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File orig: Deer Creek Catalog #2 + 6
cc → ~~Lowell~~ Dianne

United States Department of the Interior
OFFICE OF SURFACE MINING
Reclamation and Enforcement
BROOKS TOWERS
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DENVER, COLORADO 80202

RECEIVED
MAR 18 1985
DIVISION OF OIL GAS & MINING

March 15, 1985

Dr. Dianne Nielson, Director
Division of Oil, Gas and Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

Dear Dr. Nielson:

I have enclosed a draft final copy of the technical analysis (TA) for the Deer Creek Mine in Emery County, Utah. We have incorporated the comments of the Division which were generated as a result of the Wilberg Mine permit approval and subsequent clarification meetings held at the Division offices last year. Please review the document for accuracy and compliance with the Utah regulatory requirements.

The Utah repermitting schedule calls for Administrative approval of the Deer Creek Mine permit application package by March 22, 1985. Because of delayed responses by the applicant to critical design issues, the preparation and review schedule for the decision document has been compressed.

If you or your staff have any questions, please contact either Louis Hamm at (303) 844-5656 or Walter Swain at (303) 844-3806.

Sincerely,

[signature] for

William J. Kovacic
Chief, Mine Plan Review Branch

cc: Robert Hagen, OSM - Albuquerque
Pamela Grubaugh-Littig, DOGM

TECHNICAL ANALYSIS

DEER CREEK MINE

EMERY COUNTY, UTAH

UTAH POWER & LIGHT COMPANY

INTRODUCTION

Utah Power & Light Company of Salt Lake City, Utah, has submitted an underground mining and reclamation permit application for the Deer Creek Mine complex in Emery County, Utah, in compliance with the Coal Mining and Reclamation Permanent Program (Chapter I) of the State of Utah. The permit area and mining plan area consist of 14,620 acres and will be mined to the year 2032 (life of mine). The term of permit is five years, with right of successive renewal. The applicant anticipates adding approximately 2,280 acres (northern leases U-06039, SL-051221, and U-024317) at a later date during life-of-mine. The Deer Creek Mine is presently operating under an approved mining permit issued by the State of Utah, Division of Oil, Gas and Mining (Act/015/018A) issued on May 11, 1978, and with approval under 30 CFR 211 issued by the U.S. Geological Survey on January 23, 1978 (MSHA I.D. No. 42-00121).

The Deer Creek Mine is one of three separate mines owned by Utah Power & Light Company (UP&L). These mines are located in the area of East Mountain (T17S, R7E), and are largely within the Manti-La Sal National

Forest. The three mines are the Wilberg, Deer Creek and Des-Bee-Dove, containing three mineable coal seams: Hiawatha, Cottonwood and Blind Canyon. Operations of the Deer Creek Mine overlap those of the Wilberg Mine. The coal reserves within the (lower) Hiawatha Seam are being mined predominantly by the Wilberg Mine and the (upper) Blind Canyon coal reserves are mined predominantly by the Deer Creek Mine. A third seam, the Cottonwood, occurs between the Hiawatha and Blind Canyon seams and is mined only in the south part of the Wilberg Mine. The anticipated life-of-mine production is 110 MM tons. Total in-place reserves within the Deer Creek Mine boundaries are approximately 186 MM tons which includes 51 MM tons to be mined from the Hiawatha Seam. Approximately 65% of the Deer Creek recoverable coal reserve will be extracted by long-wall mining systems; the remaining 35 percent will be extracted by room-and-pillar methods. Estimated annual production will average 2.6 MM tons through the first decade of the next century.

Utah Power & Light Company purchased the Deer Creek Mine in 1977 from Peabody Coal Company, which had acquired leases on the Deer Creek property and begun operations in 1969. Private coal mining operations had taken place on fee land in Deer Creek Canyon prior to 1946 when the first federal coal lease was issued in this area.

The Deer Creek Mine surface facilities are located on a 25-acre site at the junction of Deer Creek Canyon and Elk Canyon. Surface facilities for the Deer Creek Mine operation include coal handling facilities with a coal surge bin, transfer tower, breaker and crusher stations, coal weigh bin, truck loadout, and conveyors; embankment fills that support material storage; mine office and bathhouse facilities, parking, and a warehouse-shop building; sediment control impoundment; and miscellaneous features such as drainage structures. There are some 11 portals associated with the mine, most of which are for ventilation purposes. Ventilation portals create little surface disturbances since they are constructed from within the mine.

Coal and Special-Use Leases

The approximately 14,620 acres contained in the Deer Creek Mine permit area cover all or part of the following leases:

SL-064607-064621	613.92 acres
SL-064900	160.00 acres
U-1358	320.00 acres
SL-070645, U-02292	2,560.00 acres
U-084923	2,252.42 acres
U-084924	1,211.48 acres
U-083066	2,485.00 acres
U-040151	1,720.00 acres

U-04[redacted]5	4[redacted]0 acres
U-014275	80.00 acres
U-024319	1,040.00 acres
U-47979	1,063.38 acres

A separate group of leases to the north of the main permit area body (U-06039, SL-051221 and U-024317) are not included in the permit area because the required level of detail and corridor information have not been provided by the applicant (UMC 784.11; correspondence to the applicant from OSM on December 28, 1984; correspondence to OSM from applicant on January 22, 1985).

Other owners of coal to be mined in the Deer Creek permit area include:

The Estate of Malcolm McKinnon	440.00 acres
Cooperative Security Corp.	425.00 acres
Utah Power and Light Company	453.00 acres

The following special-use lease agreement is in effect within the permit area:

State of Utah Special Use	
Lease Agreement No. 284	160.00 acres

Description of Operations

The Deer Creek Mine is a multi-seam operation utilizing long-wall and room-and-pillar techniques for coal extraction. Two long-wall systems and three continuous mining units are currently being utilized. The continuous miners will be used for development of mains and panels and for retreat mining in pillar sections and in mains and submains once mining in an area is complete. The applicant intends to mine all areas within the mine limits, constrained only by safety conditions.

The seams which will be recovered are the Blind Canyon seam and the Hiawatha seam. Mining, as presently planned, will recover the uppermost seam first, then the lower seam. Approximately 3,060 acres of mineable coal in the Hiawatha seam and 11,590 acres in the Blind Canyon seam are accessible from the Deer Creek Mine (Attached Figure 2-3). The minimum seam thickness which can be economically recovered is 5 feet. This limit defines the horizontal extent of mining in many areas. The maximum thickness of coal to be recovered has not been identified by the applicant, although the USBM Information Circular identifies 10 feet of coal being mined in the long-wall sections. The thickness of coal in the mine area reaches 16 feet, although 10 feet is average.

Geologic Setting

The three UP&L mines, including Deer Creek, are located in the central

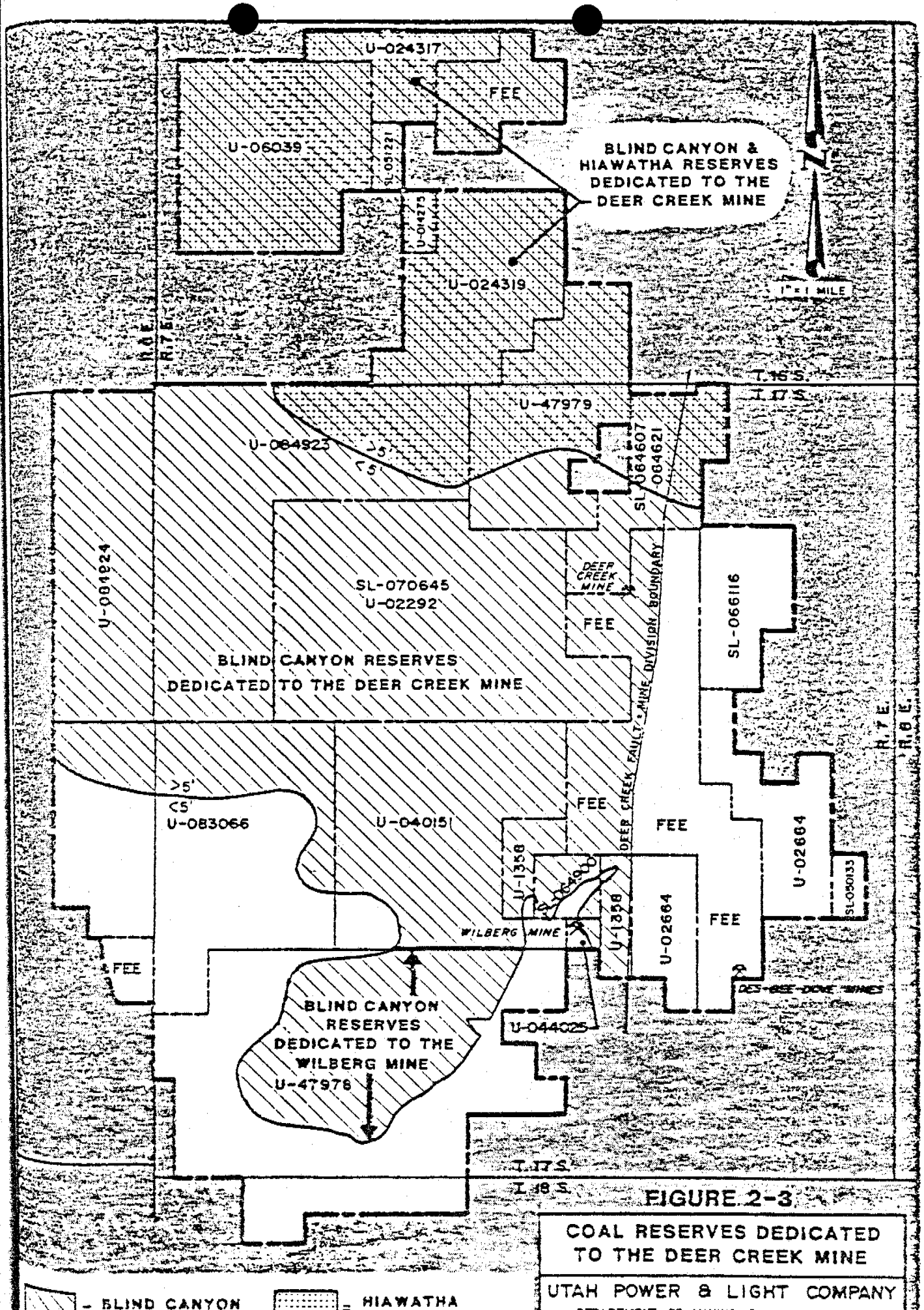

FIGURE 2-3

COAL RESERVES DEDICATED TO THE DEER CREEK MINE

UTAH POWER & LIGHT COMPANY
DEPARTMENT OF MINING & EXPLORATION

Utah coal basin. The coal seams are located in the lower 150 feet of the Blackhawk Formation in the Mesa Verde Group. The Hiawatha seam is located on or near the Starpoint Sandstone, which is a marker bed between the Blackhawk Formation and the Mancos Shale. The Blind Canyon seam is located 14 to 190 feet above the Hiawatha seam. Approximately 800 feet above the Starpoint Sandstone is the Castlegate Sandstone. This massive sandstone is almost 200 feet thick in this area and is a prominent cliff former. Above this is the Price River Formation, which is sandstone-interbedded shale and conglomerate and is approximately 350 feet thick. Above this is the North Horn Formation, which is interbedded shales and sandstones and is approximately 750 feet thick. Finally, capping East Mountain in the Deer Creek Mine area is the Flagstaff Limestone, approximately 100 feet thick. Figure 22 (permit application package (PAP)) (Vol. 1, Attached), shows the general stratigraphy of the mine area. Total thickness of all formations is approximately 2,200 feet. East Mountain is very dissected and overburden above the coal seam is usually much less than the total thickness of all formations.

Renewable Resources and Structures

Several types of structures occur above the mine, including buildings, roads, and a landing strip. The buildings are occupied periodically since access to the top of East Mountain is restricted to the summer months. Photographs of the structures are given in Appendix XI (PAP, Vol. 3). Most of the structures are wood -framed; some have block or

Figure 2-2
Stratigraphy of East Mountain
(Doelling, 1972)

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

Generalized section of rock formations, Wasatch Plateau coal field.

concrete slab foundations. A small landing strip is located in the northwest corner of Section 17 overlying the mine. A 345 KV transmission line parallels Meetinghouse Canyon and traverses the permit area from east to west. No oil or gas wells, pipelines, or other utility structures which would be affected by surface subsidence exist within the Deer Creek Mine area, with the exception of a small waterline from Burnt Tree Spring to a nearby cabin. Several unimproved roads cross the top of the mine and provide access to the cabins and most grazing areas.

