeral. Indian Creek itself is located approximately one half (½) mile to the west of the permit boundary. As stated in the Mill Fork EA and confirmed with filed observations, Indian Creek is perennial from the southeastern quarter of Section 34, Township 15 South, Range 6 East, approximately one mile north of the permit boundary. Most of the flow originates from the canyons on East Mountain as either surface flow or from springs at the base of the colluvial/alluvial toe in the valley floor. Additional contribution comes from a series of large springs located on the east side of Bald Mountain located within the Joes Valley graben. Indian Creek progressively gains flow from headwaters to below the Mill Fork State Lease due to the contribution groundwater. A portion of Indian Creek is diverted at a structure located in Section 15, and flows in a ditch roughly parallel to Indian Creek along the western base of East Mountain. Flow records collected by the Forest Service from 1972 to 1975 ranged between 1 to 30 cfs. Seven relatively small ephemeral drainages flow from the western slope of East Mountain within the permit areas. (Refer to Hydrologic Map MFS1830D). The total drainage area within the permit area encompasses approximately 2,047 acres.

b. Water Quality And Quantity

PacifiCorp maintains an extensive surface monitoring program to evaluate both quantity and quality of the two major drainage systems which incorporate the permit area. The following will be divided by major drainage systems.

(1) Huntington Creek Drainage System

(a) Huntington Creek
Huntington Creek is comprised of many smaller tributary systems that feed the main stream. Crandall Creek, Mill Fork Creek, and Right Fork of Rilda Canyon, are the only tributaries to Huntington Creek that emanate from within the Mill Fork permit area.

Huntington Creek flow data are recorded on a continuous basis by Utah Power at two locations; one station is located near the Huntington Power Plant, the other below Electric Lake which is about twenty-two miles upstream from the Huntington Plant. Flow records are maintained by Utah Power in order to determine water entitlements and reservoir storage allocation for the various users on the river.

The Utah Power station near the plant was established in the fall of 1973. Prior flow records were obtained from the USGS station located about one mile downstream from Utah Power's existing station. The USGS station was established in 1909 and discontinued in 1970 after determination of available water supply for the Electric Lake Dam. The dam was completed in December 1973, and water storage commenced shortly afterward.

The calculated natural flow rates, which consider actual flow recorded at the plant, plant diversions, Electric Lake storage, and lake evaporation along with yearly comparisons, are reported annually in the Hydrologic Monitoring Report.

In addition to the sites monitored by Huntington Plant Environmental Service (refer to Volume 9 Hydrologic Section), three sites were added on Huntington Creek near the Deer Creek confluence in conjunction with the Deer Creek discharge permit (refer to Volume 9).

Specific water quality data as well as yearly comparisons are reported annually in the Hydrologic Monitoring Report. This practice will continue throughout the life of the permit. In general, the water shows a gradual increase in concentration of dissolved minerals as the flow proceeds down Huntington Canyon. The values at the station below Electric Lake do not express the actual natural drainage water quality characteristics because of the lake effect, but it appears that the surface flow in Huntington Canyon is of very high quality in the upper reaches with some natural degradation occurring as the flow proceeds to the canyon mouth. Predominant dissolved chemical constituents in surface waters area calcium, magnesium and bicarbonate. Sediment yields in the Upper Huntington Canyon drainage were estimated at 0.1 ace-feet per square mile by Wadell, et. al, 1981.

(b) Crandall Creek

As stated earlier, only a small portion of the permit area is within the Crandall Canyon drainage area, and stream characteristics are extensively monitored by Genwal Resources. To reduce redundant information, monitoring of Crandall Creek will not be included as part of the Mill Fork permit application unless Genwal Resources terminates monitoring.

Water quality samples taken below the confluence of the north and south forks of Crandall Canyon Creek have a mean TDS of about 300 mg/l and are of the Ca^{2+}-Mg^{2+}-HCO_3^- type with lesser amounts of SO_4^{2-} (Appendix B Table 2). This water includes drainage from the Mill Fork permit area as well as the area to the north.

(c) Mill Fork Canyon Creek

Mill Fork Canyon Creek is a tributary of Huntington Creek and was included in PacifiCorp's monitoring program starting in 1997. Monitoring of Mill Fork will be conducted according to the following schedule (see Hydrologic Monitoring Schedule in Volume 9 Hydrologic Section).

a.) Locations:
   (1). Above old mines – MFA01
   (2). Mill Fork Canyon Culvert – MFB02
   (3). Above projected Mill Fork Graben crossing - MFU03 (refer to Hydologic Monitoring Map MFS1851D).

b.) Flow information is collected during the first or second week of each month.

c.) Water samples will be collected and analyzed quarterly (one sample at low flow and high flow) during the first or second week of the quarter. Parameters analyzed are those listed in the DOGM Guidelines for Surface Water Operational Quality. The program was initiated in 1997, except for MFU03 which was added in 2002. Field measurements, including pH, specific conductivity, temperature will be performed quarterly in conjunction with quantity measurements. Data regarding flow in Mill Fork Canyon Creek is presented in the annual Hydrologic Monitoring Report.

As stated above, flow information is collected monthly throughout the year. Hydrographs comparing annual flows are reported in the annual Hydrologic Monitoring Report.

Historical monitoring data collected by Beaver Creek Coal Company - No. 4 Mine and the United States Geological Survey (site No. 76 Open File Report 81-539) has been incorporated in PacifiCorp's hydrologic database. Operational water quality monitoring was conducted during 1997 and 1998 (refer to Quarterly Hydrologic submittals). Baseline quality analysis was conducted from

November 1998 through the fourth quarter 2000 (refer to respective Annual Hydrologic reports and Appendix C: Water Quality tab). Thereafter, baseline analysis will be repeated once every five- (5) years.

Water quality samples taken below the confluence of the north and south forks of Mill Fork Creek have a mean TDS of about 480 mg/l and are of the Ca^{2+}-Mg^{2+}-HCO_3^- type with lesser amounts of SO_4^{2-} (Appendix B Table 2). Most of this water originates in the Mill Fork permit area .

(d) Rilda Canyon Creek

Rilda Canyon Creek is a tributary of Huntington Creek and is monitored according to the following schedule (see Hydrologic Monitoring Schedule included herein).

a). Locations:
- (1). Right Fork of Rilda - RCF1*
- (2). Left Fork of Rilda - RCLF1 (Field data only)
- (3). Left Fork of Rilda - RCLF2 (Field data only)
- (4). Rilda Canyon - RCF2 (Field data only)
- (5). Rilda Canyon - RCF3
- (6). Rilda Canyon - RCW4 (refer to Volume 9 Map HM1).

* During mining of the North Rilda Leases, an additional site has been added upstream of RCF1 (adjacent to drill hole EM-163) to monitor surface/groundwater flow relationships. Flow will be measured yearly during base flow conditions.

b). Flow information is collected during the first or second week of each month.

c). Water samples will be collected and analyzed quarterly (one sample at low flow and high flow) during the first or second week of the quarter. Parameters analyzed are those listed in the DOGM Guidelines for Surface Water Operational Quality. The program was initiated in June 1989. Field measurements, including pH, specific conductivity, temperature, and dissolved oxygen, will be performed at the perennial stream locations, i.e., RCF3 and RCW4, monthly in conjunction with quantity measurements. Data regarding flow in Rilda Canyon Creek is presented in the annual Hydrologic Monitoring Report.

As stated above, flow information is collected monthly throughout the year with the use of three Parshall flumes and one V-notch weir (refer to Volume 9 Map HM1). Hydrographs comparing yearly flows are reported in the annual Hydrologic Monitoring Report and also as Figure HF33 in Volume 9 Hydrologic Section.

In accordance with the Hydrologic Monitoring Plan baseline quality analysis was conducted for a two year period; 1989-90, (refer to the respective Annual Hydrologic reports). Baseline analysis will be repeated once every five (5) years. Quality sampling was initiated in 1989; results of the samples collected are presented in Volume 9 Table HT7 and in the Annual Hydrologic Monitoring Reports.

Water quality samples taken below the confluence of the north and south forks of Rilda Creek have a mean TDS of about 400 mg/l and are of the Ca^{2+}-Mg^{2+}-HCO_3^- type (Appendix B Table 2). This water is mostly drainage from the Mill Fork permit area. Water quality of Rilda Canyon deteriorates slightly from the upper reaches to the confluence with Huntington Canyon.

(2) Cottonwood Creek Drainage System

The western portion of East Mountain is intersected by Cottonwood Creek and its associated tributaries, including Cottonwood Canyon Creek and Indian Creek. The Cottonwood Creek drainage is about equal in size to the Huntington drainage, with total discharge from each drainage about 70,000 acre feet per year. The major cultural feature on Cottonwood Creek is the Joe's Valley Reservoir, located about twelve miles west of the town of Orangeville. The 63,000 acre foot reservoir was constructed by the U.S. Bureau of Reclamation and provides storage water for irrigation, industrial, and municipal needs in the Emery County area.

(a) Cottonwood Canyon Creek

An extensive baseline study conducted on Cottonwood Canyon Creek to determine water characteristics prior to mining at the proposed Cottonwood Mine began in 1979. A property acquisition in 1981 resulted in mine plan changes; therefore, the baseline study was terminated as of January 1, 1984. As agreed upon with DOGM, PacifiCorp will continue to monitor the flow and water quality field measurements at the USGS flume location on monthly basis (see Volume 9 Figure HF34).

The Cottonwood Canyon located south of the Mill Fork permit area 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. For a complete discussion on Cottonwood Canyon Creek drainage refer to Volume 9.

(b) Indian Creek

Indian Creek is a tributary of Lowery Water located in upper Joes Valley. Four permanent runoff sampling sites were established in 2000 and are sampled as listed below (see Hydrologic Monitoring Schedule included herein).

a). Locations:
   - (1). Indian Creek Above - ICA
   - (2). Indian Creek Flume - ICF (Installed by Genwal Resources)
   - (3). Indian Creek Below - ICB
   - (4). Indian Creek Ditch - ICD (refer to Hydrologic Map MFS1851D)

b). Flow information will be collected during base flow conditions at ICA, ICF, ICB and ICD.

c). Water samples will be collected and analyzed during base flow sampling. Parameters analyzed are those listed in the DOGM Guidelines for Surface

Water Operational Quality. Field measurements, including pH, specific conductivity, dissolved oxygen and temperature, will be performed in conjunction with quantity measurements.

As stated above, flow information will be collected during base flow conditions with the use of Parshall flume and a portable v-notch weir (see Hydrologic Map MFS1851D for locations). Hydrographs comparing yearly base flows will be shown in the Hydrologic Monitoring Reports.

Historical flow monitoring data collected by Genwal Resources at Indian Creek Flume (ICF) has been incorporated in PacifiCorp's hydrologic database and is included in Appendix C: Water Quality tab). In accordance with the hydrologic monitoring guidelines, baseline quality analysis was conducted for a two year period (2000 and 2001). Information from the baseline sampling is included in Appendix C: Water Quality tab. After the initial baseline period, additional baseline analysis will be repeated once every five (5) years.

Quality of Indian Creek is similar to the data collected in the Huntington Drainage. Quality remains relatively constant throughout the upper Joes Valley area. Indian Creek has mean TDS of about 270 mg/l and are Ca^{2+}-Mg^{2+}-HCO_3^- type with lesser amounts of SO_4^{2-} (refer to Appendix C: Water Quality tab and Table MFHT-5). Water quality of Indian Creek Ditch (ICD) is influenced by groundwater discharge from a series of springs throughout the length of the ditch and is slightly higher in TDS (average of about 410 mg/l) than Indian Creek.

2. Soil Loss - Sediment Yield

Sediment load concentrations in the area of the permit vary dramatically depending on the percentage of disturbed areas, ruggedness of the terrain, geologic formations present, the amount of precipitation the area receives, and stream flow volume.

As part of the U.S. Geological Survey water monitoring program in Utah coal fields (Open File Report #81359), fourteen water samples associated with the permit area were collected between

August 1978 and September 1979 at gaging station 09318000 on Huntington Creek to determine suspended-sediment concentrations and loads. Three samples each were collected at gaging stations 09317919, 09317920, and 09324200 in Crandall and Tie Fork canyons and on Cottonwood Creek. Five additional samples were collected by project personnel from these and other streams in the study area. Representative suspended-sediment concentrations and loads of streams in the study area are listed below.