Renewable resources overlying the underground mine include springs, seeps, grazing land, timber and wildlife. The springs and seeps are shown on Map 2-12 (PAP, Vol. 6). The groundwater section (Chapter III) of this technical analysis provides a detailed description of the hydrologic characteristics of the springs and seeps (also see the following section, Hydrologic Resources).

The wildlife land uses above the mine include deer winter and summer range, elk winter range, and raptor habitat (PAP, Vol. 6, Map 2-18). The range lands are widespread over the surface of the mine. The raptor habitat is associated with the sandstone outcrops.

Hydrologic Resources

The Deer Creek permit area includes tributary drainages of Huntington and Cottonwood Creeks (see Cumulative Hydrologic Impact Analysis -- CHIA --

documents including the CHIA summary, Attachment A of this document, concerning these basins for additional information). Huntington Creek tributaries within the permit area include:

Deer Creek	3,710 acres	75% within permit area
Meetinghouse Canyon Creek	5,560 acres	83% within permit area
Rilda Canyon Creek	5,240 acres	50% within permit area

Cottonwood Creek tributaries within the permit area include:

North Cottonwood Creek	12,550 acres	21% within permit area
Left Fork Grimes Wash	2,270 acres	100% within permit area
Right Fork Grimes Wash	1,220 acres	100% within permit area

The Deer Creek Mine facilities area is located in the Deer Creek basin and occupies the valley floor. Deer Creek and adjacent small tributaries are passed underneath the facilities area in a seven-foot-diameter culvert. The culvert and the associated diversions collect runoff from 3,100 acres of the Deer Creek basin. Runoff from 123 acres around and including the facilities area is controlled by a storm drainage system that discharges to a sediment pond with a volume of 12.0 acre-feet. The facilities area constitutes a 20.0-acre disturbance without the conveyor system which extends 1,300 feet to the Huntington Power Plant coal pile.

No mining-related disturbances, except for ventilation portals, exist on the surface of the other basins within the permit area. Subsidence from mining operations in the Deer Creek and Wilberg Mines has caused a general lowering of the land surface within the permit area. Changes in surface elevation have been recorded throughout the permit area (see Subsidence Monitoring, Chapter IX of this document), and as yet no significant changes have been noted in either drainage basin topography or channel morphology.

Both the Left Fork of Grimes Wash and Deer Creek are perennial streams within the permit area as indicated by current monitoring data. Each is sustained by groundwater inflows derived from numerous springs in the upper portions of each basin. Both Meetinghouse Canyon Creek and Rilda Canyon Creek are observed to be perennial or intermittent streams, ~~although only limited data are not available~~. Meetinghouse Canyon Creek is considered to be perennial below Elk Spring. Rilda Canyon Creek is considered to be perennial below the confluence of the left and right forks (PAP, Vol. 6, Map 2-11). All streams within the permit area experience annual snowmelt runoff. Maximum peak flows result from thunderstorms.

Surface-water quality data have been collected by UP&L since 1978 in conjunction with the hydrologic monitoring program. Water quality parametersmeasured include pH, conductivity, total dissolved solids (TDS), total suspended solids (TSS), iron and manganese. Water quality is good, with measured values falling within a range acceptable for drinking water.

The geohydrologic system within the permit area consists of an isolated recharge zone on the top of East Mountain associated with the Flagstaff Limestone. This formation is nearly level and is highly fractured, which allows for vertical transport of water with little lateral movement or runoff.

Significant recharge occurs in the Flagstaff Limestone during the March through June snowmelt period. Few springs occur in this formation.

Below the Flagstaff Limestone is the North Horn Formation, composed of a sedimentary sequence of variegated shales, sandstone, conglomerates, and fresh-water limestone. A large number of springs are formed in the North Horn formation where shales form relatively impermeable layers that halt the downward migration of some of the ground water and transport it to the outcrop laterally. A ~~respective~~ resistive shale bench just below the Flagstaff Limstone is a notable topographic feature in the Deer Creek and Grimes Wash basins. Faults and fractures in the North Horn Formation provide a groundwater connection to lower formations on East Mountain.

Springs also occur in the Price River Formation for the same reasons that they are found in the North Horn Formation, but to a more limited extent. The Price River Formation has a similar composition to the North Horn Formation, but with an increasing amount of sandstone in its lower portions. Springs are found where a confining layer of shale forces lateral movement of groundwater within the formation.

A conceptual model of the groundwater system on East Mountain is a cascade of water from the recharge zone to a number of aquifers perched atop shale layers in the North Horn and Price River Formations. Where these shale layers outcrop, springs are likely to occur. ~~The nonuniform nature of~~ Fluctuations in the shale layers together with faulting and fracturing complicate this conceptual picture. An accurate accounting of groundwater as it moves vertically and laterally on East Mountain cannot be developed at this time, since the hydrologic data have not been collected over a long enough period of time. Also, the streamflow measurement techniques used by the applicant for Deer Creek and Grimes Wash are only capable of measuring moderate-to-low flow conditions and have not recorded annual peak runoff. However, the recession period of the flow has ~~generally~~ been measured accurately.

Water quality for East Mountain springs is measured quarterly as a part of the hydrologic monitoring program. Measurements indicate that the water quality of springs meets drinking-water standards.

The Deer Creek Mine is in contact with aquifers in the Blackhawk Formation. Ground-water inflows in the mine have been associated with sandstone on the roof of the coal seam, faults and fractures. The coal seams are in contact with ancient stream channels (now sandstone layers and stringers) in the Blackhawk Formation. Faults within the mine are also a source of water, as are joints and fractures. The fault system on East Mountain probably enhances local permeabilities in the area of the fault plane, providing lateral and vertical flow channels within and across geologic units. Mine dewatering

consists of water dra[redacted]ed from aquifers in the Blackh[redacted]k Formation and from natural recharge to these aquifers from the upper formations on East Mountain.

In-mine water quality for the Deer Creek Mine is measured as water is discharged from the mine to a pipeline which conveys it to UP&L's Huntington Power Plant. TDS concentrations are slightly above standards for drinking water (590 ppm versus 500 ppm), while other water quality parameters fall within the standards. All water leaving the Deer Creek Mine is used in the cooling towers at the power plant. UP&L does not have a water right to the outflow of the mine, but uses the water by exchange with water rights that it does have on Huntington Creek.

Vegetative Resources

The permit area includes five major vegetation types: mixed conifer, pinyon-juniper, sagebrush, grass, and riparian. Mixed conifer primarily occurs at higher elevations and on north-facing slopes, and is the most extensive floral community. The next most extensive community is pinyon-juniper, which occurs on steep rocky slopes with a southern exposure and on more gentle terrain at lower elevations. The sagebrush and grass communities occur at higher elevations on drier sites. The riparian community occurs only along Deer Creek as it exits the northeastern side of the permit area.

Because this is an active mine and most disturbances have already occurred, baseline vegetation data for disturbed areas were impossible to obtain. Therefore, only reference areas were selected (and sampled) from representative locations around the disturbance area.

The main facility area including the conveyor system has displaced a total of 25 acres of vegetation, including 19.5 acres of pinyon-juniper, 4.0 acres of mixed conifer, and 1.5 acres of riparian vegetation. It is expected that this acreage will be lost for the duration of mining to the point that reclamation is complete. Comparisons of similarity between each of the three reference areas and estimates of the predisturbance characteristics of respective disturbed communities are presented on pages 2-118 and 2-119 (PAP, Vol. 1).

Field investigations revealed no threatened or endangered species present near any area of disturbance. The Office of Endangered Species, U.S. Fish and Wildlife Service, provided a letter on January 10, 1984, stating that it has found no potential conflict with the proposed action.

Soils

Soils occurring within the proposed permit area are composed of three soil mapping units. These units are Typic Chryochrepts-Lithic Cryorthents--Rock Outcrop, loamy skeletal shallow association (40 to 60 percent slopes); Pachic Cryoborolls, loamy and loamy skeletal (10 to 25 percent slopes); and Typic Cryoborolls, loamy and loamy skeletal (25 to 40 percent slopes).

Due to previous mining operations, little soil remains on disturbed areas. The final graded surface to be used as a seedbed will be composed primarily of cut, fill, and mine-generated spoil materials which include some coal waste in small proportions from spillage over time. The pH of selected spoil samples ranged from 7.6 to 8.4, with coal waste samples having values of 8.1 and 8.2 and the one road-slag sample having a pH of 10.9. Electrical conductivity (EC) values for coal wastes and spoil samples taken in 1980 and 1983, respectively, varied widely. The 1983 values were all less than 0.6, while the 1980 values for spoil material ranged from 0.5 mmhos/cm to 9.0 mmhos/cm, with the coal waste and slag values ranging from 0.7 mmhos/cm to 7.0 mmhos/cm. Sodium adsorption ratios (SAR) were relatively low for most materials analyzed (<2.3). Nitrogen, phosphorous, and potassium levels were generally low for all samples analyzed. Percent saturation values for 1983 fill samples ranged from 20 to 30, indicating coarse spoils with relatively low water-holding capacities. Textures of 1980 fill samples are primarily sandy loam, with two samples being loamy. Textures of 1983 fill samples are sandy clay loam and loamy sand.

The soil units which are found adjacent to the disturbed area include the Comodore-Beenom Complex (Co-Be), 40 to 60 percent slopes, and the Rock Outcrop-Rubble Land-Sunup Gravelly Loam (Ro-R-S), 40 to 70 percent slopes. The Co soil (50 percent of unit) is shallow and well drained and primarily supports Douglas fir and mixed conifer vegetation. The Be soil (40 percent of

unit) is also shallow and well drained and primarily supports grass vegetation. The Rock Outcrop developed from sandstone and shale. The Rubble Land portion consists primarily of sandstone boulders (75 percent of unit). The Sunup soils (25 percent of unit) are shallow and formed in material derived from sandstone. Permeability is moderately rapid in the soil above the rock.

Fish and Wildlife Resources

Wildlife species inhabiting the mine permit area and vicinity are typical for this region of the Wasatch Plateau; no critical habitats for threatened or endangered wildlife species occur in the areas disturbed, or to be disturbed, by mining operations. The bald eagle is a winter visitor to the region, but will not be affected by mine activities.

Riparian habitat along Deer Creek is considered by the Utah Division of Wildlife Resources (UDWR) to be of critical value to the area's wildlife resources. No fish species occur in Deer Creek; however, the drainage is tributary to Huntington Creek, which does support trout. Several game and high-interest wildlife species inhabit the general vicinity of the mine permit area. Most, except for mule deer and several species of raptors, will not likely be exposed to any impact resulting from mine operations (see Chapter VII of this document).

Cliffs in the vicinity of the mine portal and facilities area represent potentially valuable cliff-nesting habitat for several species of raptors (e.g.

golden eagle, red-tailed hawk, and prairie falcon). Wooded habitats within the permit area also provide nest sites for tree-nesting species such as northern goshawk, Cooper's hawk, sharp-shinned hawk, red-tailed hawk, American kestrel, and screech owl. A 1981 U.S. Fish and Wildlife Service raptor survey for cliff-nesting species identified a group of four buteo nests (#48-three inactive; one active red-tailed hawk nest) approximately 1,500 feet from the Deer Creek mine portal area. The red-tailed hawk nest was inactive in 1982. An inactive raven nest was also identified aproximately 700 feet from the South Fork Meetinghouse Canyon breakout. Map 2-18 (PAP, Vol. 6) of the application gives the locations of all nest sites. The USFWS has made recommendations concerning protection of raptor nest sites on or in the vicinity of the permit area in its letter dated July 10, 1984.

Mule deer occur within the mine plan area year-round. During the summer they are found predominantly in habitats at the mid to upper elevations in the permit area (e.g., mixed conifer, sagebrush, and grassland). In the winter, habitats (especially pinyon-juniper) at the lower elevations along the benches and slopes of the southern and eastern portions of the East Mountain in the vicinity of the Deer Creek mine are designated by the UDWR as high-priority and critical mule deer winter range. Map 2-19 (PAP, Vol. 6) shows the location of mule deer winter range in relation to the mine permit area. Approximately the last half-mile of the Deer Creek overland conveyor to the Huntington Power Plant traverses critical mule deer winter range. Also, approximately one mile of the access road (from the main highway) passes

through critical mule deer winter range. A "critical" designation is given to "sensitive use areas" which are considered necessary to sustain the existence and perpetuation of one or more species of wildlife during crucial periods in their life cycle. For mule deer, critical winter range represents those areas where mule deer congregate during the most severe winters.

Land Use

Surface ownership of the Deer Creek portal and facilities area is private and is leased to UP&L. The majority of the remaining land within the mine permit area is either privately owned or is part of the Manti-La Sal National Forest. Mineral ownership within the permit area consists of Federal and fee coal. No oil or gas wells have been drilled within the permit area, and no gas or oil fields are known on the south end of East Mountain.

Premining land uses in the disturbed areas associated with the Deer Creek mine were livestock grazing and wildlife habitat. Land use on and adjacent to the permit area consists of recreation, mining, wildlife habitat, and limited livestock grazing. Land use and local land use classifications are shown on Map 2-18 (PAP, Vol. 6).

Recreational use of the permit area occurs primarily as hunting and sight-seeing on East Mountain.

Coal mining in Deer Creek Canyon has occurred since the early 1940's. UP&L

has operated the Deer Creek Mine since 1977. Prior to the development of the Deer Creek Mine, mining in the Blind Canyon coal seam removed about 394,000 tons of coal.

No farming or commercial forest harvesting has occurred within the permit area. In the vicinity of the mine facilities, steep rocky terrain, poor soils, and low precipitation preclude any potential for farming. The rugged terrain and rocky cliffs also limit livestock grazing in the vicinity of the mine portal and facilities. BLM grazing allotments in the vicinity of the mine portal area are judged in poor and declining condition. Range condition for USFS land on East Mountain above the mine portal area is judged as good, with a static to upward trend. Total forage productivity of the pinyon-juniper vegetation type ranges from 25 to 100 lbs/acre (dry weight on the steep rocky slopes) to 100 to 325 lbs/acre on the benches, as estimated by the applicant. Mixed conifer and riparian range productivity is 167 to 290 lbs/acre (dry weight) and 1,500 to 2,500 lbs/acre (dry weight), respectively.

I. TOPSOIL

1.1 Description of Applicant's Proposal

The applicant provided a soil map and corresponding discussion which generally characterized the soils (to subgroup) occurring over the entire permit area (Vol. 1, pp. 2-112 to 2-113). The mapping corresponded basically to an Order III-IV Soil Conservation Service (SCS) survey. With the exception of possible

subsidence effects, these soils will not be disturbed by mining.

The surface area affected by the existing operations had been disturbed by pre-law mining. There is no soil on this redisturbed area, so a soil survey was not conducted. A sampling program was begun in 1980 to characterize the fill materials which would serve as the planting medium following final grading (Vol. 1, pp. 2-103 to 2-109). Additional sampling was conducted in 1983 to further evaluate the physical and chemical characteristics of fill material and waste rock.

Existing cut-and-fill material will constitute the majority of the seedbed material following grading, since the proposed mine is located on a previously disturbed area where no topsoil was salvaged. Most of this medium, given the absence of soil materials (see 817.103), is considered suitable for reclamation, based on chemical and physical analyses. Electrical conductivity, pH, and sodium adsorption ratios are within acceptable limits. Textures range from sandy clay loam to loamy sand. Water-holding capacities are low (Vol. 2, Table 1, pp. 4-14, 4-15).

Because soil for reclamation is lacking, the applicant proposes to attempt to develop a substitute "soil" by temporarily reclaiming various existing fill slopes which will not be disturbed during mining (see Section X, Revegetation). It is theorized that the surface material of the slopes, through temporary reclamation, will increase in organic matter content and microbial populations, thereby providing a planting medium superior to endemic seedbed materials. At the onset of grading, this topsoil would be stripped from reclaimed slopes and stockpiled. As grading is completed and cut-and-

fill seedbed materials are distributed, the topsoil would be redistributed on newly graded surfaces to a depth of 6 to 12 inches at random locations throughout the site to enhance revegetation potential.

Following grading, all seedbed materials will be sampled to determine fertilizer requirements and detect the presence of localized high electrical con- ductivity and sodium adsorption ratios values (Vol. 2, p. 4-22). Fertilizer

will be broadcast prior to planting according to recommendations based on soil test results.

1.2 Evaluation of Compliance

UMC 817.21 Topsoil: General Requirements

The applicant has complied with the requirements of this section.

UMC 817.22 Topsoil: Removal

The applicant has complied with the requirements of this section.

UMC 817.23 Topsoil: Storage

The applicant has complied with the requirements of this section.

UMC 817.24 Topsoil: Redistribution

The applicant is in compliance with the requirements of this section.

UMC 817.25 Topsoil: Nutrients and Soil Amendments

The applicant proposes to conduct soil sampling (Vol. 2, p 4-22) for fertility analysis following final regrading. Two samples from the 0 to 20 inch depth will be composited per acre for analysis. In addition, one core per fill with samples at two-foot intervals will be analyzed to detect aberrant SAR levels. Given this sampling program, the applicant has complied with the requirements of this section.

II. HYDROLOGIC BALANCE - SURFACE WATER

2.1 Description of Applicant's Proposal

The Deer Creek Mine facility is located on a 25-acre site at the junction of Deer Creek Canyon and Elk Canyon. This area contains the entrance to the mine and all surface facilities used for support of mine operations. The site is characterized by moderate vegetation and rugged, steep terrain. In addition to the main mine entrance in Deer Creek Canyon, there are five air intakes in Meetinghouse Canyon with two more proposed. These intakes are constructed from within the mine and no surface disturbance occurs beyond the entrance.

Diversion ditches and a single sedimentation pond are used at the Deer Creek Mine to protect the surface-water hydrologic balance. The applicant proposes to continue the use of the existing drainage facilities for the duration of mining operations. These drainage facilities consist of two separate systems which are classified by the applicant as "undisturbed" and "disturbed" collection systems. The "undisturbed" system collects uncontaminated water above the portal site and from side slopes adjacent to the site and conveys it underneath the disturbed area into the natural channel of Deer Creek. The "disturbed" collection system consists of a network of open ditches and culverts which collect runoff water from areas disturbed by human activity and drain into a sedimentation pond.

The principal undisturbed drainage, Deer Creek, is carried by a 7-foot-diameter culvert from a point about 800 feet southwest of the mine portal and discharged into the natural Deer Creek channel downstream of the sedimentation pond. The culvert is 2,800 feet long with a vertical drop of 420 feet. A secondary drainage, Deer Drainage, is diverted into a 36-inch-diameter culvert which feeds into the main Deer Creek culvert. The applicant has pre- pared designs to increase the carrying capacity of the Deer Drainage culvert. He proposes the install~~ment~~ation of an additional 54-inch culvert parallel to the existing culvert. A 30-inch culvert now lies in the drainage channel of Elk Canyon Creek and diverts runoff to the main 7-foot diameter Deer Creek culvert. Two side drainages from the south side of Elk Canyon Creek are diverted into this feeder culvert. A terrace on the south side of

the facilities area diverts runoff to the main bypass culvert. All diversions are protected at the intake by concrete retaining walls and catch basins with trash racks. The Deer Creek culvert was designed to pass the 50-year, 24-hour storm event. The two-side drainage culverts were designed to pass the 10-year, 24-hour storm event. Map 3-12 ~~permit application package~~ (PAP), (Vol. 7) shows the layout of the system. To increase the carrying capacity of the Elk Canyon Creek diversion system, the applicant has committed to install a 42-inch culvert parallel to the existing culvert. The "disturbed" collection system collects runoff from roads, parking lots, storage areas, and the portal area and conveys it into a sedimentation pond located just downstream of the junction of Deer Creek and Elk Canyon Creek. This system consists of concrete catch basins, small-diameter culverts, and open ditches designed to collect and pass peak flow from a 10-year, 24-hour precipitation event. The system is shown on Map 3-13 (PAP, Vol. 7).

The sediment pond is situated in the approximate location of the old Deer Creek channel just downstream of its confluence with Elk Canyon Creek. The pond design capacity is 14.0 acre-feet: 2.0 acre-feet for sediment and 12.0 acre-feet for runoff. The pond will completely impound runoff from the 10-year, 24-hour runoff event of 2.25 inches. The runoff volume was determined by the applicant using a runoff curve number (CN) of 81 and a drainage area of 123.0 acres. All runoff from 20 acres of disturbed area is collected and routed through the pond. Considering this 20 acres, a sediment storage volume of 0.10 acre-foot per acre of disturbed land was provided. Map 3-15 (PAP, Vol. 7) shows the design layout of the pond.

The sediment pond was designed with an operational spillway consisting of a single 24-inch culvert and manually operated lift gate/riser for pond dewatering. A grouted riprap emergency spillway provides release of runoff from a 100-year, 24-hour precipitation event. The pond is located against the hard rock strata of the Deer Creek Canyon. Pond slopes vary depending on the material of which they are constructed. Slopes excavated in rock are nearly vertical, with a 1 horizontal to 4 vertical slope. Fill slopes were designed at 2.5 horizontal to 1 vertical. The riprapped upstream dam slope was designed at 2.5 horizontal to 1 vertical; the downstream dam slope design is 2 horizontal to 1 vertical. Design details of the dewatering device, spillway, and dam are shown on Drawing 3-16 (PAP, Vol. 7).

Reclamation at the Deer Creek Mine facilities site will consist of removing the temporary drainage system, sediment pond, and other structural facilities. Land slopes in the area will be recontoured, with the mine area fill and waste rock disposal fill left in place. Riprapped channels with 10-to 20-foot base widths and 2:1 side slopes are proposed for reconstructing the main Deer Creek, Deer Drainage, and Elk Canyon Creek drainages. These channels are designed for the 100-year, 24-hour storm event.

The two stages of reclamation proposed for the Deer Creek Mine drainage system are shown on Map 4-1 (PAP, Vol. 7). During Stage I, reconstruction of the channels will be completed above the sediment pond area. The sediment pond will be left in place during this stage to serve as a sediment control for the disturbed areas. An existing arch culvert (part of the old bypass system) will be used to convey the Deer Creek and Elk Canyon Creek flows past the pond. During Stage II, the arch culvert will be removed and the Deer Creek and Elk Canyon Creek channels will be completed through the area where the sediment pond is now located.

A significant feature of the reclamation drainage plan is the passage of Deer Creek flows across the mine area fill. Leaving this fill in place presents a problem for channel stability due to the steep gradient at the down-valley face of the fill. To help address this problem, the applicant proposes to route the Deer Creek channel along the north side of the fill, then over a sandstone outcrop opposite the Elk Canyon drainage confluence. Construction will require cutting a channel 30 to 40 feet wide in the Starpoint Sandstone. Water will flow from a riprap-lined channel constructed on fill to the channel on the rock ledge and over the edge of a cliff. Loose material will be removed and the channel widened where it flows off the cliff edge. The Starpoint Sandstone is resistant bedrock that will form a stable drop for the new channel.

A riprap-lined splash basin will be used at the base of the cliff to dissipate energy and transition the Deer Creek flows into those of Elk Canyon Creek (Map

4-1 PAP, Vol. 7). During Stage I reclamation the energy dissipator will include a splash basin at the outlet of the culvert from Elk Canyon. This splash basin is designed for the 10-year, 24-hour event. Map 4-1 indicates that the splash basin will be removed for Stage II reclamation.

The applicant currently monitors flows in Deer Creek above and below the mine facilities, and at Grimes Wash above and below the Wilberg Mine facilities. During periods of runoff, monthly discharge measurements and grab samples for water quality analysis are collected. Samples are analyzed for pH, conductivity, total dissolved solids, total suspended solids, total iron and manganese. The monitoring locations are permanent, allowing collection of the data from a consistent location. The data are collected on a regular schedule to aid in identifying seasonal trends and variation from year to year. Measuring flumes used at both the Deer Creek and Grimes Wash locations are typically overtopped during peak runoff.