			Suspended sediment	
Stream	Site No.	Date	Concentration (mg/L)	Loads (tons per day)
Huntington Creek	88	8-13-78	104	27.00
(gaging station 09318000)		11-17-78	72	2.50
		6-13-79	114	66.00
		8-7-79	44	15.00
Crandall Canyon	51	8-12-78	49	0.14
(gaging station 09317919)		11-18-78	60	0.08
		6-14-79	15	0.41
		8-6-79	56	0.15
Tie Fork Canyon	67	8-13-78	12	0.03
(gaging station 09317920)		11-18-78	57	0.12
		6-14-79	38	0.68
		8-6-79	66	0.17
Bear Creek	81	10-25-78	8,860	1.90
Deer Creek	87	6-14-79	609	3.10
Cottonwood	104	8-15-78	5	0.003
(gaging station 0932400)		11-19-78	130	0.20
		8-5-79	63	0.09

As indicated from the samples collected by the USGS, the suspended-sediment concentrations varied widely among the drainages analyzed. The relatively low concentrations of suspended sediment were attributed to well established channels, low flow periods, and a scarcity of roads. Higher concentrations appeared to be associated with the activities of man and erosion of large exposures of the Mancos Shale formation in the lower reaches of the drainages. Sediment concentrations generally increased with increased stream discharge. Note that the highest values at all of the locations occurred during the spring runoff period, but not enough data were available to compute daily sediment discharge.

PacifiCorp has collected samples on a quarterly basis from the streams within and adjacent to the permit area. Samples taken at periods of both high and low flow have been tested for total suspended solids (TSS) to identify stream stability and are reported annually in the Hydrologic Monitoring Report.

Runoff from disturbed areas is diverted through sediment control facilities or protected from abnormal erosion. Each sediment control facility is sized according to calculated annual sediment accumulations (see Operational section of the individual permit applications for specific information on sediment yields from disturbed areas). Water discharged from the sediment pond facilities is monitored according to the stipulations set forth in the UPDES permits (refer Volume 9 Hydrologic Section Appendix B).

R645-301-723 SAMPLING AND ANALYSIS

Water quality sampling and analysis of samples collected by PacifiCorp will be done according to the "Standard Methods for the Examination of Water and Wastewater." Refer to Volume 9 Hydrologic Section Appendix A for sample documentation and analytical methods and detection limits.

R645-301-724 BASELINE INFORMATION

PacifiCorp maintains an extensive groundwater and surface monitoring program to characterize premining and any mining related impacts both to quality and quantity. As an integral part of the permit application, an annual Hydrologic Monitoring Report is prepared by PacifiCorp and submitted to appropriate government agencies. Baseline information for the East Mountain property will be divided into the following categories: 1) Groundwater and 2) Surface Water.

1) Groundwater

The characteristics of the groundwater resource are dependent upon the geology of the water-bearing strata and on the geology and hydrology of the recharge area. Groundwater movement and storage characteristics are dependent on the characteristics of the substratum. To characterize the baseline quality and to document the existence of seasonal variations, PacifiCorp developed a groundwater monitoring program which includes sampling both surface springs and in-mine groundwater sources. The program was initiated during a period from 1977 through 1979 for majority of East Mountain and during the year 2000 for the Mill Fork area. Routine monitoring continues to support the quality data collected during the initial phase. In general, data from the springs and in-mine sources are representative of the groundwater quality in the geologic strata from which the groundwater sources issue. Cation-anion diagrams have been utilized to depict the groundwater characteristics and to monitor quality trends (refer to Appendix C: Water Quality tab for cation-anion diagrams for the Mill Fork Area). Results of the data collected have shown that in both the surface springs and in-mine groundwater sources variations in quality from individual sources do exist, but the quality from the individual sources remains consistent with time. Spring water is mostly calcium-bicarbonate with some magnesium and sulfate. As discussed in the General Requirement Section - R645-301-711, quality decreases with increasing downward vertical movement and from north to south with sulfate becoming a major constituent. Cation-anion diagrams have been included in the Annual Hydrologic Reports to support the lack of seasonal variation.

2) Surface Water

The Mill Fork permit area is drained by four major drainage systems: Crandall Canyon Creek, Mill Fork Creek, Right Fork of Rilda Canyon, and a series of un-named drainages in Joes Valley. PacifiCorp and Genwal Resources along with government agencies have documented that all of the streams emanating from within the permit area with the exception of Crandall Creek and the lower portion of Rilda Canyon cease flowing in the fall or winter, suggesting that they are not perennial but ephemeral. Flow in the drainage is a combination of snow melt and springs. Most of the runoff occurs during the months of April through July. Even though the drainage systems are ephemeral, except for Crandall Canyon and the lower portion of Rilda Canyon, variations in quality do exist. Total dissolved solids increase gradually in concentration as flow proceeds from the upper plateau areas to the confluence of the major drainages of Huntington and Cottonwood Canyons. Surface waters in the mine permit area are predominantly bicarbonate, calcium, and magnesium in the upper reaches with sulfate becoming a major constituent in the lower reaches. The increase in sulfate concentration is due to the influence of the Mancos Shale, a marine shale which outcrops in the lower reach of each of the drainage systems. Seasonal total suspended solids variations also occur with the highest concentrations occurring during the initial runoff period.

R645-301-724.100 GROUNDWATER INFORMATION

A detailed description of the ownership of existing wells, springs, and other groundwater resources, including seasonal quality and quantity of groundwater and usage, is given in sections R645-301-721 and 722.

R645-301-724.200 SURFACE WATER INFORMATION

A detailed description of all surface water bodies, i.e., streams and lakes, including quality, quantity, and usage is given in section R645-301-722.

R645-301-724.300 GEOLOGIC INFORMATION

Applicable geologic information can be referenced in the Geologic Section of the this Volume.

R645-301-724.400 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).

A. PRECIPITATION

The climate of the permit area has been described by the U.S. Geological Survey, which states that it is semi-arid to subhumid and that 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 twentyfive (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 and will continue to be 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.

B. TEMPERATURES

Air temperatures vary considerably both diurnally and annually throughout the permit area 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 PacifiCorp 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.

C. WINDS

The winds in the area are generally variable. The wind rose presented in Volume 9 Figure HF36 displays the variability for the Meetinghouse Ridge area for January to December 1978.

R645-301-724.600 SURVEY OF RENEWABLE RESOURCES LANDS

Information describing the existing groundwater resources, including descriptions of permit area aquifers and areas of recharge can be found in section R645-301-721. Impacts related to mine subsidence can be found in section R645-301-728.

R645-301-724.700 ALLUVIAL VALLEY FLOORS

Utah Regulations require that the presence of alluvial valley floors in or adjacent to the mine project area be identified. The regulations define an alluvial valley floor as "unconsolidated streamlaid 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 unconcentrated runoff or slope wash together with talus, or other massmovement accumulations, and wind blown deposits." The 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;
    b. The capability of an area to be flood irrigated, based on streamflow, water yield, soils, water quality, topography, and regional practices; or
    c. Subirrigation of the lands in question, derived from the groundwater system of the valley floor.

A. SCOPE

The purpose of this section of the report 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 permit areas. It is divided into three parts. First, a general description of the surface operations and site disturbances associated with the permit areas is presented. Next, discussions of the characteristics of geomorphology and irrigation are presented. Finally, the conclusions of the alluvial valley floor determination are summarized.

B. SITE DESCRIPTION

Surface facilities associated with the permit area will consist of the portal area and associated facilities: for Deer Creek Mine - Deer Creek and Rilda canyons.

The climate of the general area is semi-arid to arid and continental. Daily minimum temperatures recorded at the East Mountain weather station in winter range from the average low of -6.3° F to the maximum record low of -15.2° F, and daily maximum temperatures in summer range from the average high of 84.7° F to the maximum record high of 89.3° F.

Temperatures in the region tend to be inversely related to elevation. Average annual precipitation recorded for a 20 year period (1981-00) at the East Mountain weather station averaged 13.59 inches. Approximately fifty percent of the annual precipitation falls during the winter as snow with most of the remainder coming as summer thunderstorms.

C. ALLUVIAL VALLEY FLOOR CHARACTERISTICS

In this section of the report the various criteria for determining the existence of an alluvial valley floor are examined in relation to the overall permit and adjacent areas.

D. GEOMORPHIC CRITERIA

Alluvial deposits in and adjacent to the mine permit area have been mapped and reported in Doelling's "Wasatch Plateau Coal Fields, 1972." The report indicated that alluvia in the area are found solely along Huntington Creek below the Rilda Canyon confluence in the Huntington drainage system, in the Cottonwood drainage system along lower Cottonwood Creek and at the mouth of the North Fork of Cottonwood Creek, and in the Joe's Valley drainage.

E. FLOOD IRRIGATION

Flood irrigation near the permit area is currently (and has historically been) confined to the alluvial areas of Huntington Creek approximately one mile below the confluence of Deer Creek and Huntington Creek. In the Cottonwood drainage system flood irrigation is currently, and historically, confined to the alluvial areas of lower Cottonwood Creek. No flood irrigation has historically been practiced on the narrow alluvium land upstream in the canyons opening to lower Cottonwood and Huntington Canyon creeks. 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.

Water quality of Cottonwood and Huntington creeks is good. A detailed review of the surface water quality has been presented previously in this report and is updated each year in the annual Hydrologic Monitoring Report.

F. SUBIRRIGATION

Some subirrigation of vegetation does occur on the alluvial valley floors. The subirrigated species (mainly cottonwoods and willows) are found along the channels of Cottonwood Creek and in the Joe's Valley drainage above the reservoir and along the channels of Rilda Canyon and Huntington Creek. This suggests that subirrigation is confined to the channel areas where the water table is near the surface.

G. ALLUVIAL VALLEY FLOOR IDENTIFICATION

Based on the foregoing analysis, the narrow canyons associated with the permit area cannot be considered to have an alluvial valley floor due to insufficient alluvium and the very limited area for supporting an agriculturally useful crop. The valley floor of Huntington Creek below the confluence with Deer Creek, however, can be classified as an alluvial valley floor due to the presence of both flood irrigation and limited subirrigation on the alluvium.

H. POTENTIAL IMPACTS OF ALLUVIAL VALLEY FLOORS

Very little potential exists for the mine operations to impact the Cottonwood and Huntington Creek alluvial valley floor due to the location of the operations in comparison to the alluvial deposits. All surface disturbances in the portal area will be protected by sediment control facilities and have been designed and constructed according to R645 standards 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 believed that the overall permit area and associated activities will have no significant hydrologic impacts on the alluvial valley floor along Cottonwood and Huntington creeks. Details concerning the monitoring program are outlined in section R645-301-731.

R645-301-725 BASELINE CUMULATIVE IMPACT AREA INFORMATION

Hydrologic and geologic data required to assess the probable cumulative impacts of the coal mining and reclamation activities are presented in the Hydrologic (including the Annual Hydrologic Reports), Operational, and Reclamation sections of the Deer Creek permit application.

R645-301-728 PROBABLE HYDROLOGIC CONSEQUENCES (PHC) DETERMINATION

Probable hydrologic consequence determinations are based on extensive investigations conducted to determine existing groundwater and surface water resources along with ongoing hydrologic research and comprehensive monitoring programs including hydrologic and subsidence. Data utilized to arrive at the conclusions presented in this section were discussed earlier (see Section R645-301-721), and specific information pertaining to impacts to the hydrologic balance will be discussed under the appropriate section.

A. DESCRIPTION OF THE MINING OPERATION

The PacifiCorp mine permit areas are located in the central portion of the Wasatch Plateau Coal Field in Emery County, Utah. Generally, this area is a flattopped mesa surrounded by heavily vegetated slopes which extend to precipitous cliffs leading to the valley below. Much data has been collected regarding the geology and the hydrology of the East Mountain property including the Mill Fork permit area. In all, approximately 150 drill holes have been completed from the surface, over 500 from within the mines; and a comprehensive hydrologic data collection program is ongoing, all of which have provided data used in this PHC. The most applicable data have been included in this document. For a review of additional data it is suggested that the reader refer to the annual Hydrologic Monitoring Report.

B. GEOLOGY

A detailed description of the geology (structure and stratigraphy) has been presented in a previous section and will not be duplicated here. (Refer to R645-301-600 Geologic Section of this Volume).

C. MINING METHODS

Mining of the Mill Fork area will be conducted entirely by underground mining methods consisting of continuous miner and longwall techniques. Two mineable coal seams exist within the property. In ascending order they are the Hiawatha and Blind Canyon (refer to the Engineering Section). Interburden between the two seams ranges from approximately eighty (80) to one hundred twenty (120) feet. Based on the proposed mine plan, there will be areas in each seam one seam will be mined, and an area where both seams will be extracted. Thin coal prohibits mining in the southwestern portion of Sections 22 and 23 (T. 16 S., R 6 E.), and eastern half of Section 13 (T. 16 S., R 6 E.) and 18 (T. 16 S., R 7 E.). Multiple-seam mining is projected to occur in Sections 11, 12, 13 and 14 (T. 16 S., R 6 E.).

The chemical and physical properties of the overburden have been identified and described in the Geologic section of the permit application.

Because mining is limited to underground mining techniques, only minor amounts of overburden directly in contact with the seam, either roof or floor, will be removed during mining operations.

D. SURFACE WATER SYSTEM

A detailed description of the regional and permit area surface water resources has been presented in previous sections and will not be duplicated here. (Refer to R645-301-722). In general, the surface drainage system on East Mountain is divided into two major drainages; the southwest portion forms part of the Cottonwood Creek drainage, and the northeast portion contributes to the Huntington Creek drainage. The Huntington Creek drainage covers seventy percent (70%) of the East Mountain leases held by PacifiCorp. Both of these perennial streams are located adjacent to but not within the permit boundaries. PacifiCorp has observed that all of the streams emanating from within the Mill Fork permit boundary, with the exception of Crandall Canyon Creek, are either intermittent or ephemeral. Most of the streams are spring fed. PacifiCorp has monitored all of the surface waters since 1979 (except for Rilda Canyon, Mill Fork Canyon and Indian Creek, 1989 , 1997 and 2000 respectfully) and will continue to monitor them in the future. The data collected is included in each annual Hydrologic Monitoring Report.

Impacts to surface water due to the underground operations of Deer Creek are minor, both in terms of quality and quantity. Due to the type of mining and relatively small areas of surface disturbance, surface water impacts are limited. Through the use of sedimentation ponds and the diversion of runoff from undisturbed areas around the surface facilities, impacts to surface waters are negligible. (See Volume 9 Appendix B for UPDES permit information.) One impact associated with the Deer Creek operations is mine dewatering. A detailed analysis of the associated impacts is described in the Hydrologic Balance section below.

E. HYDROLOGIC BALANCE - SURFACE WATER SYSTEM

As mentioned previously in this report, the major drainages conveying runoff away from the mine permit areas are streams in Crandall, Mill Fork, Rilda Canyons and un-named drainages in Joes Valley. With the exception of the very 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 twenty (20) year period concerning subsidence and surface drainages has not detected any surface stream impacts. Consequently, subsidence should not cause significant impacts to the surface water system. Surface facilities are located in the following canyons:

Deer Creek Mine:	Deer Creek Canyon
	Rilda Canyon

Natural tributary flows are diverted around surface facilities. Surface runoff from disturbed areas is detained in sedimentation ponds prior to release. All discharge from the sedimentation ponds is sampled in accordance with the stipulations in the UPDES permits (see Volume 9 Appendix B).

Underground coal mines in the Wasatch Plateau Coal Field typically intersect groundwater from strata surrounding the coal seam. Mines operated by PacifiCorp; including Deer Creek, Wilberg/Cottonwood and Trail Mountain mines have intersected quantities of water in excess of operational needs and therefore have discharged intercepted groundwater. Dewatering of Deer Creek, Wilberg/Cottonwood and Trail Mountain has had only a minor impact on surface quality and quantity on a regional basis; however, on a site specific basis the flow in Deer Creek and Grimes Wash has increased from premining conditions. During periods of high runoff changes in quality are insignificant; however, in low flow conditions some degradation is likely due to the fact that the mine discharge waters are higher in TDS than the surface waters. It is difficult to assess the degradation because it is not known from where or how much of the water discharged from the mine would naturally have been discharged into the receiving streams by natural groundwater flow. It is anticipated that mining in the Mill Fork permit area will intercept groundwater similar adjacent operations (Deer Creek and Genwal Resources). The section below will describe the dewatering of Deer Creek and related surface impacts.

Deer Creek Mine

Excess water not utilized in the mining operation or for domestic use is either pumped to storage areas or discharged from the mine. (Quality and quantity is reported in the Annual Hydrologic Report.) The locations of the sump areas within the mine are shown in the Annual Hydrologic Report.

Inline flow meters are utilized to record the amount of water discharged from the mine, after which it passes through underground sedimentation sumps. Prior to December 1990 all of the water discharged from Deer Creek was piped directly to PacifiCorp's Huntington Power Plant. As of November 16, 1990, the State of Utah-Department of Health granted PacifiCorp a temporary discharge permit under a bypass agreement. On June 1, 1994, Department of Health granted PacifiCorp a site specific permit which included discharge from the Deer Creek Mine. Excess water not utilized in the mining operation or for domestic use is either pumped to storage areas or discharged to the Huntington Plant or Deer Creek drainage in accordance with stipulations of UPDES Permit Number UT0023604-02 (refer Volume 9 Appendix B for UPDES permit information).

F. MITIGATION AND CONTROL PLANS

Runoff from disturbed areas is diverted through sediment control facilities or protected from abnormal erosion. Any mine discharge will be routed through the underground sediment pond and reservoir in the old workings or specialized sump areas and will be monitored in accordance with UPDES permit standards and state and federal regulations. (See Appendix B for UPDES permit information.)

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

G. SURFACE MONITORING PLAN

A hydrologic surface monitoring program, initiated in 1979 (except for Rilda Canyon, Mill Fork Canyon and Indian Creek, 1989 , 1997 and 2000 respectfully), has been underway at each of the surface monitoring stations shown on Hydrologic Map MFS1830D. Stations were established to monitor water quality and quantity above and below the mine permit areas. The parameters for laboratory analyses are those established by DOGM in "Guidelines for Surface Water Quality" (see Appendix A). Once baseline data have been collected (two year period), the surface sites described in the hydrologic monitoring schedule in Volume 9 Appendix A will continue to be monitored quarterly (when accessible) throughout the operational phase of the mine. The quarterly monitoring during the mine operational phase will include flow and quality to delineate seasonal variation and assess changes in water quality.

Future data may show that modifications of the monitoring schedule are justified. Any changes to the monitoring schedule (frequency or parameters) will be made only with the approval of DOGM. Results of all water quality data will be submitted to that agency quarterly, with an annual summary.

Postmining monitoring of surface water will continue at representative stations determined with the aid and approval of DOGM. Representative surface water stations will be monitored biannually during high and low flow conditions. Monitoring will continue until the release of the reclamation bond or until an earlier date to be determined after appropriate consultation with local, state, and federal agencies.

H. GROUNDWATER SYSTEM

Detailed descriptions of the regional and permit area groundwater resources have been presented in previous sections and will not be duplicated here (refer to R645-301-722). In general, the majority of all natural groundwater discharge points located on the East Mountain property (including the Mill Fork State Lease/UTU-84285 area) are in the form of seeps and springs. PacifiCorp has mapped approximately one hundred ninety eight (198) springs within and adjacent to the Mill Fork permit area area ranging in discharge from <1 gpm to as high as 145 gpm (see Spring Map MFS1831 and Appendix C).

PacifiCorp has collected an extensive database of information pertaining to the groundwater quality and quantities of the East Mountain region and adjacent areas. Included in the database is longterm quality and flow information both for springs and for groundwater intercepted by mining. In addition to the studies completed by PacifiCorp, Mayo & Associates was contracted in 1996 and 2000 to conduct comprehensive study to characterize the hydrology and hydrogeology of the East and Trail mountains (refer to Volume 9 - Hydrologic Support Information No.11 and Appendix B of this section). The hydrogeology of the PacifiCorp leases were elevated by analyzing: 1) solute and isotopic composition of surface and groundwaters, 2) surface and groundwater discharge data, 3) piezometric data, and 4) geologic information. The following is summary of the conclusion of this study (refer to Volume 9 Hydrologic Support Information No. 11 and Appendix B of this section for complete details):

Conclusions From Mayo & Associates Hydrologic Investigation

1. The δ^2H and $\delta^{18}O$ compositions demonstrate that all groundwaters are of meteoric origin (i.e. snow and rain).
2. Active and inactive groundwater regimes occur in the mine lease area.
3. The active regime includes alluvial groundwater, groundwater in the Flagstaff Formation, and all near surface exposures of the other bedrock formations except, perhaps, the Mancos Shale. The near surface extends about 500 to 1,000 feet into cliff faces. Groundwaters in the active regime contain abundant ^3H and anthropogenic ^{14}C.
4. Comparison of long-term discharge hydrographs with precipitation records demonstrates that active regime groundwaters:

   1) are in direct hydraulic communication with the surface 2) are recharged by modern precipitation, and 3) have large fluctuations in spring discharge rates which can be attributed to seasonal and climatic variability. High-flow/low-flow discharge rates vary as greatly as 600 gpm to nearly dry; however, most high flow rates are less than 50 gpm.

5. Despite the seasonal variability in discharge rates, the solute concentrations of active region groundwaters do not exhibit significant seasonal variability.
6. The inactive regime includes groundwater in sandstone channels in the North Horn, Price River, and Blackhawk Formations which are not in direct hydraulic communication with the surface (i.e. greater than about 500 to 1,000 feet from cliff faces). Mine workings are largely part of the inactive regime. The sandstone channels are vertically and horizontally isolated from each other and when encountered in mine workings are usually drained quickly. Coal seams are hydraulic barriers to groundwater flow. The blanket sands of the Star Point Sandstone are also largely in the inactive zone. Except where exposed near cliff faces, faults encountered in mine workings are part of the inactive regime. Except near cliff faces, faults are not conduits for vertical hydraulic communication between otherwise hydraulically isolated pockets of groundwater.
7. Inactive region groundwater systems contain old groundwater (i.e. 2,000 to 12,000 years), and are not influenced by annual recharge events or short term climatic variability.
8. In-mine inactive regime groundwaters occur in nearly stagnant, isolated zones which have extremely limited hydraulic communication with other inactive regime groundwaters in the vicinity of mine workings and with near-surface active regime groundwaters as evidenced by the following:
   a) Groundwaters discharging into mine openings have ^{14}C ages ranging from 2,000 to 12,000 years

   b) Roof drip rates rapidly decline when water is encountered in the mine indicating that the saturated zone above the coal seam is not hydraulically continuous and has a limited vertical and horizontal extent.

   c) Unsaturated conditions have been identified in boreholes drilled vertically into sandstone channels located above coal seams.
9. The fact that inactive region groundwaters encountered in mine openings do not have an infinite age means that, at some time, there has been some hydraulic communication with the surface. This communication is extremely limited as illustrated by calculated steady

state recharge-discharge rates of faults and sandstone channels in the inactive zone which range from 0.001 to 1.23 gpm.

10. Groundwater in the Star Point Sandstone is part of the inactive regime as evidenced by the 6,000 year ^{14}C age of the sample from well TM-3. In the down dip direction along the axis of the Straight Canyon Syncline, potentiometric pressures in the Spring Canyon member results in upwelling of groundwater into Hiawatha seam mine openings. Such upwelling may locally reduce the pressure in the Spring Canyon member.
11. Areally extensive groundwater regimes in the lower Blackhawk Formation and Star Point Sandstone do not exist within the lease area. Therefore, it is not meaningful to create piezometric surface maps of these systems.
12. Streamflow is dependent on snow melt, precipitation and thunderstorm activity. There is no apparent hydraulic communication between streamflow and groundwater encountered in mine openings.
13. The groundwater discharging into the Rilda Canyon alluvial collection system is of modern origin and is closely tied to seasonal recharge. This is evidenced by its modern radiocarbon and ^{3}H contents and by the discharge hydrographs. The alluvial groundwater is not related to the groundwater encountered in the mines.
14. The groundwater discharging in Cottonwood Canyon near Cottonwood Spring and Roans Spring discharges from glacial deposits and is of modern origin. The radiocarbon and ^{3}H contents of this water indicate a modern origin. The water in the shallow glacial deposits is not related to the groundwater encountered in the mines.

The USGS has conducted extensive studies to determine the regional groundwater system for the central Wasatch Plateau Coal Field. The studies indicate a regional aquifer exists in the coal-bearing sequence of the Blackhawk and the underlying Star Point Sandstone formations. The studies have also concluded that several isolated or perched aquifers existed above the Blackhawk/Star Point Sandstone aquifer. PacifiCorp agrees with conclusions of the USGS studies concerning the perched aquifers above the coal-bearing sequence of the Blackhawk Formation but has some reservations about the significance of the Blackhawk/Star Point Sandstone aquifer which will be discussed below. The majority of the groundwater is discharged from the perched aquifers which occur along the base of the North Horn Formation in the form of seeps and springs (refer to Spring Map MFS1831D). Several other perched aquifers exist mainly along the formational contacts with the North Horn Formation, including the upper contact with the Flagstaff Limestone and the lower contact with the Price River Formation.

The majority of the groundwater recharge on East Mountain comes from the winter snowpack which melts and infiltrates into the surface of East Mountain. The water flows down vertical fractures which intersect sandstone channel systems in the North Horn and Blackhawk formations. The majority of the groundwater reaching this point intersects the surface in springs located in the North Horn Formation. Very little recharge intersects the Price River Formation and Castlegate Sandstone sandstones; consequently, they are not water saturated where intersected in the numerous drill holes penetrating those units.