Huntington Creek is monitored by the USGS and UP&L above and below the Deer Creek confluence. Flow is recorded continuously and water-quality samples are taken monthly. The data are used in conjunction with the regulation of Electric Lake for the Huntington Power Plant and other water users.

Deer Creek Mine has been issued NPDES permit number UT-0023604 for the sedimentation pond at the mine. The applicant indicates that the pond has not discharged to date. The applicant is required to monitor and report discharge quality under the NPDES regulations.

2.2 Evaluation of Compliance of Proposal

UMC 817.41 Hydrologic Balance: General Requirements

The applicant's compliance with this regulation is discussed in Chapter IV.

UMC 817.42 Hydrologic Balance: Water Quality Standards and Effluent Limitations

All surface drainage from the Deer Creek Mine is passed through the sedimentation pond. There is no uncontrolled discharge to the environment from the underground workings. Discharge is routed to the Huntington Power Plant as a coolant. Discharges from the sedimentation pond are expected to meet all applicable effluent limitation standards.

UMC 817.43 Hydrologic Balance: Diversions and Conveyance of Overland Flow, Shallow Groundwater Flow, and Ephemeral Streams

The applicant has designed the "disturbed" area runoff collection system at the Deer Creek Mine to pass the 10-year, 24-hour runoff event adequately. The two-year, 24-hour storm was used at the waste rock site. Inspection of the temporary drainage system on Map 3-13 (PAP, Vol. 7) indicates that it has been designed adequately. Adequate channel stability is provided in the system, with flow down steep slopes conveyed in culverts. Energy dissipators are not used at discharge points; however, operation of the drainage system has not

caused any significant outlet scour problems to date.

During Stage I reclamation the existing disturbed area drainage system will be removed and the affected land regraded and revegetated. Drainage from the disturbed area will be routed to the sedimentation pond using two small ditches as shown on Map 4-1 (PAP, Vol. 7). "Ditch B" will be temporary and was designed using a two-year, 24-hour storm. "Ditch A" will be permanent and was designed using the larger 100-year, 24-hour event. Temporary culverts for "Ditch A" and "Ditch B" were designed considering the two-year, 24-hour event. Upon final reclamation (Stage II), all culverts and Ditch B will be removed. The system as designed meets the requirements of this section.

UMC 817.44 Hydrologic Balance: Stream Channel Diversions

The applicant has designed the "undisturbed" runoff system for Deer Creek to pass the 50-year, 24-hour runoff event. This event is larger than required by regulations, which only specify the use of a 10-year, 24-hour event for temporary diversions of stream channels. The peak flow at the main Deer Creek diversion was based on hydrologic analysis conducted by Stone and Webster, Inc. (report dated April 14, 1978) that gave a peak flow of 805 cfs. The main Deer Creek diversion is adequate to convey this flow.

The existing diversion culverts of Deer Drainage and Elk Canyon Creek are 36-inches and 30-inches in diameter, respectively. Neither culvert is capable of conveying the required 10-year, 24-hour design storm. The applicant has

presented revised designs for the two drainages on Map 3-12 and page 3-48A of the PAP. The applicant's calculations are presented in Appendix VII of the PAP. In order to convey the 10-year, 24-hour storm, the applicant proposes to install a 42-inch diameter culvert parallel to the existing culvert in Elk Canyon. Although the applicant has designed a 54-inch diameter culvert to be installed parallel to the existing Deer Drainage culvert (Map 3-12), he requests a variance from its installation (page 3-48A). The basis for the request is (1) conservative runoff figures, (2) additional construction costs, and (3) six years experience with no overtopping of the existing 36-inch pipe. However, the regulatory authority denies the request for variance on the following basis: (1) conservative figures are an integral part of these designs. In the event of a major storm (i.e., rainfall over snowmelt), the applicant's chosen hydrologic coefficients may not be conservative, (2) the design life of the structures is in excess of 40 years, and six years of experience does not provide a valid basis for any determination, and (3) failure by overtopping would result in damage to the facilities area and the rapid filling of the sedimentation pond with sediment. The sediment pond would not contain the 10-year, 24-hour storm event, nor would the dewatering pipe function adequately. As a result, a significant possibility of sediment pond failure exists. The applicant shall commit to the installa- tion of the 54-inch CMP in Deer Drainage (Condition 3).

The permanent reclaimed drainage system (Map 4-1) at the Deer Creek Mine has been designed for the 100-year, 24-hour runoff event as required by regulations. Peak flows were determined using the SCS Curve Number Method.

The choice of curve numbers and calculations are acceptable. Flow capacities of the diversion channels were determined by computing normal depth using the Manning Equation. Additional freeboard depth was provided in the final design to allow for waves and surface fluctuations of the flow. The design capacities of the channels are adequate. Energy dissipation basins are designed at both Deer Creek inlets. Three-foot diameter riprap sufficient to sustain the 100-year, 24-hour event will be placed in these basins. The designs are adequate and should ensure long-term stability.

Drawings and calculations in the permit application indicate that the upper 810 feet of the reclaimed Deer Creek channel will not be protected with riprap. The applicant indicates that this section of the channel will be excavated to bedrock. This will help provide channel stability on the steep slopes (up to 40 percent). Riprap protecion is provided, where needed, along channel banks constructed of fill material.

Flow through the remaining diversion ditches will take place at high velocities. These ditches will be built on erodable materials, so riprap protection is provided. The applicant makes proper use of the riprap design procedures and pro-vides a riprap size adequate to stabilize these channels.

Although the mean diameters of riprap are adequate, the applicant does not provide riprap gradations. A typical riprap gradation will have rock sizes ranging from less than half the mean size to twice the mean size. This is generally applicable when the mean diameter is less than about two feet. For larger mean diameters this gradation becomes impractical, since very large-diameter rocks would be included in the gradation. This is especially critical considering the channel widths proposed, since the large rock could significantly restrict the flow area of the channel. From riprap thicknesses spe- cified in the permit application it appears the applicant does not anticipate much variation for these larger sizes. Because of the small channel, the applicant must ensure that blockage of the channel by a large riprap element cannot occur. Maximum riprap size should not exceed one-third the dimension of the channel bottom width (Condition 5).

Specifications for a gravel filter under the riprap are provided in the permit application. A 2-foot clay liner is also specified for areas where the channel crosses fill. The clay liner will prevent water from saturating the fill and will ensure channel stability with respect to ground shifting and erosion. This clay liner is presented on Map 4-1 of the PAP. The proposed designs of the gravel and clay filters are adequate.

A final major issue concerning the reclamation channel system is the proposal to route flows across the mine area fill, over a rock face, and into a riprap splash basin. This design represents a reasonable solution to the complicated problem of routing the Deer Creek channel down the steep valley without

removal of the mine area fill. The applicant adequately addresses the transition of flow from the rock bench over the cliff face. Map 4-1 (PAP, Vol. 7) shows flow lines curving down the rock face to meet the splash basin. The channel is entrenched into the rock face sufficient to direct the flow. Other aspects of the design of the channel system over the fill, including the riprap splash basin, are adequate. The temporary splash basin used for the culvert outlet of Elk Canyon Creek during Stage I reclamation is also adequate. The applicant's design for constructing the reclaimed channel over the fill is adequate. The requirements of UMC 817.72(d) call for diversions to be routed away from fill. However, because of the disproportionately large construction costs, and detrimental environmental consequences associated with moving the fill, the applicant is granted a variance from the requirements of UMC 817.72(d).

UMC 817.45 Hydrologic Balance: Sediment Control Measures

The existing drainage system at the Deer Creek Mine site provides an adequate means of controlling sediment runoff. Undisturbed flow from above the mine site is diverted below the disturbed area using underground culverts. Disturbed area runoff is directed to a sedimentation pond using a system of culverts and open ditches.

During Stage I of reclamation it is anticipated that some erosion will occur on vegetated areas. Annual maintenance is planned for these areas and runoff

will be routed to the sedimentation pond. This will provide an adequate means of sediment control during this period. Upon final reclamation (Stage II), the slopes will be vegetated and the sediment pond removed.

All aspects of this section have been adequately addressed by the applicant.

UMC 817.46 Hydrologic Balance: Sedimentation Ponds

The sediment pond was designed to completely retain runoff from the 10-year, 24-hour storm. Calculations provided in the permit application showed the runoff from this event to equal 8.0 acre-feet. An additional volume of 2.0 acre-feet for sediment storage was also considered in the design. This represents 0.10 acre-foot of sediment for each acre of disturbed land. The total design volume of the sediment pond is adequate. Plans in the permit application show the sediment pond (Map 3-15, Map 3-16) for as-built conditions.

The sediment pond was designed with a manually operated dewatering device. This device can provide a 24-hour detention time or any other detention time that would be required. An "as-built" design drawing of the dewatering device is provided on Drawing 3-16 (PAP, Vol. 7). The inlet to the dewatering device is above the maximum elevation of sediment storage. However, Map 3-16 indicates that the dewatering pipe is not designed to fully evacuate the 10-year, 24-hour storm event. It appears that 3 or 4 acre-feet of storage above the sediment level cannot be drained. When water is occupying this 3 to

4 acre-feet of storage, the remaining available storage volume may not be adequate to store the 10-year, 24-hour event (Condition 1).

The emergency spillway crest is situated above the maximum 10-year, 24-hour pool elevation. This spillway is designed to pass the 25-year, 24-hour storm event with approximately one foot of freeboard. Calculations supporting this determination are presented in Appendix VII of the PAP. The design of the emergency spillway addresses the requirements of this section.

The combined upstream and downstream slopes of the sediment pond dam equal 1V:4.5H. Although this exceeds the 1V:5H required under this section for the settled embankment, the applicant has provided a geotechnical report to show that the dam is stable. The applicant has been determined to be in compliance with this requirement.

All other requirements of this section have been addressed adequately by the applicant.

UMC 817.47 Hydrologic Balance: Discharge Structures

The applicant adequately addresses the use of riprap energy dissipators at the outlets of the temporary and permanent diversions and the sediment pond and is in compliance with this section. Energy dissipator designs and calculations are presented in Appendix IX of the PAP, Vol. 3.

UMC 817.49 Hydrologic Balance: Permanent and Temporary Impoundments

The only impoundment at the Deer Creek Mine site is the sediment pond addressed under Section UMC 817.46. All additional requirements under this section have been addressed adequately by the applicant.

UMC 817.52(b) Hydrologic Balance: Surface Water Monitoring

Grimes Wash and Deer Creek are routinely monitored for water quality and quantity measurements. Quality measurements are made quarterly. The applicant has committed to weekly water quantity measurements on Deer Creek and Grimes Wash (PAP, page 2-93). UP&L has completed annual hydrologic monitoring reports since 1979.

Since the peak flow periods have overtopped the flumes, it is likely that 50 to 70 percent of the annual runoff has not been recorded. Issues related to the hydrologic balance of East Mountain can only be assessed if sufficiently accurate measurements of discharge from the Deer Creek and Grimes Wash basins are available. In particular, base-flow measurements will be extremely important in determining the influence of mining-induced subsidence on perched aquifers. Condition 2 requires improved methods of measuring peak discharge.

The applicant's water quantity measurement flumes on Deer Creek and Grimes Wash allow annual runoff peak flows to exceed flume capacity. (Hydrologic Monitoring Program Annual Reports, Appendices C and D).

2.3 Conditions

1. Within 30 days of the permit effective date ~~approval~~, the permittee shall calculate the sediment pond storage volume minus sediment storage volume, and water volume between full sediment level and the dewatering pipe intake (water which cannot be evacuated after a storm event) and submit the calculations to the regulatory authority for review. The permittee must show that the net available volume in the sediment pond is sufficient to contain the 10-year, 24-hour storm event (calculated to be 8.0 acre-feet). If the net available volume of the pond is not sufficient to contain the 10-year, 24-hour storm event, the permittee shall modify the sediment pond system to ensure that the volume of the 10-year, 24-hour storm event can be stored as required by UMC 817.42 and UMC 817.46. Any necessary modifications to the sediment pond system must be completed within 120 days of permit issuance.

2. Within 60 days of permit issuance, the permittee must install surface-water monitoring devices on both Deer Creek and Grimes Wash that are capable of measuring all flow including peak runoff.