The hydrogeologic characteristics of the coal-bearing Blackhawk and overlying formations effectively limit the extent of impacts to the hydrologic system. Impacts to water quality are negligible and may be slightly beneficial. As discussed previously, two separate aquifers-water bearing zones occur on the East Mountain property: 1) perched aquifers associated mainly with the North Horn Formation, and 2) Blackhawk-Star Point Formation, which exhibits limited potential as a property wide, water saturated zone. The following hydrologic balance section will segregate the two zones and describe the significance and possible impacts to each zone.

I. HYDROLOGIC BALANCE - GROUNDWATER

Mining within the Mill Fork permit area will have negligible impact on the regional hydrologic balance, but there could be some possible local impact. This section discusses the possible mining-related impact on the hydrologic balance due to 1) subsidence - perched aquifer systems, 2) mining in the Rilda Canyon area - NEWUA springs, 3) mining in the Mill Fork area - Little Bear Spring, and 4) interception of groundwater by mine workings.

1. Subsidence: Perched Aquifer Systems Above The Mine Horizon

As discussed earlier, most of the groundwater in the permit area discharges in the form of seeps and springs. Springs issuing from the perched groundwater in the Flagstaff Limestone throughout the Blackhawk formations will only be impacted by mining activities if fracturing from subsidence reaches upward into these formations and is not sealed by swelling or fracture filling from plastic mudstones. As discussed earlier, the majority of springs on the East Mountain property (including the Mill Fork area) are associated with the North Horn Formation. As discussed in the regional groundwater characteristics section, the North Horn Formation is comprised of a variety of rock types which range from highly calcareous sandstone to mudstone. Lenticular sandstone channels are often present in the upper and lower portion 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 sandstone channels intersect the land surface. A Spring Geologic Conditions Inventory sheet has been completed for each spring inventoried on the East Mountain Property and can be found in Appendix C.

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 Sandstone below. The mudstones present appear to 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. To identify and verify the existence of these bentonitic-plastic type mudstones, PacifiCorp conducted a special surface drilling program in 1989 to determine the rock strength and lithologic characteristics of the overburden on the East Mountain property. The entire sequence of the formations which are present on the East Mountain property, from the Flagstaff through the Star Point Sandstone Formation, was penetrated using two drill holes, identified as EM136C and EM137C. Drill hole EM136C penetrated the Flagstaff Limestone and the upper 200 feet of the North Horn Formation. Hole EM137C penetrated the lower portion of the North Horn Formation through the upper Star Point Sandstone Formation (refer to Volume 9 Hydrologic Support Information: No.8). Previous East Mountain surface exploration programs have experienced swelling and caving problems associated with plastic mudstone zones located in the upper and lower portions of the North Horn Formation. Regional as well as property wide drilling, along with limited accessible outcrop data, has shown that even though projecting the lateral extent of individual lithologic units is not practical, the basic lithologic characteristics of the North Horn Formation are consistent on regional and permit area bases. Drilling of EM136C and 137C confirmed existence of soft, plastic type mudstones which form an aquiclude, preventing significant recharge to the lithologic units below the North Horn Formation. Field investigations have shown that even along major fault systems, i.e., Pleasant Valley and Roans Canyon, vertical migration is interrupted by the lithologic characteristics of the North Horn Formation, forming springs along the fault traces. Examples of springs of this type are shown on Volume 9 Table HT1 and Map HM4.

The depth of the aquifers in the North Horn Formation is 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 Deer Creek Mine is limited in quantity and occurs very slowly.

Studies conducted by PacifiCorp, along with independent governmental research have concluded that impacts to the perched aquifers have been negligible (refer to 1.] Annual Hydrologic Monitoring Reports, 2.] Supplemental Volume 1, Phase I, II, and III Lease Relinquishment Information for the Cottonwood/Wilberg Mine, C/015/019, Deer Creek Mine, C/015/018, and Des Bee Dove Mine

C/015/017, Emery County, Utah, 3.] United States Department of Interior: Bureau of Mine Information Circular 9405). As stated in IC9405; the Bureau of Mines evaluated the hydrologic and overburden failure data to assess the response of local ground water to underground coal mining in single- and multiple-seam conditions. Surface subsidence did not appear to play a major role in response of springs at this site. The lack of observed responses was attributed to geologically driven site-specific conditions that buffered the effects of mining. These conditions included thickness of overburden, presence of hydrophilic clays and estimated elevation of fracturing.

To identify any mining related impacts to the perched aquifer systems above the mine horizon PacifiCorp monitors a significant number of springs which have been undermined or will be undermined within the next five years (see Hydrologic Monitoring Schedule in Appendix A and Hydrologic Monitoring Map MFS1851D). A field verification meeting will be held each year with the government agencies involved to determine if changes in the springs monitored are required. Each year in the annual Hydrologic Monitoring Report spring flow rates will be compared to East Mountain climatology as to how closely spring discharge follows local annual precipitation or to verify any mining related impacts.

2. Mining In The Rilda Canyon Area-Newua Springs

As discussed in R645-301-721, North Emery Water Users Association (NEWUA), a major concern to PacifiCorp is the proximity of proposed mining activities in Rilda Canyon to the Rilda Canyon springs. Probable hydrologic consequences of mining in the vicinity of the Rilda Canyon Springs is described in Volume 9 Hydrologic Section and will not be repeated here. Mitigation alternative information for Rilda Canyon Springs can be found in Volume 9 Appendix D.

3. Mining in the Mill Fork area - Little Bear Spring

The potential for mining activities to impact Little Bear Spring is believed to be minimal for several reasons. First, the spring is located one and one half (1½) miles from the Mill Fork permit area and more than two miles from the nearest proposed mining activities (refer to Hydrologic Monitoring Map MFS1851D). Second, Little Bear Spring discharges from an active zone groundwater system that is in good communication with shallow recharge sources. These types of groundwater systems are isolated from the deep, inactive zone groundwater systems encountered in area coal mines.

Although the headwaters of the Mill Fork drainage is within the Mill Fork permit area, the potential for adversely affecting surface waters in the drainage is remote. In those areas in the headwaters region that are proposed for full extraction mining, the stream channel resides primarily on the North Horn and Price River Formations (Appendix B Figure 5). The thick sequence of relatively low permeability rock that separates the mined horizon from the stream channel effectively prohibits the downward migration of surface water and groundwater into deeper horizons. Thus, the potential for diminished flow in Mill Fork Creek, and corresponding decreases in the recharge to Little Bear Spring, is minimal (for alternative mitigation information related to Little Bear Spring refer to R645-301-731.530).

PacifiCorp cooperated with Huntington City, Elmo City, Cleveland City and CVSSD in developing a comprehensive mitigation plan. The agreement was signed on July, 2004. As part of the agreement, PacifiCorp constructed a water treatment plant in 2005 located near at the existing Huntington City plant in Huntington Canyon. The mitigation agreement information is found in Appendix D of Volume 9.

4. Interception Of Groundwater By Mine Workings

As previously discussed in this section, the Blackhawk Formation consists of interbedded layers of sandstone and mudstone separated by various mineable and nonmineable 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.

The interception of groundwater varies and is dependent on several factors. One of the most 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. As reported in the annual Hydrologic Monitoring reports, flow rates for individual areas including fault zones normally decrease to less than ten percent of the initial flow rate. (Historical information can be found in the annual Hydrologic Monitoring reports.)

Long term monitoring of water producing zones in both Deer Creek and Wilberg/Cottonwood mines has established that once base flow has been reached, the flow is consistent over time. Monitoring has not indicated any seasonal or yearly variations (see annual Hydrologic Monitoring reports for in-mine long term flow information).

As pointed out by Theis (1957, p. 3), water discharged from a well or, in this case, underground mines, must be balanced by 1) an increase in recharge to the groundwater system, 2) a decrease in natural discharge from the system, or 3) a decrease of groundwater in storage, or by a combination of all of these. As hydrologic studies have shown and monitoring of intercepted groundwater has verified, recharge into the underground workings is limited even in areas of faults and fractures. Based on the hydrologic characteristics of the Blackhawk and the underlying Star Point Formation (low porosity and hydraulic conductivities) and data from surface hydrologic monitoring, decrease in the natural discharge of the system is considered to be only a minor factor; therefore, groundwater intercepted in the permit area is believed to be from storage. One factor which verifies this conclusion is rapid dewatering of intercepted groundwater with no apparent change in the surface hydrological system. As the USGS pointed out in Open File 81539 and monitoring by PacifiCorp has shown, the majority of surface flow is due to the runoff from the winter snowpack and not from groundwater recharge. It is possible that over a long period of time the groundwater system of the Cottonwood and Huntington Creek drainage systems could be impacted from a slight reduction in recharge; but this is more than offset by the interception of the groundwater, especially in terms of quality, which will be discussed later.

a. Depletion Of Storage

Two main areas-types of groundwater depletion are projected to occur within the Mill Fork permit area and will be discussed separately, 1) fluvial sandstone channel systems, and 2) geologic structures; including folding, faults and fractures.

(1) Fluvial Sandstone Channel Systems

In the Deer Creek Mine sandstone channels (ancient river systems) overlie and scour into the underlying strata (refer to Volume 9 Maps HM2 and HM3). Based upon drilling results, similar geologic conditions are projected to occur in the Mill Fork permit area. These channel systems were part of a deltaic depositional setting active during and after the coal forming peat accumulation. The largest influx of water originates from the roof when mining advances beneath sandstone top. The sandstone, which is semipermeable and porous, affords an effective route of water transport. Mudstone, siltstone, and interbedded materials generally act as aquicludes which impede water flow unless fracturing of the formation has allowed for secondary permeability. Of the water producing areas, those closest to the active mining face exhibit the greatest flows. As mining advances, the area adjacent to the active face continues to be excessively wet and previously mined wet areas experience a decrease in flow. Data collected by PacifiCorp indicates a ninety percent reduction in water flows from roof sampling sites over a fivemonth period (or less) as the mining face is advanced (review annual Hydrologic Monitoring reports). It has also been noted that the outermost entries of a multiple entry system remain wet for a longer period of time than the inner entries. It appears that the water source is being dewatered since excavated areas of the mine do not continue to produce water indefinitely. The water source must be either of limited extent, i.e., a perched aquifer, or have a limited recharge capacity, i.e., poor horizontal and vertical permeability (refer to Volume 9 Figure HF42 depicting an idealized view of the dewatering process).

As documented in Appendix B, in-mine groundwater occurs in isolated, inactive systems as demonstrated by the small ^{3}H content and radiocarbon ages of mine waters which range from 2,000 to 19,000 years (Appendix B Table 5), with the exception of two sites which are discussed below. This indicates that in-mine waters are not in hydraulic connection with near-surface spring waters that respond to seasonal and climatic changes and contain anthropogenic carbon and appreciable amounts of ^{3}H.

(2) Geologic Structures Including Folding, Faults And Fractures

Folding: Strata in the Mill Fork area are gently folded in two broad structural features. The Flat Canyon Anticline crosses the southeastern portion of the permit area. This anticline trends southwest to northeast, and plunges to the southwest. Dips in the anticline range from two to six degrees with the south limb dipping the steepest. To the north, the north limb of the Flat Canyon Anticline becomes the south limb of the Crandall Canyon Syncline, a flat-bottomed syncline. This syncline also trends southwest to northeast. Dips on the northwest side are much steeper than on the southeast side.

Groundwater inflow related to folding has been minimal in the vicinity of the Mill Fork permit area, except for the western portion of the Trail Mountain Mine located approximately nine miles to the south of the Mill Fork permit area. A major geologic structure known as the Straight Canyon Syncline bisects the Trail Mountain Mine area. Gradient from the portal area to western portion of the mine was in excess of nine hundred feet in a distance of approximately three miles. The trough of the Straight Canyon Syncline can be observed at the Joes Valley Dam. Drilling along the trough of the syncline intercepted artesian flow (refer to Trail Mountain Permit: Hydrologic Section for discussion of well TM-3 located in Section 3, Township 18 South, Range 6 East). As mining progressed to the west in the Trail Mountain Mine, groundwater inflow was encountered related to depressurization of the Star Point Sandstone.

As stated above, the strata in the Mill Fork area are gently folded in two broad structural features with overall gradients across the lease of approximately one hundred feet in a distance of approximately three miles. Exploration drilling has been conducted along the trough of the Crandall Canyon Syncline on the eastern and western boundaries of the lease (refer to map MFU1828D). Drilling conducted by PacifiCorp has not detected measurable groundwater inflow from the lower Blackhawk/Star Point formations (refer to R645-301-600 Appendix B). Personnel communications with representatives of Genwal, hydrologic studies conducted at the Genwal Mine (refer to Genwal MRP: Hydologic Section) and observations of the mine verify that interception of groundwater related to the depressurization of the Star Point Sandstone is minimal.

As stated earlier, Little Bear Spring is located in Little Bear Canyon along the base of the Crandall Canyon Syncline. Little Bear Spring discharges from active zone groundwater system that is in communication with shallow recharge sources. These types of groundwater systems are isolated from the deep, inactive zone groundwater systems encountered in the coal mines. PacifiCorp's Hydrologic Monitoring Program has been specifically designed to monitor potential impacts to the lower Blackhawk and Star Point Sandstone formations with the inclusion of springs MF-213 and Little Bear Spring (refer to map MFU1851D and Appendix A).

Faults and Fractures: Groundwater inflows associated with the Roans Canyon Fault system have occurred in the Deer Creek Mine and the Joes Valley Fault in the Crandall Canyon Mine. Hydrologic concerns regarding fault inflows are; 1) the capture of water supplying baseflow to creeks or springs, and 2) the discharge of fault-related water to creeks. In general, we do not believe that fault-discharge waters are tied to active, modern groundwater systems. However, locally fault related groundwater inflows, associated with the Roans Canyon and Joes Valley faults, have hydraulic communication with the surface as evidenced by their ^{3}H contents. Wells drilled into and near the fault systems demonstrate that there is limited lateral communication along the fault system and the radiocarbon age most fault-discharge waters are 2,500 or more years. Mining within 200 to 300 feet of the Joes Valley Fault could intercept appreciable quantities modern near surface water. For a complete discussion of Faults and Fractures of the Deer Creek Mine southeast of the Mill Fork permit area refer to Volume 9 Hydrologic Section - PHC).

To prevent interception of groundwater from the Joes Valley Fault, the Forest Service included Stipulation #19 to the Special Coal Lease Stipulations. It states, "*Except at specifically approved locations, mining that would cause subsidence will not be permitted within a zone along the Joes Valley Fault determined by projecting a 22 degree angle of draw (from vertical) eastward from the surface expression of the Joes Valley Fault*". A buffer zone entitled "Joes Valley Fault Buffer Zone", (22 degree angle of draw from the lowest coal seam - Hiawatha), is indicated on all maps associated with the Mill Fork permit area.

On January 25 (revised March 20), 2006, PacifiCorp filed an application for a federal coal lease by application (LBA) for access to unleased federal coal adjacent to the Mill Fork State Lease. The serial number assigned to this LBA is UTU-84285.

Leasing of the Mill Fork West Extension Tract, serial number UTU-84285, would encourage and enable the greatest ultimate recovery and conservation of this natural resource, while promoting full development of the economically recoverable coal located between the western lease line of the Mill Fork State Lease ML-84258 and the Joes Valley Fault zone which would otherwise become subject to bypass. This would be accomplished by allowing westward mine development and extraction beyond the existing Mill Fork western lease boundary until mining advancement is terminated due to the actual location of the Joes Valley Fault (refer to R645-301-600 Geology Section for a complete discussion of the location of the Joes Valley Fault.

Mining in Federal Lease UTU-84285 area will consist of longwall gateroads, setup and bleeder entries. First mining will be conducted with continuous miners. Longwall gateroads will be extended to the west but in no case will second/full extraction mining occur within the Joes Valley buffer zone. The Joes Valley buffer zone was established during the NEPA process to prevent interception of groundwater from the Joes Valley Fault. No pillars will be removed within the Joe Valley buffer zone during mining within the UTU-84285 area, and therefore no subsidence will occur.

In an effort to minimize interception of groundwater from the Joes Valley Fault, as mining in the longwall gateroads approaches within 200 feet of the projected location of the fault, an underground drill will be setup in the western extent continuous miner section development and drilled roughly perpendicular to the known fault trend until they intersect the fault zone. The holes will be drilled slightly upward at the start to aid circulation. The holes will be roughly 3" in diameter. Drilling results will be examined by a professional geologist for evidence of faulting, fracturing, and water influence (weathering). Presence of faulting will be determined by fault gouge, weathering, and/or sudden lithologic change. This is a large displacement fault, fault gouge should be significant.

Precautions against water inflow will include cementing at least 10 feet of "surface" casing with a full flow valve, through which the hole will be drilled. This will allow shutting the valve in the event of large water inflows. If significant water is flowing at the time of completion of the hole, the hole will be cemented to prevent continued inflow of water.

If faulting is encountered prior to reaching the planned bleeder entries, mining will be terminated and the bleeder entries will be relocated. At least 50 feet of solid coal will be left between the bleeder entry and the fault. Energy West will notify DOGM and the surface management agency immediately if substantial water (greater than 50 gpm) is produced from the drill holes, entries or the Joes Valley Fault.

Mining in the Genwal Mine located to adjacent to the Mill Fork State Lease provided hydrologic information related to the Joes Valley Fault. Minor quantities of groundwater were intercepted in entries which penetrated the fault (Main West -Mine visit Chuck Semborski and Ken Fleck) and in drill holes within UTU-77975 (personal communication with John Lewis - Genwal Mine engineer). Although significant groundwater has not been intercepted by mining near the Joes Valley Fault, Energy West has developed an emergency plan contend with interception of groundwater as a preventative measure. The plan consists of the following:

1) Notify governmental agencies
2) Remove all mining equipment
3) Erect two solid concrete block seals at least 2 feet apart with appropriately sized de-watering pipe with valve at the bottom of the seal
4) Quick dying cement will be pumped into the space between the two seals.
5) After the cement has cured, the de-watering valve will be closed.

b. Quality

The mines in the coal fields of the Wasatch Plateau tend to act as interceptor drains. The groundwater that is brought to the surface has a lower dissolved solids content than would have existed were the water to continue its downward movement through shale layers, dissolving increased amounts of salt with distance (Southeastern Utah Association of Governments, 1977; Vaughn Hansen Associates, 1979; Danielson et al., 1981).

Additional studies by PacifiCorp have confirmed the primary findings of the USGS concerning regional trends in quality. Originally, decreasing quality from north to south was believed to depict the groundwater flow direction, and the quality decreased as a function of the time it traveled through the strata. The time travel component is probably an important factor. But in 1985 a surface exploration program identified the existence of an area of residual heat from an ancient burn on the outcrop throughout the southern portion of East Mountain. The high temperature was also explored within the mine and a portion of reserves were lost because of the situation. It is now theorized that the high temperature water dissolved the mineral constituents of the formations, thereby altering the water chemistry. The quality also decreases vertically downward because of the influence of marine sediments as well as along the trend of decreasing quality from north to south.

c. Quantity

As stated earlier, interception of groundwater varies and is dependent on several factors. One of the most significant is that when the mine enters virgin country, in some areas significant amounts of water are liberated. Mining quickly dewaters the saturated horizon immediately above the mined horizon and this water is not replaced as evidenced by the rapid decline and often complete drying of roof drips. In-mine groundwater occurs in isolated, inactive systems as demonstrated by the small ^3H content and radiocarbon ages of mine waters which range from

2,000 to 19,000 years (refer to Appendix C: Table 5). This indicates that in-mine waters are not in hydraulic connection with near-surface spring waters that respond to seasonal and climatic changes and contain anthropogenic carbon and appreciable amounts of ^{3}H.s

Based on data collected by PacifiCorp, discharge of intercepted groundwater from the Mill Fork Area has been similar to that of the Deer Creek Mine and adjacent Genwal Mine. Discharge from the these to mines range from 650 to 1,500 gpm (Deer Creek Mine average discharge ranges from 1,000 to 1,500 gpm [Energy West Mining Company 2001 Annual Report], discharge from the Genwal Mine averages approximately 650 gpm [Genwal 2000 Annual Report]). All of the intercepted groundwater will be discharge to the Deer Creek drainage system. Discharge from the Deer Creek Mine will be monitored as specified in the UPDES permit (refer to Volume 9, Appendix B).

d. Post Mining

The monitoring of in-mine water sources has shown that the longterm water flow from a given area is much less than ten percent (10%) of the initial flow from the area. Most of the current inflow into the mine workings is from areas where water storage has not been depleted. After the storage has been depleted, the flow will reduce to roughly equal the recharge rate which is expected to be less than ten percent (10%) (data presented earlier in this report) of the current discharge rate. The current discharge rate from the Deer Creek Mine approximately 1000 to 1500 gpm; therefore, the postmining discharge rate is expected to be approximately 100 to 150 gpm. For verification purposes, PacifiCorp has monitored selected areas of the mine to formulate discharge recession curves over time, enabling a better understanding of the ratio of initial discharge rates and long-term post mining discharge values (discharge recession curves from long-term in-mine water sources can be found in Volume 9 - Hydrologic Support Information, In-Mine Discharge Recession Curves). There is no reason to assume the postmining discharge water quality will differ from that currently being discharged (see

Groundwater Quality section). The cumulative effect of discharge water on the receiving stream will be insignificant based on data collected from Deer Creek and in comparison to flow differential.

Because the permit area is divided between the Huntington Creek Drainage Basin and the Cottonwood Creek Drainage Basin, seventy percent and thirty-percent, respectively, the amount of interbasin water transfer that occurs must be considered. PacifiCorp will install seals as a mitigation effort to minimize interbasin transfer. The average annual flows of Huntington and Cottonwood creeks are 96.3 and 95.1 cfs, respectively (USGS Open File reports #81539 and #81141). The current discharge rate from PacifiCorp's total permit areas ranges from 1000 to 1500 gpm, less than three and one half percent of either of the creeks' average flows. Because a limited portion of the projected Mill Fork permit area mine workings (less than thirty percent) intersects water that would normally migrate toward the Cottonwood Basin but is discharged out Deer Creek Canyon, the interbasin water transfer from the Cottonwood drainage to Huntington Creek will probably never exceed one percent (<1%) of the average annual discharge of either system.

R645-301-729 CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT (CHIA)

The Division will provide an assessment of the probable cumulative hydrologic impacts of the proposed coal mining and reclamation operation and all anticipated coal mining and reclamation operations upon surface and groundwater systems in the cumulative impact area.

R645-301-730 OPERATION PLAN

R645-301-731 GENERAL REQUIREMENTS

PacifiCorp has submitted a plan to minimize disturbance to the hydrologic balance, to prevent material damage, and to support approved postmining land use (see Operational and Reclamation plan for the Deer Creek Mine).

R645-731-100 HYDROLOGIC BALANCE PROTECTION

A. GROUNDWATER PROTECTION

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.

B. SURFACE WATER PROTECTION

Surface water quality will be protected by handling earth materials, groundwater discharges, and runoff in a manner that minimizes the potential for pollution.

R645-731-200 WATER MONITORING

A. GROUNDWATER

Groundwater within the Mill Fork permit area will be monitored according to the schedules in Appendix A. PacifiCorp has conducted baseline and operational monitoring of spring sources in and adjacent to the permit area. The springs located within or immediately adjacent to areas overlying coal to be mined in the next five (5) years or areas overlying previously mined areas will be monitored. The data collected have provided information useful in the understanding of potential hydrologic consequence of mining.

1. East Mountain Springs - Mill Fork

In preparation for coal leasing, Genwal Resources conducted baseline spring and seep surveys from 1994-1996 (northern portions of the lease were surveyed in 1989-90). With PacifiCorp's acquisition of the Mill Fork State Coal Lease, a complete re-evaluation of groundwater resources was initiated in 2000 and continued through 2001. During the 2000-2002 baseline evaluation, a total of 198 springs were identified within and adjacent to the permit area. Each spring site on East Mountain has been studied to determine the geologic circumstances that cause the springs to occur. The mode of occurrence for each spring has been tabulated on the "Springs Geologic Conditions Inventory" sheets located in Appendix C. The springs on East Mountain originate in several different ways (see Table MFHT-1 and Mill Fork Spring Map MFS1831D); however, many springs share the same mode of occurrence and, in some cases, are related.

The ground water monitoring plan in Appendix A includes a selection of springs based on the following criteria:

- ❖ Stratigraphic position
- ❖ Area of potential influence from subsidence
- ❖ Aerial distribution
- ❖ Established water rights
- ❖ Measurable flow based on historical surveys
- ❖ Reliable measuring point(s)

The following table outlines the rationale for springs selected for long term monitoring. Selection of the springs to be monitored was based upon the factors listed along with discussions with the water users (CVSSD, Emery Conservancy District, NEWUA) and the surface management agency.