3. Prior to the end of the 1985 calendar year, the permittee must increase the capacity of the Deer Drainage and Elk Canyon Creek

UMC 817.55 Hydrologic Balance: Discharge of Water into an Underground Mine

No discharge of surface water into underground mines is proposed at the Deer Creek Mine.

UMC 817.56 Hydrologic Balance: Postmining Rehabilitation of Sedimenation Ponds, Impoundments, and Treatment Facilities

Rehabilitation of all temporary diversions and sedimentation ponds at the Deer Creek Mine have been addressed adequately by the applicant.

UMC 817.57 Hydrologic Balance: Stream Buffer Zones

There are a number of perennial streams within the permit area [pp. 2-85 (A-D), Vol. I]. Mining operations (primarily long-wall mining) will pass underneath significant portions of each of these streams. Operation of the Deer Creek and Wilberg Mines will remove both major coal seams from beneath the stream channels. The resulting subsidence (Chapter IX of this technical analysis) may cause a uniform lowering of the land surface of approximately 10 to 12 feet. Possible effects on the stream channel include alteration of the channel shape, profile, or surface cracking. Because of the uniform nature of long-wall mining, no major change in channel shape is anticipated. Single seam long-wall mining in the southern portion of the Deer Creek permit area has taken place with no visible change in basin topography or channel shape.

Channel profile changes are possible where discontinuities in the mining operation are present, such as between barrier areas and the long-wall mining area. The magnitude of these changes is, however, quite small in comparison to the gradients of the existing channels. Although surface cracking has not been observed away from the perimeters of East Mountain, the applicant has provided a commitment to repair any surface cracking that affects the flow of streams in the permit area (p. 4-50, PAP, Vol. 2). Temporary culverts over the crack are proposed by the applicant as a mitigation measure. The applicant has a thorough subsidence monitoring program in place at the Deer Creek Mine, as discussed in chapter 9 of this document. Together with the applicant's water monitoring programs, any surface effects of subsidence should be readily detectable. The major issue concerning perennial streams within the permit area is not the possible subsidence effects on the stream channel itself, but rather the possible influence of subsidence on the source of water that contributes to the base-flow of those streams. The base-flow is derived from the flow of numerous springs associated with the occurrence of perched aquifers on East Mountain. Loss of flow from these springs due to subsidence of the source area is discussed in the Probable Hydrologic Consequences chapter of this technical analysis (TA). The applicant's water monitoring programs will generate receasion curve graphs which will allow tracking of any deviation in normal flow of springs and surface streams.

Because the effects of subsidence on channel geometry and profile are considered neglibible, a stream buffer zone is not necessary for the protection of the hydrologic balance for perennial streams on East Mountain.

The response to subsidence of various strata overlying Deer Creek mining operations is of concern for impacts on ground-water quantity. Studies to date (see Chapter IX) have indicated that expected subsidence is expressed on the surface very rapidly. The greatest potential subsidence-related impact can be to springs in the North Horn Formation. The overburden separating the springs from the coal seams is relatively thick, 1,200 to 2,000 feet, and should serve to dampen the effects of subsidence on the aquifers. The aquifers will be somewhat distorted and this may alter their character. Subsidence could disrupt aquifer water yield, and consequently result in the temporary or even permanent loss of flow at some existing springs and/or creation of new springs at new locations.

Cracking from subsidence may extend to perched aquifers that exist in the lower Price River Formation. This would enhance the vertical permeability of the underlying confining layer and reduce the outflow from a perched aquifer. Depending on the size and extent of cracking, the underlying confining shales may or may not seal in a reasonable period of time.

Spring flow varies greatly within the permit area, and while fewer springs exist in lower formations, their respective flows do not necessarily decrease. The applicant has proposed mitigation measures that address a relatively small loss of water when compared to the size of most springs on East Mountain. The applicant has not described the mitigation measures to be implemented should a substantial loss of water occur (Condition 1a).

In accordance with the requirements of UMC 784.14(a), the applicant should propose a plan to ensure the protection of the hydrologic balance should subsidence disrupt the discharge of these springs. A water replacement plan should be part of the overall hydrologic protecion plan. (Condition 1b).

In regard to the springs developed by the Emery Water Users Association, the proposed monitoring and evaluation of the springs will be a prudent way to study the spring system. This approach is acceptable because of (1) the complicated nature of the hydrologic system in the Rilda Canyon basin (Chapter III, this document, and Huntington Creek CHIA report to OSM, May 29, 1984) and (2) the "no material damage" findings and conclusions of the Huntington Creek CHIA. Mitigation measures can be devised if monitoring data indicate that

impacts are occurring. This meets the requirements of UMC 786.19(c) and 817.41.

4.2.3 Conclusions

The probable hydrologic consequences of mining operations at the Deer Creek Mine meet the regulatory requirements. A trend in water production from the Deer Creek Mine is expected to increase the amount of water available to the Huntington Power Plant over the next 20 years. To date, no related trend showing change in water yield for the springs on East Mountain is apparent. Continued monitoring of water yield and aquifer properties is necessary to determine the effect of mining operations on East Mountain aquifers.

Analyses in the permit application package and the cumulative hydrologic impact analysis (CHIA summary, attachment A of this document) indicate that no material damage is likely. There have been no detrimental impacts positively identified to date. The monitoring program proposed by the applicant is necessary to track changes in the hydrology as they may occur in the future. Monitoring will provide a trigger mechanism by which any necessary mitigation can be developed and instituted as necessary. It will also provide a tracking system to revise analyses if the monitoring indicates incongruities in the development of data.

4.3 Conditions

1. The permittee shall replace any water demonstrated to have been lost or adversely affected by mining operations with water from an alternate source in sufficient quantity and quality to maintain the rights of present users and current and postmining land uses. The permittee will advise the regulatory authority of the loss or adverse occurrence within two working days of becoming aware that it has occurred, and within 14 calendar days of notification shall submit to the regulatory authority for approval a plan to replace the affected water. Upon acceptance of the plan by the regulatory authority, the plan shall be implemented in the time-frames dictated by the regulatory authority's approval notification.

V. MISCELLANEOUS COMPLIANCE

The miscellaneous compliance sections of the permit application (UMC 817.11 Signs and Markers, UMC 817.131 - .132 Cessation of Operations: Temporary and Permanent, UMC 817.180 Other Transportation Facilities, and UMC 817.181 SupportFacilities and Utility Installations) have been reviewed. Operations at the Deer Creek Mine are conducted in compliance with the performance standards of these regulations.

The applicant is conducting mining operations so as to maximize the economic recovery of coal at the Deer Creek Mine as stated by the Bureau of Land Management (October 31, 1984 concurrence letter). The applicant is therefore in compliance with UMC 817.59.

No surface blasting is being conducted at the Deer Creek Mine. Therefore, performance standards UMC 817.61 through UMC 817.68 do not apply.

VI. DISPOSAL OF UNDERGROUND DEVELOPMENT WASTE

6.1 Description of Applicant's Proposal

Development waste, coal reject material from the breaker station, and mine entry rehabilitation from the Deer Creek mine will be disposed of at the development waste disposal site in the Deer Creek facilities area. The

applicant has estimated that present mining plans could generate approximately 100,000 cubic yards of material which will require disposal at the site over the life of the mine. As much non-carbonaceous material as possible will be disposed of underground until available space is depleted.

The volume of spoil was determined by the applicant based on the proposed mine layout and operating history and is shown on page 3-59 of the PAP. This estimate shows waste rock volumes from rock slope construction in Main West. No information was provided on the rock slopes and air return shafts which will be constructed in 3rd North. These slopes will provide access through a fault area and to the Hiawatha seam. The number of years used for determination of the amount of breaker station reject material was 35. However, if the mine is to operate until 2032 (see page 4-1 of the PAP), then 48 years of waste will be generated. Because of these inconsistancies, the applicant will be required to construct additional waste disposal sites at some point in the future. On page 3-59, the applicant states that approval of additional sites will be obtained as needed. It is fairly certain that this will be the case unless substantial volumes of material can be disposed of underground.

The proposed disposal site is a fill structure located along the east slope of the existing portal fill. The location of the fill and cross sections is shown on Map 3-17. The fill will be constructed in four-foot lifts and compacted by machinery used to grade the material. The foundation of the fill is the Starpoint Sandstone and no seeps or springs have been identified in the

fill area. Surface water drainage is controlled to prevent erosion through the fill area. The final slope of the disposal pile along the outside edge will be 1V:2H and the final elevation above the existing ground level will be approximately 140 feet.

6.2 Evaluation of Compliance

UMC 817.71 Disposal of Excess Spoil and Underground Development Waste: General Requirements

The waste material will be placed in a manner which ensures stability of the pile and prevents degradation of surface or ground waters. The disposal site is suitable for reclamation and revegetation, and will be compatible with the natural surroundings. The applicant is in compliance with UMC 817.71(a).

The fill has been designed by a registered professional engineer using recognized professional standards (see statement on page 3-60 of the PAP). The applicant is in compliance with UMC 817.71(b).

Diversion ditch designs for the disposal site are in compliance with UMC 817.43. The applicant is in compliance with UMC 817.71(d).

The applicant has located the waste disposal site on the most moderately sloping and naturally stable areas available. The bottom of the disposal site slopes gradually to the east and south, therefore keyway cuts or rock toe

buttresses are not required. The north and west sides of the fill are constructed against the portal fill area and the canyon wall, respectively. The applicant is in compliance with UMC 817.71(e).

The fill material is being placed in four-foot lifts and compacted by the machinery used in construction. The outside slopes of the fill will be graded to 1V:2H and the top of the fill is to be graded to the west at a 0.5% slope to prevent drainage down the outslope. Therefore the long-term mass stability of the waste pile is ensured, and a long-term safety factor of 1.5 will be achieved. The applicant is in compliance with 817.71(f).

The configuration of the proposed fill is suitable for postmining land uses and is in compliance with UMC 817.71(g).

There are no terraces proposed in the construction of the fill, therefore UMC 817.71(h) does not apply.

The applicant has proposed plans to inspect the fill quarterly and during critical construction periods. Inspection reports will be submitted to the Division within two weeks of inspection and a copy will be retained at the mine. The applicant is in compliance with UMC 817.71(i).

With the exception of the material disposed of underground, the applicant is proposing to dispose of coal waste with the development waste. This waste material accounts for approximately one-third of the total waste volume and is

a very coarse refuse material. The applicant will blending the coal wastes with the rock development wastes and compacting the material in four-foot lifts. The proposed method of construction will ensure the stability of the disposal site and adequate mixing of the coal refuse. Therefore the applicant was found to be in compliance with the intent of UMC 817.85.

Part (d) of UMC 817.85 states that the pile must be covered with four feet of cover material unless physical and chemical analyses show that less material can be used and the requirements of UMC 817.111-817.117 can still be met.

There are no seeps or springs in the disposal site; therefore the applicant is in compliance with UMC 817.71(k).

The fill is located on an essentially flat area where the Starpoint Sandstone outcrops. The sandstone layer is a massive, competent layer which will provide an adequate foundation for the fill. The applicant is in compliance with UMC 817.71(l).

Conversation with the Mine Safety and Health Administration (Mr. Stephen Miller, Denver) on March 12, 1985, indicates that no carbonaceous material has been disposed of underground at the Deer Creek Mine, and there are no indications that the applicant plans to do so (telephone memo, March 12, 1985; decision document concurrence section). Therefore, no MSHA approval for underground disposal is required. The applicant's disposal plans have been

found to be satisfactory and in compliance with the requirements of UMC 817.71(m).

The proposed fill is considered a valley fill, and was originally constructed pre-law. As discussed in Chapter Two of this document, the applicant has proposed construction of the reclaimed channel over the fill. The requirements of UMC 817.72(d) call for diversions to be routed away from fill. However, the alternative to construction of the diversion over the fill is complete removal of the fill. The applicant's design submittal for construction of the diversion over the fill was found to be sound engineering design, and preferable to the detrimental environmental impacts and large construction costs associated with removal of the fill.

The overall design of the fill is adequate for the requirements of UMC 817.72.

The proposed fill is neither a head of hollow fill, nor a durable rock fill. Therefore, UMC 817.73 and UMC 817.74 do not apply.

VII. PROTECTION OF FISH, WILDLIFE, AND RELATED ENVIRONMENTAL VALUES

7.1 Description of Applicant's Proposal

The applicant's plan for protection of fish and wildlife is presented on pages 4-50 to 4-54 (PAP, Vol. 2). The applicant has committed to (1) reporting any golden eagle nesting activity in the vicinity of the mine disturbance areas to

the USFWS, (2) consulting with the USFWS if any additional mine-related developments are planned in the raptor nesting zone (Map 2-18, PAP, Vol. 6), (3) placing deer crossing signs along the access road within the permit area, (4) reporting the occurrence of deer road-kills to the UDWR, and (5) providing wildlife educational instruction to all employees to reduce the potential for harassment of wildlife. The UDWR is currently conducting a deer road-kill monitoring program that includes the Deer Creek Mine access road. If any hazardous areas are identified along the road within the permit area, the applicant will consult with the UDWR for appropriate mitigation measures.

The applicant has supplied a map showing the location of golden eagle nests in relation to the mine facilities (PAP, Map 2-18) and has committed to consulting with the USFWS if any additional activities are planned in the raptor nesting zone (page 4-53, PAP, Vol. 2).

To limit sedimentation in Deer Creek and its effect on aquatic wildlife, surface water from undisturbed areas is diverted past the mine disturbance area in buried culverts. In addition, storm runoff waters from the portal facilities area are diverted into a sedimentation pond prior to release into Deer Creek.

The 12 KV line that serves as the power source for the Deer Creek Mine has been determined to be raptor-safe by the USFWS (letter dated November 10, 1982, to UDOGM). The line is constructed without a cross arm, precluding perching by raptors.

Following cessation of mining, the applicant will restore stream channels and revegetate disturbed sites. Plant species selection and planting patterns were designed to restore wildlife habitat as a principal post-mining land use. Details of the revegetation plan are provided on pages 4-22 through 4-28-A of the PAP (Vol. 2) and in Section X of the technical analysis.

Because of the importance of springs as a water source for the area's wildlife, the applicant has stated (page 4-50, PAP, Vol. 2) that any surface-water disturbance resulting from subsidence associated with the Deer Creek Mine will be replaced or repaired by the following methods:

1. "Streams will be bridged across bedrock fractures by culverts until sediments fill the cracks."

2. "Springs will be replaced with a series of guzzlers adequate to replace lost flow."

7.2 Evaluation of Compliance

UMC 817.97 Protection of Fish, Wildlife, and Related Environmental Values

Surface disturbances associated with the Deer Creek Mine total approximately 25 acres. This disturbance will last for the life of the mine and until reclamation is completed. Because of the limited areal extent of surface

disturbance, wildlife impacts resulting from loss of habitat will remain relatively minor.

None of the areas affected represent any critical habitats for threatened or endangered species (USFWS, Endangered Species Office, January 10, 1984, memo). The bald eagle is a winter visitor to the region but will not be affected by mining activities. Also, since the Deer Creek Mine will not reduce downstream flow in Deer Creek or Huntington Creek, the OSM has determined that populations of the Colorado squawfish and the humpback chub in the Colorado River will not be impacted by continued operation of the Deer Creek Mine (USFWS, Endangered Species Office, March 5, 1985, memo).

Other mine-associated wildlife impacts that may be more significant than direct loss of habitat include (1) human harassment of all wildlife, (2) mule deer road-kills, (3) disruption of mule deer movement patterns by the overland conveyor, and (4) the potential effects of subsidence on springs and raptor cliff nesting habitat.

The effects of human harassment on wildlife, either inadvertent or purposeful, should be considered from a cumulative standpoint since at least three other mines are currently operating along the southern end of East Mountain. However, since premining baseline data for wildlife populations in the area are lacking, these effects are extremely difficult to quantify. At a minimum, mining activities will likely preclude raptor nesting use of potential nest sites within 1 kilometer of the Deer Creek Mine facilities.

The applicant has sh[redacted], in a study on the effects of[redacted]e Deer Creek Mine C-2 overland conveyor on mule deer migration (submitted to UDOGM, June 2, 1983), that the conveyor is not a barrier to mule deer movement.

The potential for mule deer road-kills is greatest during the winter months when mule deer congregate in critical winter range traversed by the Deer Creek Mine access road. However, unless a particularly hazardous area is identified by UDWR monitoring, this impact is not expected to be significant.

Mine-related subsidence could impact springs on East Mountain and raptor cliff-nesting habitat, particularly in areas where surface fracturing is possible. The effect of subsidence on springs and raptor cliff nesting habitat cannot be fully determined at this time. Future monitoring will be required to provide sufficient information regarding the extent of impacts related to subsidence.

With regard to subsidence impacts on raptor cliff nesting habitat, the applicant will be mining under a few miles of cliff where the Castlegate Sandstone and Price River Formation are exposed in Meetinghouse and Deer Creek Canyons. Mining under these types of escarpments may have a significant impact on their stability. To date, fracturing of the Castlegate and Price River Formations has occurred over the Des-Bee-Dove Mine Complex and in Grimes Wash (see the annual Subsidence Reports, 1982). It can be expected, therefore, that there will be surface fracturing in the Castlegate Sandstone and/or Price River

Formation in Meetinghouse and/or Deer Creek Canyon. This represents an accelleration of a natural process. Based on the 5-year mine plan, mining under escarpments may affect only one inactive raven nest (No. 46) (Maps 3-1, 3-2, 3-3, 3-4, 3-5, and 2-18, PAP, Vol. 6). Unless newly constructed nests are affected by subsidence, no significant impacts to raptor nesting habitat is anticipated, since subsidence-related fracturing of cliff faces would not be expected to eliminate cliff faces, but merely create new escarpments.

In the event that existing or new nests are affected, the nests could be damaged or lost depending on the degree of subsidence. The applicant has not committed to mitigate this potential impact.

7.3 Conditions

1. Existing raptor nests affected by mine related subsidence shall be replaced or otherwise mitigated by the permittee in consultation with the U.S. Fish and Wildlife Service and the Utah Division of Wildlife resources according to the requirements of UMC 784.21 and UMC 817.97. Notification of the loss to the above named agencies and the regulatory authority shall take place within two working days of the permittee becoming aware that the loss has occurred.

VIII. BACKFILLING AND GRADING

8.1 Description of the Applicant's Proposal

The Deer Creek Mine is located in Deer Creek Canyon, a steep-sided drainage which flows intermittently. The mine facilities are built on benches which have been constructed using cut-and-fill techniques. The only other surface disturbances associated directly with the mine are ventilation breakouts which provide intake air. These breakouts have been or will be constructed from within the mine. There are no facilities located at these sites and the entrances are fenced to prevent access. Five entries and one exhaust shaft are located in the Deer Creek facilities area and five air intakes (breakouts) will be located in Meetinghouse Canyon (see Drawing CM-10473-DR). Two of the breakouts are in the north fork and three in the south fork of Meetinghouse Canyon. A development waste and coal waste disposal site is located within the facilities area and is an extension of the bench area where the portals are located. Backfilling and grading of this site are discussed in chapter six of this document.

Proposed future surface disturbances related to the Rilda Canyon facilities are not part of this permit application as requested by the applicant (see page 3-7 PAP, Vol. 2). The applicant's lease group (U-06039, SL-051221, and U-024317) located north of Rilda Canyon, was denied acceptance in the Deer Creek permit area by letter of March 11, 1985. The applicant is planning to develop detailed plans for development of these leases and submit them for approval under the requirements of UMC 788.12 concerning permit revisions, prior to construction at some point in the future.

The major earthen structures at the facilities area are shown on Drawing CM-10385-DR. The fill is situated on the level with the portals and provides area for storage, offices, and maintenance facilities. For the most part, this fill was constructed from material excavated on the south side of the canyon on a steep slope. This slope is a pre-law disturbance and has not been utilized by the applicant since SMCRA was enacted. Above the portal level are smaller cuts and fills associated with the fan pad and water tank. Below this area is a coal bin which is cut into the existing rock. It handles run-of-mine coal prior to screening and transport to the power facility.

The applicant is proposing to backfill and grade the Deer Creek facilities area to essentially premining topography except where the large fill and the development waste disposal site are located. This operation will entail backfilling on-site material. The backfilling and grading operation is described in the PAP on pages 4-3 to 4-6. Volume of material to be handled and cross sections showing the postmining slopes are shown on Drawing CM-10551-DR. All backfilled slopes will be at or less than 2H:1V. Asphalt and toxic or acid- forming material will be buried in the coal bin area which has sufficient capacity for this material. The steep cut slope will not be backfilled because this disturbance is pre-law and the applicant has not utilized it since its fill construction.

Most of the non-carbonaceous underground waste produced during mining will be disposed of in underground workings. The remainder of the waste will be disposed of above ground by extending existing fills. Laboratory analyses

Structure removal and portal backfilling will begin at the conclusion of mining operations, year 2032. Revegetation operations will begin the following September on all disturbed areas. The sediment pond will remain in operation following revegetation and through the ten-year responsibility period. It will then be graded and revegetated.

The applicant is in compliance with the requirements of this section.

UMC 817.101 Backfilling and Grading: General Requirements

The applicant is planning to return the surface disturbances associated with the Deer Creek Mine to a suitable postmining topography capable of supporting the intended postmining land use. The fill supporting the surface facilities will remain. The location of this fill in the canyon will not be inconsistent with the surrounding topography. The stability of the fills (see Chapter VI of this analysis for a discussion on the stability of the waste bank) as they exist and after reclamation has been evaluated and meets the requirements of the regulations. This conclusion is based upon analyses presented by the applicant, and the duration of the fills over which there have been no major slope failures. The environmental and economic factors associated with the alternative of removing the fill are considered detrimental when compared to the applicant's proposal and designs for leaving the fill. The post-mining drainage system has been evaluated in Chapter II of this Technical Analysis document and been found to be adequate. The applicant was granted a variance from the

requirements of UMC 8[redacted].72(d) which calls for diversi[redacted] to be routed away from fill.

Specific plans have been provided for grading along the contour. The applicant is in compliance with this section of the regulation.

UMC 817.103 Backfilling and Grading: Covering Coal and Acid- and Toxic-Forming Materials

Coal waste and pyritic materials will be diluted with low-sulfur rock and fill and will be buried under four feet of fill. Road base material and sediment from the sediment pond will be buried under four feet of non-toxic fill. The applicant is in compliance with this section of the regulations.

UMC 817.106 Regrading or Stabilizing Rills and Gullies

Plans have been submitted for the repair of rills and gullies in the bond estimate. Based upon the current maintenance program, 32 hours of work per year are needed to repair rills and gullies. The applicant has described the methods used to repair rills and gullies. The applicant is in compliance with this section.

IX. SUBSIDENCE CONTROL PLAN

9.1 Description of Applicant's Proposal

The applicant's subsidence control plan (UMC 784.20) is to utilize complete extraction methods (i.e., primarily long-wall mining), to achieve, as much as possible, an even lowering of the surface. The applicant intends to mine areas as wide and long as feasible in order to minimize the area which would be on the sloping edge of the subsidence trough. Pillars which are located between extraction panels are designed to yield and eventually crush as mining progresses past them. This will have the effect of maintaining an even subsidence trough.

All mining, except for planned breakouts, is planned to be discontinued at a minimum distance of 200 feet from any outcrop line or cliff line in the mine area.

The applicant has stated that full extraction panels have been oriented parallel to the major faults and joints. This alignment with respect to jointing is proposed to prevent the formation of irregular sawtooth subsidence cracks in the overlying surface lands.

On the operation maps, areas of partial extraction have been identified under the transmission line and Rilda Canyon. However, mining under Rilda Canyon is not to be included in the review of this permit

application since additional information is to be submitted at a later date. Under the transmission line only first mining will occur (i.e., only pillar development will take place). Pillars to be retained in the buffer area are 80 feet by 80 feet, with 20-foot entries, and have been sized by the applicant to be stable over the long term.

The applicant has proposed a subsidence monitoring plan which is described in Appendix X of the permit application. In general, the plan consists of a combination of photogrammetry methods tied in with conventional survey methods. The survey will be conducted once a year in mid-summer when the survey can be run in conjunction with the U.S. Forest Service vegetational studies. A ground-control survey will be established on a grid system as shown on the survey location map to provide a scale for the photography. By expanding and monumenting the control survey, a primary grid will be established for measuring both horizontal and vertical displacement. Grid spacing for the areas which are shown ranges from 100 to 600 foot spacings. The location of the primary controls for the 1980 survey is shown on Map 4-5, submitted September 17, 1984.