MILL FORK GROUND MONITORING PLAN - SPRINGS							
Spring	**Stratigraphic Position**	**Projected Subsidence Zone**	**Regional Location**	**Water Rights**	**Historical Measurable Flow**	**Reliable Measuring Point**	**Comment**
EM-216	✔		✔	✔	✔	✔	Located outside projected zone of subsidence
EMPOND					✔	✔	Added to the spring monitoring program at the request of the USFS
GRANTS SPRING					✔	✔	Added to the spring monitoring program at the request of the USFS
LITTLE BEAR SPRING	✔		✔	✔	✔	✔	Located outside projected zone of subsidence. Added to the spring monitoring program at the request of the DOGM
JV-9	✔		✔			✔	Located outside projected zone of subsidence. Monitored to detect impacts to the Joes Valley alluvium
JV-34	✔		✔			✔	Located outside projected zone of subsidence. Monitored to detect impacts to the Joes Valley alluvium
MF-7	✔		✔		✔	✔	Located outside projected zone of subsidence
MF-10	✔	✔	✔	✔	✔	✔	
MF-19B	✔		✔	✔	✔	✔	
MF-213	✔		✔	✔	✔	✔	Large spring located in the Blackhawk Formation downdip from projected mining
MF-219	✔	✔	✔	✔	✔	✔	
MFR-10	✔	✔	✔		✔	✔	Large spring denoted by USGS
MFR-30	✔	✔	✔		✔	✔	
RR-5	✔	✔	✔	✔	✔	✔	
RR-15	✔	✔	✔		✔	✔	
RR-23A	✔		✔		✔	✔	Large spring within a series of springs located downdip from projected mining
SP1-26	✔	✔	✔	✔	✔	✔	
SP1-29	✔	✔	✔		✔	✔	
UJV-101	✔		✔		✔	✔	
UJV-206	✔	✔	✔	✔	✔	✔	

Water samples will be collected and analyzed during the months of July and October. Parameters analyzed are those listed in the "DOGM Guidelines for Groundwater Water Quality" (see Appendix A).

2. In-Mine

Intercepted groundwater sampling sites, (either roof drippers or contribution from the floor), will be established according to the Special Condition Stipulation in the Deer Creek permit renewal, (February 6, 1996); "*If during entry development, sustained quantities of groundwater are encountered which are greater than 5 gpm from a single source in an individual entry, and which continue after operational activities progress beyond the area of groundwater production, PacifiCorp must monitor these flows for quality and quantity under the approved monitoring plan".* In addition to the standard plan described above, if mining encounters significant quantities of groundwater which issues from a fault zone, PacifiCorp will; quantify the volume, sample for water quality according to the approved monitoring plan (baseline parameters for two year period), conduct isotopic sampling using a systematic approach (phase 1: tritium analysis, phase 2: depending the results of the tritium sampling, perform carbon age dating). Parameters analyzed are those listed in the "DOGM Guidelines for Groundwater Water Quality" (see Appendix A).

B. SURFACE WATER

PacifiCorp has conducted baseline monitoring of surface waters within and adjacent to the Mill Fork permit area. Water samples will be collected and analyzed as outlined in Appendix A. Parameters analyzed are those listed in the "DOGM Guidelines for Surface Water Quality." Locations of all surface monitoring sites and sampling schedules can be found in Appendix A.

R645-301-731.300 ACID AND TOXIC-FORMING MATERIALS

Acid-forming materials in western coal mines generally consist of sulfide minerals, which, when exposed to air and water, are oxidized causing the production of H^+ ions (acid). The sulfide mineral pyrite (FeS_2) has been identified in the PacifiCorp mines. Although the oxidation of pyrite occurs in the mine, acidic waters are not observed in the mine. The acid is quickly consumed by dissolution of abundant, naturally occurring carbonate minerals (refer to Appendix B Eqs. 3 and 4). Iron is readily precipitated as iron-hydroxide and excess iron is not observed in the mine discharge water.

R645-301-731.500 DISCHARGES

Refer to Mine Dewatering R645-301-721 and UPDES information in Volume 9 Appendix B.

731.530 State Appropriated Water Supply

PacifiCorp commits to comply with R645-301-731.530, which states: "The permittee will promptly replace any State-appropriated water supply that is contaminated, diminished or interrupted by UNDERGROUND COAL MINING AND RECLAMATION ACTIVITIES conducted after October 24, 1992, if the affected water supply was in existence before the date the Division received the permit application for the activities causing the loss, contamination or interruption. The baseline hydrologic and geologic information required in R645-301-700. will be used to determine the impact of mining activities upon the water supply". PacifiCorp has conducted baseline hydrologic monitoring to determine pre-mining hydrologic resources (refer to Appendix C). Ground and surface water monitoring programs have been designed to specifically to monitor potential impacts associated with mining in the Mill Fork permit area. Table MFHT-2 list the ground and surface water rights within and adjacent to the Mill Fork permit area. In addition, Table MFHT-2 list the quantity of the water rights within the projected affected area, and the observed flows collected during the baseline surveys and mitigation alternatives. Quality of the State Appropriated Water Supplies are reported in Appendix C.

R645-301-731.600 STREAM BUFFER ZONES

Mining related activities will not occur within 100 feet of a perennial or intermittent streams unless the Division authorizes such activities.

R645-301-731.700 CROSS SECTION AND MAPS

731.710-720 and 750 A water supply intake system known as "North Emery Water Users Association - Rilda Canyon Springs" is located in Section 28, Township 16 South, Range 7 East (refer to Volume 9 Map HM-9, a detailed drawing of the collection system is provided in Volume 9 - Hydrologic Section Map HM-8). The intake system consists of a series of french drains collecting near surface alluvial water as a supply source for culinary water (for complete description of the NWEUA system refer to Volume 9 R645-721 "Existing Groundwater Resources").

Mine Sites: All disturbed area drainage will flow into an approved sediment control device. Maps showing water diversion, collection, conveyance, treatment, storage, and discharge can be found in the Operational section of the Deer Creek Mine PAP.

730 Water Monitoring Location Map - Refer to Hydrologic Map MFS1851D.

R645-301-731.800 WATER RIGHTS AND REPLACEMENT

In order to fulfill the requirements to restore the 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 final bond release. The water will be replaced from an alternate source in sufficient quantity and quality to maintain the current and postmining land uses (refer to Table MFHT-2 for a list of State Appropriated Water Supplies; including; type, quantity (water right and baseline observations) and quality references.

Nine springs have been developed in Huntington Canyon to provide for domestic, industrial, and commercial water needs. Currently, Huntington City utilizes two springs in Huntington Canyon, Big Bear Canyon Spring and Little Bear Canyon Spring. The North Emery Water Users Association also utilizes springs in Huntington Canyon to provide for domestic and industrial water needs in areas outside of Huntington City. The Association is currently utilizing water from three springs in Rilda Canyon as well as from four other springs in the general area (refer to Volume 9 Hydrologic Section: Map HM1).

a. North Emery Water Users Association

Of concern to PacifiCorp is the proximity of proposed mining activities in Rilda Canyon to the Rilda Canyon Springs which currently serve as a culinary water source to the North Emery Water Users Association (NEWUA) serving some 410 connections. Due to the importance of these springs, a separate discussion is provided in Volume 9 Hydrologic Section.

b. Little Bear Spring

A second spring system which has been developed for culinary purposes referred to as Little Bear Spring occurs east of the Mill Fork permit area. Little Bear Spring is a large spring (average flow of approximately 300 gpm) which issues from the lowest member of the Star Point Sandstone (Panther Member) located approximately one and one half (1 ½) miles to the east of the Mill Fork permit area boundary in Section 9, Township 16 South, Range 7 East (refer to Groundwater Rights and Users for complete hydrologic characteristics related to Little Bear Spring). PacifiCorp cooperated with Huntington City, Elmo City, Cleveland City and CVSSD in developing a comprehensive mitigation plan. The agreement was signed on July, 2004. As part of the agreement, PacifiCorp constructed a water treatment plant in 2005 located near at the existing Huntington City plant in Huntington Canyon. The mitigation agreement information is found in Appendix D of Volume 9.

R645-301-732 - 764 SEDIMENT CONTROL

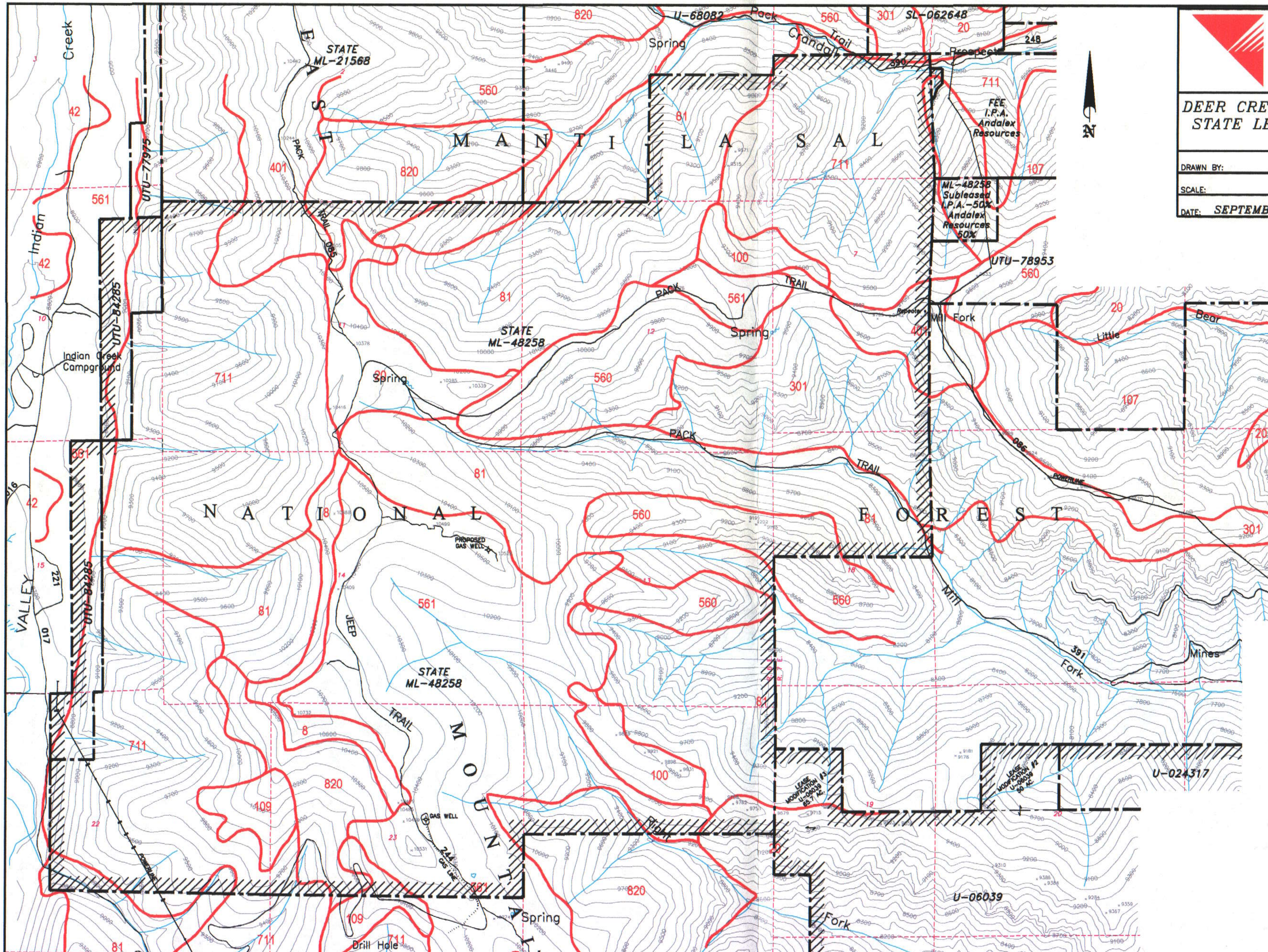
Information pertaining to sediment control can be found in the Operational plan of the Deer Creek Mine PAP.

R645-301-748, 755, 765 CASING AND SEALING OF WELLS

Each water well will be cased, sealed, or otherwise managed, as approved by the Division.

R645-301-751 WATER QUALITY STANDARDS AND EFFLUENT LIMITATIONS

Discharges of water from areas disturbed by coal mining and reclamation operations will be made in compliance with all Utah and federal water quality laws and regulations and with effluent imitations for coal mining promulgated by the EPA set forth in 40CFR Part 434 (refer Volume 9 Appendix B for UPDES permit information).



ENERGY WEST MINING COMPANY

A SUBSIDIARY OF PACIFICORP

DEER CREEK MINE – MILL FORK AREA
STATE LEASE ML-48258/UTU-84285
SOILS MAP

DRAWN BY:	K. LARSEN	MFS1834B	
SCALE:	1" =2000'	DRAWING #:	
DATE:	SEPTEMBER 1, 2006	SHEET 1 OF 1	REV. 6

LEGEND

- COAL LEASE BOUNDARY
- DEER CREEK MINE PERMIT BOUNDARY

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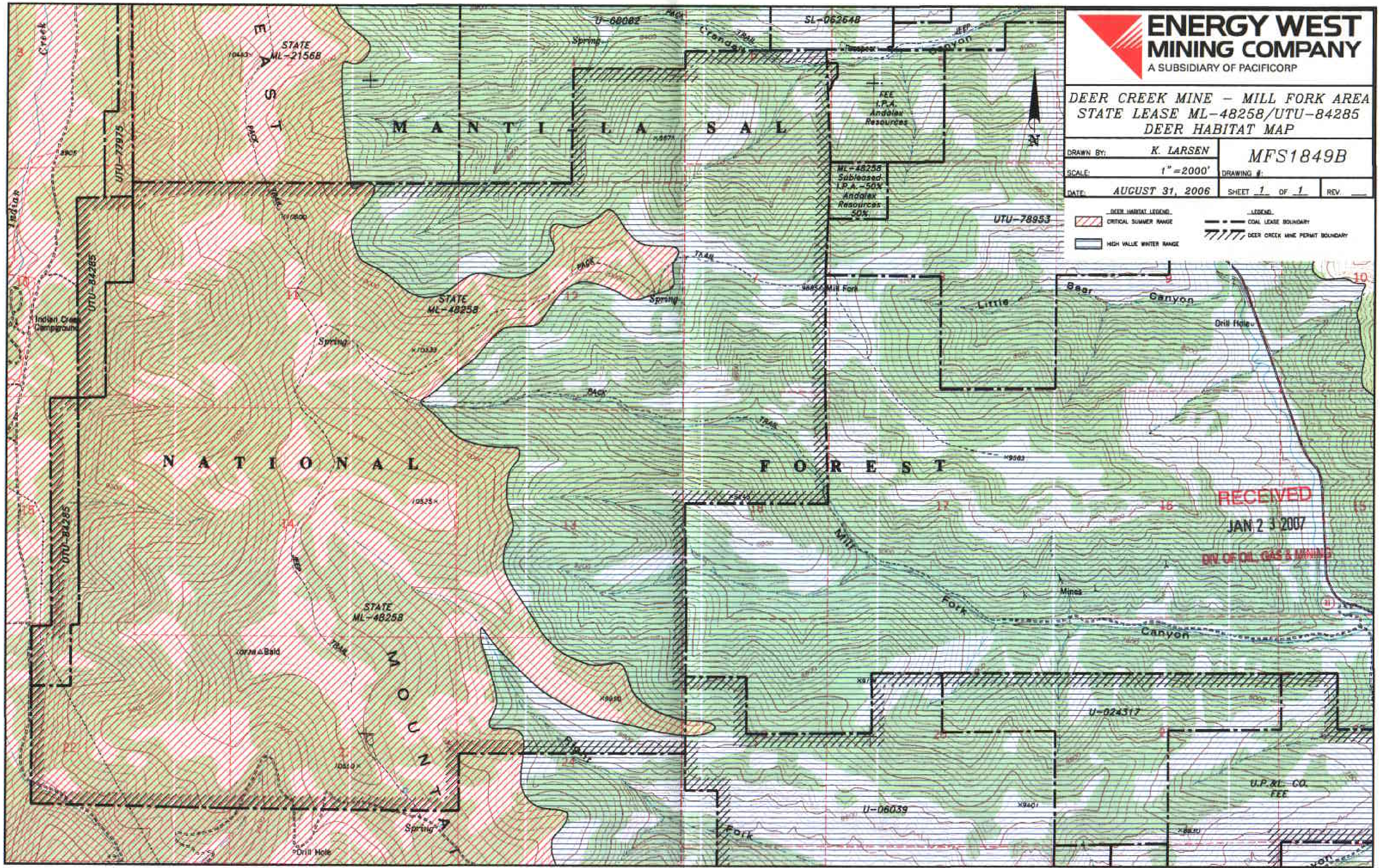
SOILS LEGEND

- 8 GREYBACK FAMILY-CRYORTHENTS COMPLEX
- 20 STRYCH-PATHEAD-PODO FAMILIES-RUBBLELAND COMPLEX
- 42 AQUIC CRYOBOROLLS
- 81 BUNDO-LUCKY STAR-SCOUT FAMILIES COMPLEX
- 100 GRALIC-BEHANIN-ELWOOD FAMILIES COMPLEX
- 107 CURECANTI-ELWOOD-DUSCHENE FAMILIES COMPLEX
- 109 ELWOOD FAMILIES COMPLEX
- 301 GREYBACK-LOAMY, MIXED (NONACIDIC) LITHIC CRYORTHENTS-BACHELOR FAMILIES COMPLEX
- 401 ADEL-MERINO FAMILIES COMPLEX
- 560 CLAYBURN-BROAD CANYON FAMILIES COMPLEX
- 561 CLAYBURN-FAIM-BEHANIN FAMILIES COMPLEX
- 711 BUNDO-LUCKY STAR-ADEL FAMILIES COMPLEX
- 820 LUCKY STAR-BUNDO-ADEL FAMILIES COMPLEX

(Soils Data provided by U.S.F.S.)


ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP
DEER CREEK MINE - MILL FORK AREA
STATE LEASE ML-48258/UTU-84285
DEER HABITAT MAP
DRAWN BY: K. LARSEN
SCALE: 1" = 2000'
DATE: AUGUST 31, 2006
MFS1849B
DRAWING #:
SHEET 1 OF 1
REV.
DEER HABITAT LEGEND
CRITICAL SUMMER RANGE
HIGH VALUE WINTER RANGE
LEGEND
COAL LEASE BOUNDARY
DEER CREEK MINE PERMIT BOUNDARY
RECEIVED
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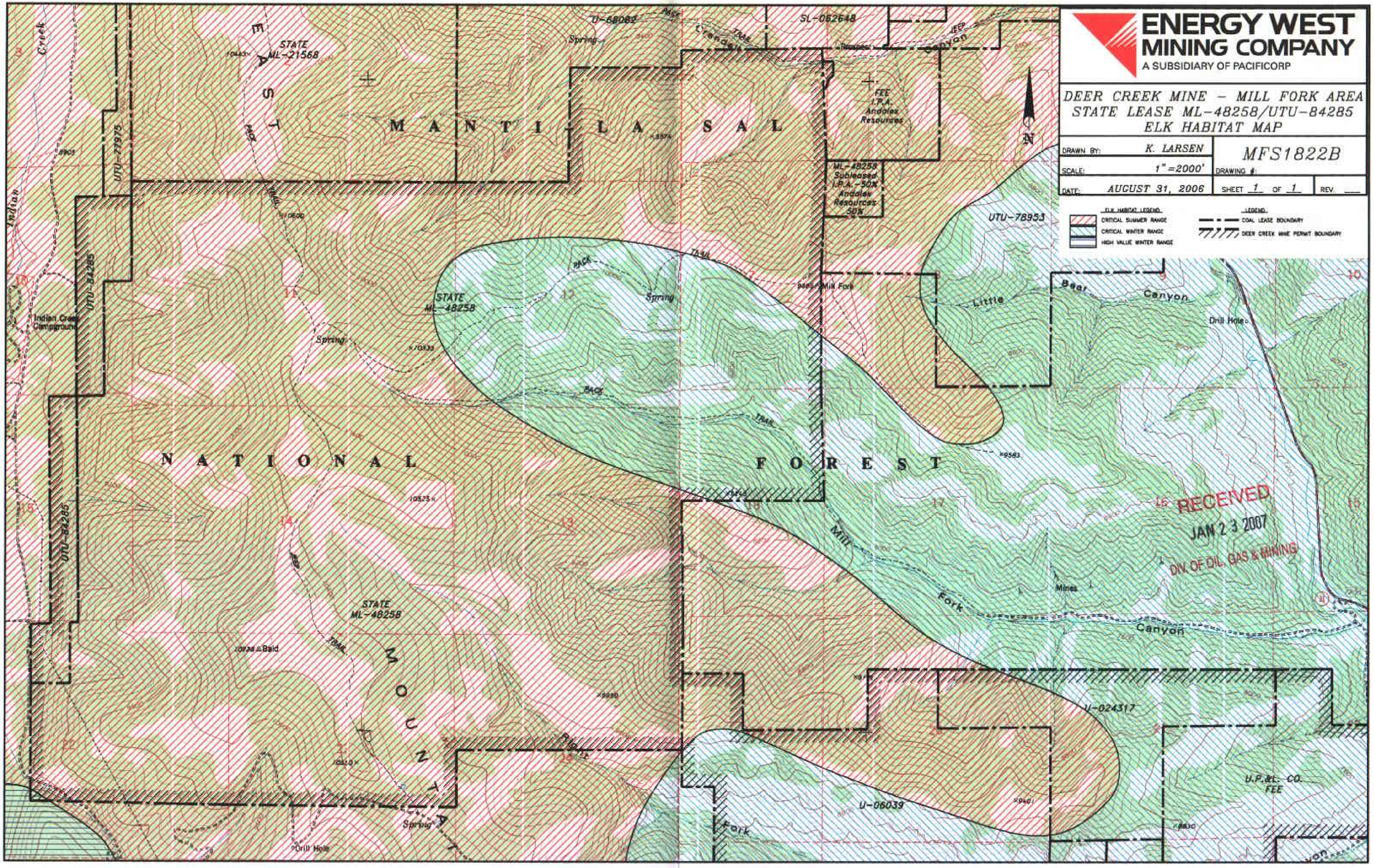
DIV. OF OIL, GAS & MINING
MANTI - LA SAL
NATIONAL FOREST
EAST MOUNTAIN
STATE ML-21568
STATE ML-48258
U-68082
SL-062648
UTU-77975
UTU-84285
UTU-78953
U-024317
U-06039
FEE I.P.A. Andalex Resources
ML-48258 Subleased I.P.A.-50% Andalex Resources 50%
U.P.&L. CO. FEE
Indian Creek
Indian Creek Campground
Crandall Canyon
Little Bear Canyon
Mill Fork Canyon
Mines
Drill Hole
Spring
PACK TRAIL
JEEP TRAIL
Bald
N


ENERGY WEST
MINING COMPANY
A SUBSIDIARY OF PACIFICORP
DEER CREEK MINE – MILL FORK AREA
STATE LEASE ML-48258/UTU-84285
ELK HABITAT MAP
DRAWN BY: K. LARSEN
SCALE: 1" =2000'
DATE: AUGUST 31, 2006
DRAWING #: MFS1822B
SHEET 1 OF 1
REV.
ELK HABITAT LEGEND
CRITICAL SUMMER RANGE
CRITICAL WINTER RANGE
HIGH VALUE WINTER RANGE
LEGEND
COAL LEASE BOUNDARY
DEER CREEK MINE PERMIT BOUNDARY
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MANTI-LA SAL
NATIONAL FOREST
EAST MOUNTAIN
STATE ML-21568
STATE ML-48258
U-68082
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UTU-78953
U-024317
U-06039
FEE I.P.A. Andalex Resources
ML-48258 Subleased I.P.A. 50% Andalex Resources 50%
U.P.&L. CO. FEE
Indian Creek
Indian Creek Campground
Spring
Bald
Drill Hole
Mill Fork
Little Bear Canyon
Mill Fork Canyon
Mines
PACK TRAIL
RECEIVED
JAN 2 3 2007
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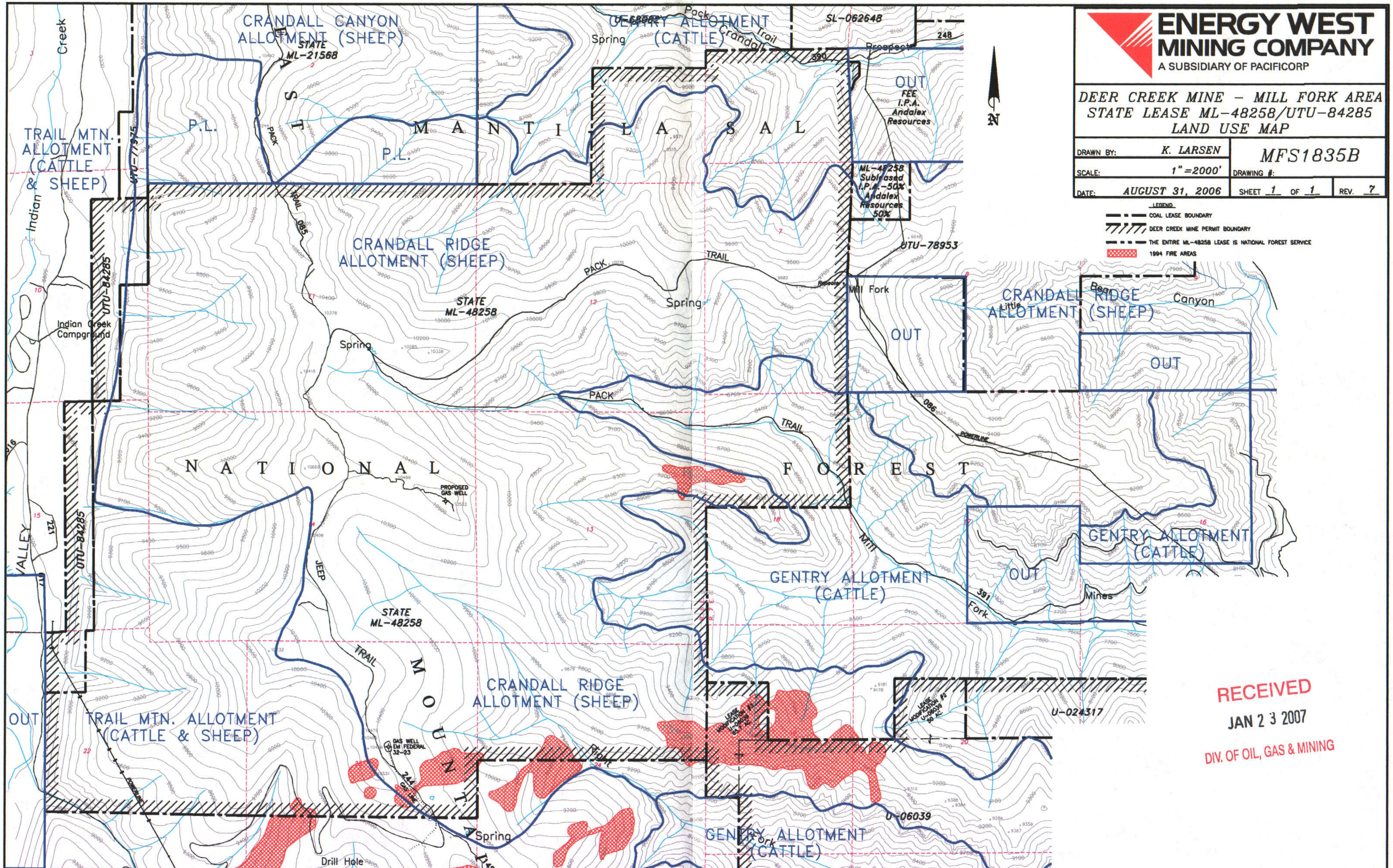