The applicant has stated that subsidence impacts to structures will be mitiated. Structures will either be repaired or the owner will be compensated for damage to the structure. In addition, any road damaged by subsidence will be repaired and regraded to restore them to their pre-subsidence usefulness.

The applicant has committed to mitigate any significant impacts to perennial streams.

The applicant has stated that public notices have been submitted to the affected surface owners which detail the areas in which mining is to take place and the planned date of the mining activity.

9.2 Evaluation of Compliance

UMC 817.121 Subsidence Control: General Requirements

A. Description of Subsidence Effects Observed To Date

Monitoring of subsidence to date has included studies by the U.S. Bureau of Mines (USBM) using standard ground survey methods, and by the applicant using photogrammetric methods, conventional survey methods and helicopter fly-overs. These data have been compiled in the applicant's annual subsidence reports and in the permit application package.

The USBM has been studying subsidence at the Deer Creek and Wilberg Mines since 1979. The initial study monitored subsidence over two long-wall panels which were developed in the Blind Canyon upper seam between 1979 and 1980. The depth of cover over these panels ranged from 1,600 feet to 1,450 feet. A baseline survey was conducted in October 1978 over Panels

5 East through 8 East (Deer Creek PAP, Vol. 6 Drawing No. CM-10473-DR, Sheet 2, Five-Year Mining Plan). These panels run in a east-west direction with Panel 5 East being the northernmost (see Figure 8, Deer Creek Long-wall Subsidence Study, USBM. Just north of Panel 5 East is a room-and- pillar section where the pillars have not been pulled. The first surface indication of subsidence occurred in September 1979 over Panel 5 East, which was mined first. At a minimum, the face had advanced 460 feet before subsidence occurred. Three inches (0.25 feet) of subsidence was measured on the surface at this time. In July 1980, when the next measurements occurred, subsidence had increased to a maximum of 1.6 feet over Panel 5 East. Mining in Panel 6 East immediately adjacent to 5 East had progressed 1,200 feet. Subsidence continued to be recorded, but by November 1980 no additional subsidence had occurred over the first 700 feet mined in Panel 5 East, indicating that subsidence from mining occurs fairly soon after mining. The maximum subsidence measured was 2.7 feet ~~in~~ which had occurred by December of 1980, when the analysis in the USBM report ends. This subsidence occurred near the midpoint of the panels and just north of the chain pillars separating Panels 5 East and 6 East but within Panel 5 East. This shows that the chain pillars crushed out and did not significantly affect the subsidence trough. The barrier pillars and the pillar sections to the north of Panel 5 East did not crush and effectively stopped subsidence except for angle-of-draw effects. The maximum slope of the subsidence trough at this time was 0.06 inches per foot in this area. No surface cracking was evident over the mine with this slope.

Additional data collected as part of the USBM study have been supplied by the applicant showing monitoring information through September 1983. Between 1980 and 1983, mining continued in Panels 7 East and 8 East in the Blind Canyon seam (upper seam), and Panel 9 Right had been mined in the Hiawatha seam (lower seam, see Drawing CM-10479-WB) almost directly below Panel 5 East (upper seam) and slightly under the room-and-pillar section to the north of Panel 5. ~~[illegible] Deer Creek [illegible] Subsidence [illegible]~~ The maximum subsidence measured on the surface to date is almost six feet over Panel 6 East (upper seam). Panels have been completely extracted to the north and south of 6 East. Therefore, it is probable that the maximum amount of subsidence which will occur due to mining in a single seam under the con- ditions in this area has been observed (over Panel 6 East). However, no mining has yet occurred under this panel, and thus the subsidence effects of multiple seam mining in this area have not yet been observed. The closest long-wall mining (to Panel 6 East) which has occurred in the lower (Hiawatha) seam is Panel 9 Right in the Wilberg Mine, located approximately 300 feet to the north. In addition, a barrier pillar is located in the Hiawatha seam in the area separating mining between Panels 6 East and 9 Right, and the subsidence troughs over these panels do not overlap at the maximum point of subsidence.

Subsidence has continued to occur over Panel 5 East, which was the first panel to be extracted in this area (in 1979). A maximum of almost five feet of subsidence was measured over 5 East in September 1983. Though

subsidence over Panel 5 East has continued since 1979 (for over four years), this is due to the initial extraction in Panel 5 East and later mining in Panel 9 Right. Since mining subsequently occurred in the Hiawatha seam (Panel 9 Right) almost directly below Panel 5 East, subsidence has continued due to multiple seam mining with a possible minor residual affect from single seam mining. It is expected that subsidence over mined areas within the permit area will not con- tinue more than a few years once all mining in an area is complete.

The subsidence profile continues to show that the chain pillars are crushing out and not creating any significant variation in the profile. The barrier pillars which are located at the ends of the panels to protect the mains from mining in the panels and the pillar section to the north of Panel 5 East do not appear to be crushing at all, and effectively stop subsidence except for angle-of-draw effects. The maximum slope measured at the edge of the subsidence trough as of June 1983 was over Panel 6 East and was 0.09 inches per foot (0.43 degrees or 0.75 percent). No surface cracking has been observed at this site to date.

Recently data have been obtained over the Panel 3 West in the Wilberg Mine in the Hiawatha Seam as part of the USBM study (PAP, Vol. 5, Drawing No. CM-10479-WB). This panel is under approximately 2,100 to 1,775 feet of cover and undermined a steep hillside with a gradient of 20 degrees. Retreat mining is occurring in Panel 2 West just to the north of

previously mined Panel 3 West. There has not been any multiple seam mining in this area. The Panel 3 West was probably mined in early 1981, as the first subsidence measurements are recorded in August 1981 and the monuments were installed and initially measured in September 1980. The maximum subsidence which has occurred to date over this panel is 2.5 feet, as of September 1983. The subsidence over Panel 3 West hasundoubtedly been enhanced by mining in Panel 2 West since the maximum amount of subsidence occurred slightly off center of Panel 3 West towards the north. This amount of subsidence is similar to what was observed over Panel 5 East, indicating that the depth of cover does not seem to be significantly decreasing the amount of subsidence observed in the areas of thick overburden cover where the Castlegate and Price River Formations exist.

Several other subsidence occurrences over the UP&L mines have been noticed by aerial inspections conducted by the applicant in a helicopter and then mapped in the field. These disturbances were recorded by the applicant in the annual Subsidence Reports and in an August 3, 1982, letter to Utah Division of Oil, Gas, and Mining. One area is located in the right fork of Grimes Wash over an area which had been retreat mined in both the Blind Canyon (1980) and Hiawatha seams (1981). The area encompasses about 40 acres of land, 35 of which are located on a steep slope and cliff area formed by the Castlegate and Blackhawk Formations. Subsidence offsets up to 12 feet were measured and toppling failure of the cliff has occurred. The area is currently fenced to protect

livestock and the public. The depth of cover in this area is approximately 900 feet to the Blind Canyon seam and 1,050 to the Hiawatha seam. The slope which slid is essentially vertical and 250 feet high. Surface cracking has also been observed in the Blackhawk Formation in this area. A second area is located over a section of the Deer Creek Mine where retreat mining occurred in the Blind Canyon seam under approximately 850 feet of cover. The fractures are located in the Price River Formation, whic outcrops along a steep hillside in this area to form a cliff face. The disturbed area is approximately 10 acres. The size of the fractures was not noted by the applicant. The mining in this area occurred in 1977 and the fractures are old, as evidenced by the growth of vegetation in the the cracks. Another area is located over the Des-Bee-Dove Mine in the Castlegate Sandstone near a steep slope and cliff area. The area of disturbance encompasses approximately 10 acres and contains several northeast trending fractures. The area overlies retreat mining which took place in October 1981.

Additional monitoring information has been provided by the applicant on subsidence observed over the Des-Bee-Dove Mine in the annual subsidence reports for mining over Panel 4 West section of the Beehive Mine. Monitoring in this area is difficult to interpret due to the extensive mining that occurred prior to the subsidence surveys. However, 2.5 feet of subsidence has been measuredover the area for single seam mining. The surface over this section of the mine does not have any cliff areas and

the depth of cover is between 1,300 and 1,600 feet. As of 1982, although both seams in this area had been mined, no surface cracking was evident. However, it is not possible to extrapolate this lack of surface cracking to the long-wall operations in the Deer Creek and Wilberg Mines. The operations at Des-Bee—Dove are room-and-pillar operations and large barrier pillars exist between the extraction panels which are most likely not crushing out, and would tend to decrease the effects of subsidence. This may also be the case with respect to the cliff areas which have been undermined in the Des-Bee-Dove operation but have not failed. The barrierpillars would effectively decrease the width of the opening in the mine, and the critical width (i.e., the width at which surface subsidence is greatest) is probably not achieved.

B. Evaluation of Probable Subsidence Effects

B.1. Lowering of the Land Surface in Areas Underlain by the Castlegate and Price River Sandstones

The effects of subsidence on the surface will be modified by the occurrence of the thick layers of the Castlegate Sandstone and the Price River Formation. These effects would tend to mitigate the possibility of surface cracking where the sandstone layers are continuous through the area. However, it can still be expected that the land surface will be significantly lowered. The maximum extent of this lowering is not known, since the effects of multiple seam mining by long-wall operations have

not been reported by the applicant as of this time.

The maximum subsidence which would be expected over a single seam maximum extraction area under 1,500 feet of cover has probably been identified in Panel 6 East in the Blind Canyon seam and is almost six feet, as shown by data collected for September 1983. Between June 1983 and September 1983 the surface only dropped an additional 0.08 feet, indicating that subsidence has probably stabilized in this area over a period of approximately three years. Depth of cover over this panel is approximately 1,500 feet. As such, the Castlegate Sandstone and the Price River Formation occur over this panel with approximately 100 feet of the North Horn Formation. It would be expected that the sandstone layers would provide a certain amount of bending action over the Blackhawk Formation as it crumbles above the underground workings. This bending action of the more competant sandstone would tend to reduce the amount of subsidence from what might be expected if only weaker strata existed above the mine. As of the last reported ground survey in 1982, no surface cracking was evident in this area.

If the information from Panel 6 East were doubled to reflect mining in two seams, then a lowering of the surface of almost 12 feet might be expected where the cover was approximately 1,500 feet and maximum extraction occurred. The applicant has estimated a maximum of 10 feet of subsidence where cumulative extraction from the two minable seams will

not exceed 20 feet. The applicant's estimate may be reasonable for areas of the mine where the depth of cover is greater than 1,500 feet given the thickness of the interburden between the Blind Canyon seam and the Hiawatha seam. In areas where the depth of cover is less than 1,500 feet, and in particular in areas where the sandstone layers do not exist, the amount of subsidence may be greater than the projected 10 feet.

Even settling of the land surface by complete extraction methods is not the primary concern associated with subsidence at the Deer Creek Mine. The major problem will be associated with areas where uneven subsidence takes place. This can occur where subsidence is unevenly distributed by (1) barrier pillars, (2) over the course of long-wall mining, and (3) during retreat mining. An advancing subsidence trough will occur on the surface. In these areas the ground surface will tilt, causing areas of tension and compression on the surface. In the case of the advancing mine face, these effects are transient and not as pronounced. However, where a barrier pillar remains, the surface tension and compression effects will remain and cause horizontal strains. The maximum slope measured to date is in the vicinity of Panel 6 East (Blind Canyon seam), and slopes at 0.09 inch/foot under 1,400 feet of cover. Although this amount seems to be a very minor slope, it would cause severe damage to an existing structure situated on the surface where the slope occurred. The slope would be expected to steepen as mining in the Hiawatha Seam (lower seam) progressed and increased the amount of subsidence within the trough. This effect has been observed in the area being monitored, where

subsidence has increased from 2.7 to almost 6 feet and the slope has increased from 0.06 inch/foot to 0.09 inch/foot.