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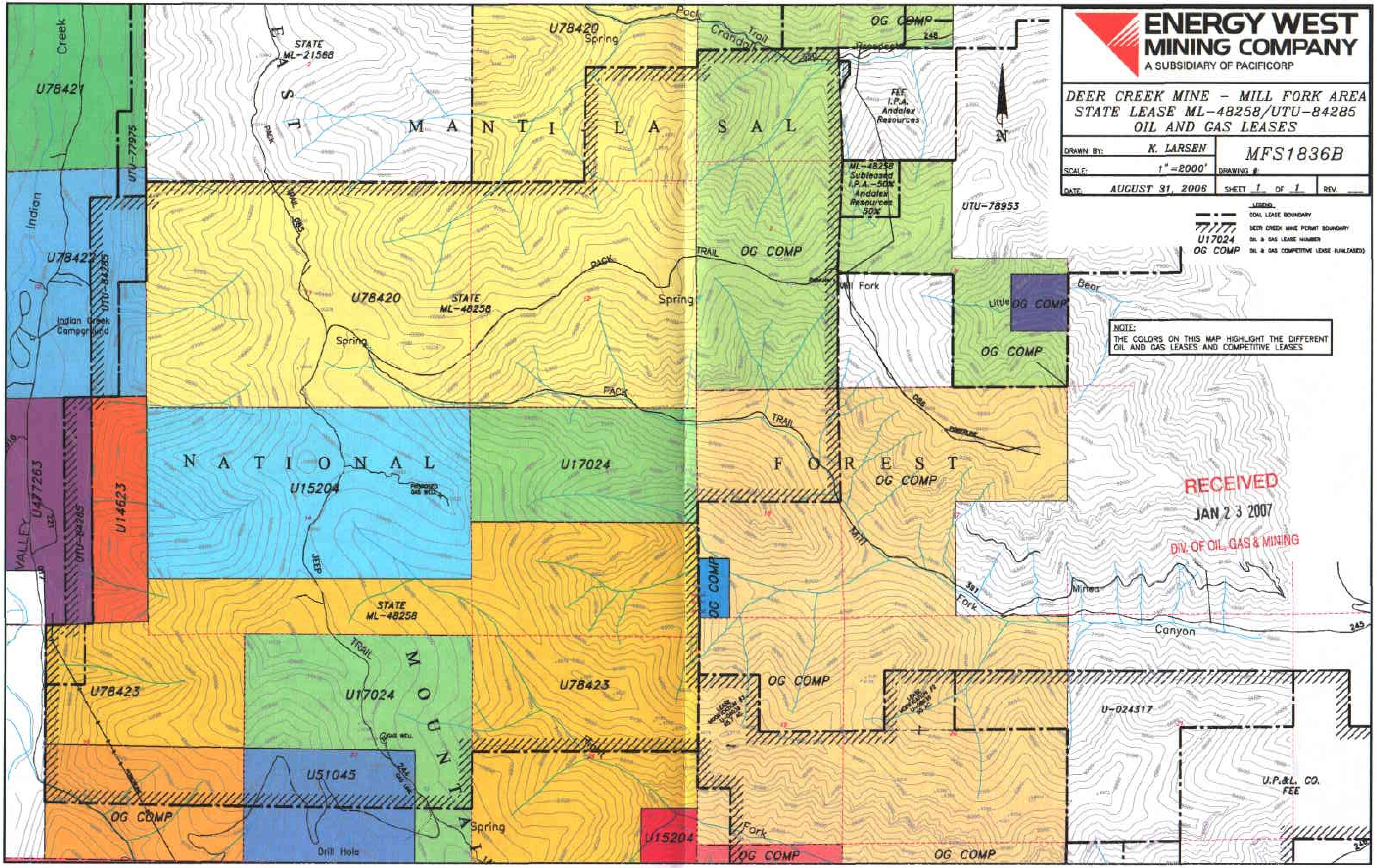

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DEER CREEK MINE - MILL FORK AREA
STATE LEASE ML-48258/UTU-84285
OIL AND GAS LEASES
DRAWN BY: K. LARSEN
SCALE: 1"=2000'
DATE: AUGUST 31, 2006
MFS1836B
DRAWING #:
SHEET 1 OF 1
REV.
LEGEND
COAL LEASE BOUNDARY
DEER CREEK MINE PERMIT BOUNDARY
U17024 OIL & GAS LEASE NUMBER
OG COMP OIL & GAS COMPETITIVE LEASE (UNLEASED)
NOTE:
THE COLORS ON THIS MAP HIGHLIGHT THE DIFFERENT OIL AND GAS LEASES AND COMPETITIVE LEASES
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EAST MANTI LA SAL NATIONAL FOREST
U78421
U78420
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U14623
U51045
U477263
UTU-77975
UTU-84285
UTU-78953
U-024317
STATE ML-21568
STATE ML-48258
ML-48258 Subleased I.P.A.-50% Andalex Resources 50%
FEE I.P.A. Andalex Resources
U.P.&L. CO. FEE
OG COMP
Indian Creek
Indian Creek Campground
Crandall
Mill Fork
Little Bear
Canyon
Spring
PACK TRAIL
JEEP TRAIL
Drill Hole
GAS WELL
PROPOSED GAS WELL
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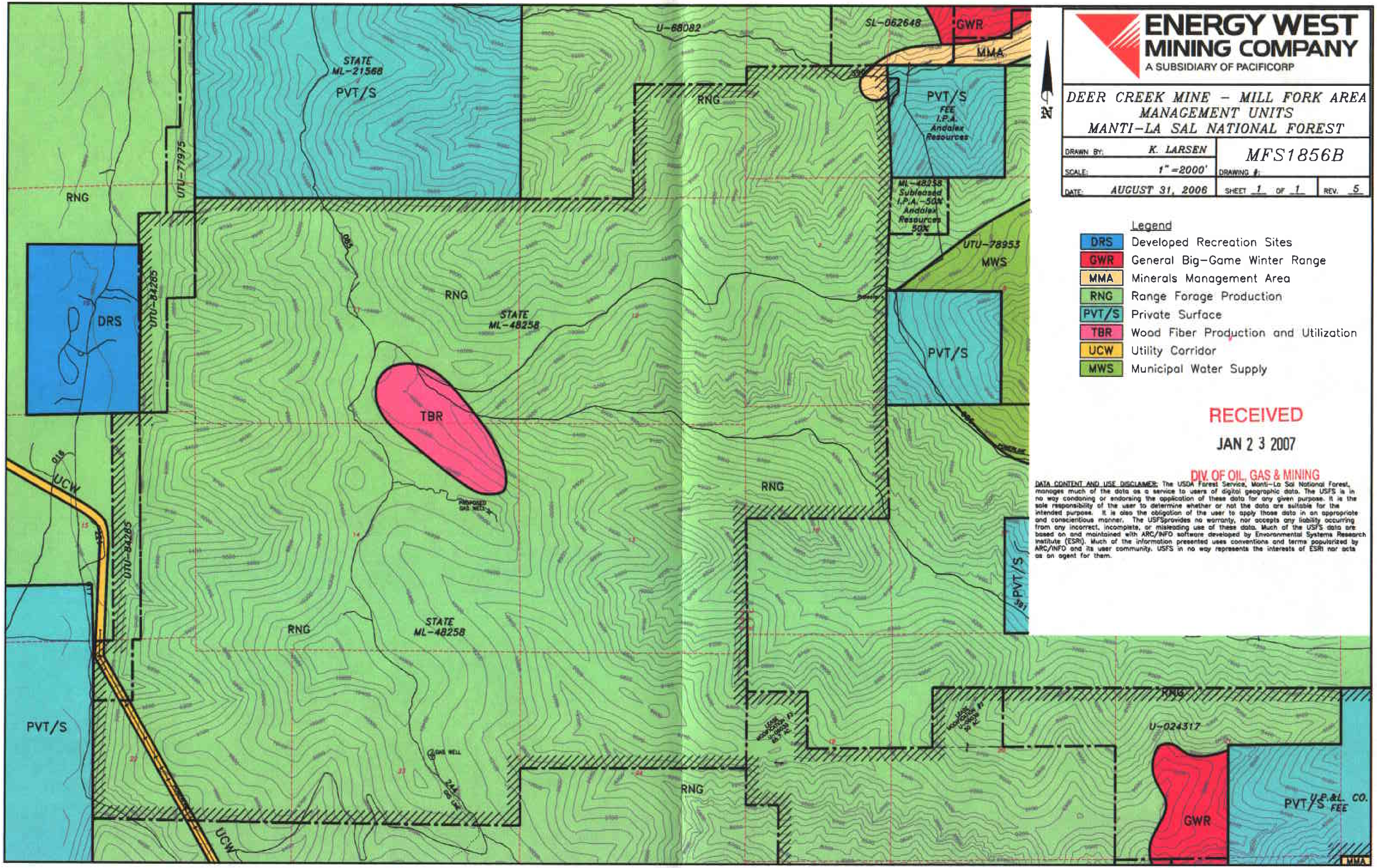
ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP
DEER CREEK MINE – MILL FORK AREA
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MANTI-LA SAL NATIONAL FOREST
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SCALE: 1" =2000'
DATE: AUGUST 31, 2006
MFS1856B
DRAWING #:
SHEET 1 OF 1
REV. 5
N
Legend
DRS Developed Recreation Sites
GWR General Big-Game Winter Range
MMA Minerals Management Area
RNG Range Forage Production
PVT/S Private Surface
TBR Wood Fiber Production and Utilization
UCW Utility Corridor
MWS Municipal Water Supply
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DATA CONTENT AND USE DISCLAIMER: The USDA Forest Service, Manti-La Sal National Forest, manages much of the data as a service to users of digital geographic data. The USFS is in no way condoning or endorsing the application of these data for any given purpose. It is the sole responsibility of the user to determine whether or not the data are suitable for the intended purpose. It is also the obligation of the user to apply those data in an appropriate and conscientious manner. The USFSprovides no warranty, nor accepts any liability occurring from any incorrect, incomplete, or misleading use of these data. Much of the USFS data are based on and maintained with ARC/INFO software developed by Environmental Systems Research Institute (ESRI). Much of the information presented uses conventions and terms popularized by ARC/INFO and its user community. USFS in no way represents the interests of ESRI nor acts as an agent for them.
STATE
ML-21568
PVT/S
U-68082
SL-062648
GWR
MMA
RNG
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FEE
I.P.A.
Andalex
Resources
ML-48258
Subleased
I.P.A.-50%
Andalex
Resources
50%
UTU-78953
MWS
UTU-77975
UTU-84285
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GAS WELL
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