The effect of this steepening on the land surface is unknown at this time. Depending upon the thickness of the overlying North Horn Formation, plastic deformation of this strata could occur, resulting in no visible effects on the surface. In areas where the depth of cover of the North Horn decreased and the sandstone layers were close to the surface or exposed at the surface, surface cracking may become evident. Continued monitoring in this area during the permit term, and possibly for a few years afterward, should identify the effects of multiple seam mining on the surface both with respect to lowering of the surface and to slope effects at the edge of the subsidence trough.

In the areas of high strain, steep slopes in the North Horn Formation may be susceptable to failure. The North Horn Formation consists of a high percentage of clay layers, and given the right moisture conditions, could slump. This has apparently occurred in the past in areas in the North Horn Formation, where in 1979 a slump 150 feet long was recorded (Memo to Coal File, Utah Division of Oil, Gas and Mining, September 6, 1979). This slump was located in an area where no mining had yet occurred in the UP&L operations. To date, no other slumps in the North Horn Formation have been recorded, even though retreat mining has occurred under steep slopes in this formation and extremely wet conditions existed in the

spring of 1983. However, given certain conditions, subsidence could potentially trigger slope failures in this formation. It would be difficult to determine if the failure were due to subsidence, or if the slope would have failed naturally, as was the situation with the 1979 failure.

B.2. Lowering of the Land Surface in Areas not Underlain by the Castlegate Sandstone

Portions of the land in the Meetinghouse Canyon area will be undermined where the strata overlying the operation consist only of the North Horn Formation. As such, the surface protection provided by the thick sandstone layers of the Castlegate and the Price River Formations will not exist.

As mining progresses in these areas of shallow cover, (150 to 750 feet of cover) surface cracking may occur along barrier pillars or between extraction panels until both panels are mined. The applicant has stated that the caving height can range from 35 to 50 times the thickness of the coal seam, therefore surface fracturing could be expected where the depth of cover ranges from 100 to 350 or 500 feet. As mentioned before, mining under this depth of cover occurs in portions of the mine area. In addition, surface cracking inthe Blackhawk Formation has been observed near the Wilberg Mine facilities area.

In these areas of shallow cover, subsidence can be expected to be greater than measured to date. Since 60 percent of the seam thickness has been reflected in subsidence at the surface over Panel 6 East, it would not be unreasonable to assume that a greater percentage of the seam thickness might be reflected in subsidence at the surface in areas where the Castlegate Sandstone does not exist. Therefore, mining in these areas with shallow cover will cause greater subsidence impacts. In addition, the effects of uneven settling of the land surface will probably be more pronounced. Continued monitoring in these areas will identify the effects of subsidence and the need for mitgation of impacts if necessary (see proposed conditions).

B.3. Disturbance to Springs, Seeps and Ponds

Potential disturbance to springs, seeps and ponds in the permit area is not well understood at this time (see Chapter IV, of this document). Depending upon the location of the water source, the effects of mining will be quite different. A few springs are located in areas either just above the Price River Formation where the thickness of the North Horn Formation is minimal, or in the Price River Formation. In these areas, a stronger potential exists for disruption of the springs, since cracking in the Price River may extend to the source of the springs. In most areas, the North Horn Formation is probably thick enough to minimize this effect, as evidenced by the lack of surface cracking (as of 1982) over the areas which have been mined out as part of the USBM studies.

Springs, seeps, and ponds are located in the areas at the edge of the subsidence trough where horizontal strains can be expected to be high. In these areas, cracking in the formations would be expected to be at a maximum. For instance, Surging Spring, Burnt Tree Spring, and Cove Reservoir are all located at or near the edge of a barrier pillar under which both seams will be extracted. The depth of cover in this area ranges from 1,600 to 1,750 feet. Therefore, the Castlegate and Price River Sandstones exist in their entirety, along with almost 500 feet of the North Horn Formation. The effects of subsidence as mining progresses on Burnt Spring will be quantified through discharge-recession studies. Mining will occur in a single seam under these springs and under the reservoir during this permit term in the Blind Canyon seam as part of the proposed Deer Creek operations. It is not known when mining of the Hiawatha seam might recommence at the Wilberg Mine, since this mine has been recently shut down because of fire. As multiple seam subsidence monitoring information is obtained in other areas of the mine, the effects of multiple seam mining will be better understood before multiple seam mining begins under these surface waters. No mining during the permit term is planned under Elk Spring, a very high-yield spring over the Deer Creek operations. Data will be available at a later date to evaluate potential effects to that spring prior to actual mining.

B.4. Disturbance to Escarpments

The applicant will be mining under several major escarpments of the

Castlegate Sandstone and the Price River Formation along the perimeter of some of the Meetinghouse Canyon area. Mining under these types of escarpments may impact their stability.

As mining progresses from the outcrop barrier to the end of the panel, mining will occur first under areas where the Castlegate Sandstone does not occur. Eventually, depending upon the location of the particular panel, mining will progress under the Castlegate Sandstone and then progress to a barrier pillar located adjacent to the mains. This type of mining operation will create cantilevering in the Castlegate Sandstone because the shallow areas not covered by the Castlegate can be expected to cave fairly soon after mining, whereas the stronger Castlegate will tend to resist caving longer. A cantilever would then form, and cracking at the surface would be expected.

This type of situation may be what caused the 12-foot subsidence offsets in the right branch of Grimes Wash. From evaluating the map shown in the applicant's August 1982 letter recording subsidence occurrences, it is difficult to determine exactly where the surface cracks occurred, but is appears that mining in this area would have created an unsupported section of the Castlegate approximately 200 to 500 feet long. Fracturing occurred within two years of retreat mining in this area. The orientation of the fractures is north-south. The subsidence fractures which occurred over the Deer Creek Mine were also similar to the scenario above Grimes Wash. Mining began retreating from a section of the mine

where the cover was only the Blackhawk Formation. Mining progressed under the Castlegate, and fracturing occurred in a northeast direction approximately 100 feet back from the outcrop of the Castlegate. The size of these fractures was not identified by the applicant. The fractures identified above the Des-Bee-Dove Mine repeat this same type of occurrence.

Within the Deer Creek Mine, a few miles of cliff formed by the Castlegate Sandstone and the Price River Formation are exposed in Meetinghouse and Deer Creek Canyons, and portions will be undermined using long-wall mining or retreat mining of room-and-pillar sections. This cliff is located in the raptor nesting zone. It is reasonable to assume that there will be surface fracturing in the Castlegate Sandstone and/or the Price River Formation along this cliff. The applicant will monitor these cliffs to determine the effects of long-wall mining under the escarpments and impacts to raptor habitat.

B.5. Disturbance to Perennial Streams

The applicant will be mining under the creeks in Meetinghouse Canyon, North Fork of Meetinghouse Canyon, Deer Creek and Whetstone Creek, and mining has already occurred under the North Fork of Grimes Wash. These streams are considered perennial all or in part. The applicant has not proposed to leave any buffer zones under these streams, therefore a determination must be made as to whether or not material damage to the

streams will result from the proposed mining operation.

Mining under the left fork of Grimes Wash in the Blind Canyon seam has recently been completed. The depth of cover to the coal seam in the area mined ranges from approximately 900 to 1,400 feet. Along parts of the stream, the channel is located in the Price River and Castlegate Formations. As such, there is concern for surficial cracking of the sandstone, resulting in loss of part or all of the stream flow. This impact could possibly be enhanced because the mains cross under the stream approximately in the middle of the undermined section with the panels to the east and west of the mains. This would create a situation where the tensile stresses on the surface would be expected to be greatest. To date, no impacts to the channel have been identified. Therefore, for the other streams which will be undermined it is not expected that there will be material damage to the streams where the depth of cover is greater than 900 feet and single seam mining occurs. As multiple seam mining subsidence data are submitted for the USBM study area, the effects of multiple seam mining will be evaluated and this information extrapolated prior to mining under the perennial stream. To ensure protection of these streams, the applicant shall be required to present these data and interpretations prior to subsequent mining (Condition 1).

With respect to the other creeks, most of them are adequately protected by the depth of cover similar to the conditions discussed for the left fork of Grimes Wash. For the areas that occur under shallower cover, protection is afforded by the buffer zone for the transmission line, barrier pillars located at the end of panels, or lack of mining due to thin seams. As such, it is not expected that there will be any material damage to these creeks. If damage does occur, the applicant has committed to mitigating these impacts. There are not expected to be any significant short-term effects between the time the damage might occur and the mitigation effort.

C. Evaluation of Compliance

UMC 817.121 Subsidence Control: General Requirements

As mining progresses and additional information is collected, the impacts associated with subsidence will be more clearly identified. Thus, the applicant's monitoring program and its interpretation are critical. The program proposed by the applicant uses photogrammetry survey methods and helicopter surveys. Survey monitoring of subsidence by the U.S. Bureau of Mines will continue at least through September of 1985. The applicant has committed to continue monitoring the U.S. Bureau of Mines study area after the Bureau has finished (Appendix X of the PAP).

ft The applicant is in compliance with the requirements of UMC 817.121.

UMC 817.122 Subsidence Control: Public Notice

The applicant has provided for public notice to all affected landowners and residents within the area above the underground workings. The notification will identify the areas in which mining will take place and the planned date of mining. The applicant is in compliance with UMC 817.122.

UMC 817.124 Subsidence Control: Surface Owner Protection

The applicant has proposed to mitigate impacts to structures and roads. As mining progresses and additional information is obtained on subsidence impacts, additional mitigation measures may be necessary. At this time it is not possible to determine the effects to springs in the area or the extent of disruption of the surface or of escarpments. The applicant has committed to monitor these features and evaluate the effect of subsidence on them. Mitigation plans will be developed by the applicant and submitted to the regulatory authority for evaluation and approval, and a final mitigation plan implemented by the applicant. Specific mitigation plans will be developed by the applicant as necessary and submitted to the regulatory authority within three months of data collection and analysis and reiterated in the annual subsidence report. With the monitoring stipulations from chapter 4, Probable Hydrologic Consequences, the applicant is in compliance with UMC 817.124.

UMC 817.126 Subsidence Control: Buffer Zones

A buffer zone has been identified around the transmission lines which can be damaged by even the slightest tilting. In this area, pillars will be left to prevent surface subsidence. The design of the pillars is adequate to protect these structures. The applicant has not proposed any buffer zones around the perennial streams across the mine. Uniform subsidence associated with longwall mining reduces the concern for disruption of streams due to subsidence. Historical effects of subsidence to streams at the Deer Creek and Wilberg Mine areas supports the applicant's contention that little or no damage to streams will occur due to subsidence. Damage that might occur to streams by surface cracking would be mitigatable by temporarily bridging the cracks with culvert material and allowing the cracks to quickly seal themselves with sediment through natural processes. A finding of no material damage to the streams for single seam mining has been made, and the proposed plan has been approved. The applicant is in compliance with UMC 817.126.

9.3 Conditions

1. Prior to beginning second seam mining inside a perennial stream buffer zone as defined by a 35 degree angle of draw, the permittee shall present a detailed evaluation of the anticipated effects of multiple seam mining on perennial streams as required by UMC 817.126(a). This evaluation must be based upon subsidence

monitoring information collected on multiple seam mining in areas with similar overburden depths and surface topography.

X. REVEGETATION

10.1 Description of Applicant's Proposal

Interim Stabilization and Vegetation Plan (Vol. 2, revised pp 4-13 to 4-30)

The objectives of this plan are to (1) control erosion on two major existing fill slopes, (2) evaluate revegetation methodologies, plant species adaptability, and potential revegetation success, (3) develop an alternate "soil" material to be applied to final graded slopes, and (4) record "soil" productivity over the life of the mine. The applicant proposes that by establishing vegetation on these slopes, the upper 18 to 24 inches of this fill material will, due to increased organic matter content, increased microbial populations, and incorporated seed, serve to increase revegetation potential. "Soil" developed as a result will be placed on random sites over the final graded surface to a depth of 6 to 12 inches. The plan is to be initiated the first appropriate season following the granting of this permit.

To revegetate each slope, the surface will be cleared of debris and the proposed seed mixture and fertilizer (at rates based on soil test results) will be broadcast. Seeding shall take place in the fall. Two tons of alfalfa hay mulch per acre will be spread over the slope surface. The surface will then be raked up-slope to cover the seed and fertilizer. Partial incorporation of mulch into the seedbed will also result. The slopes will be covered with "Vexar" netting and the netting anchored. The following spring, containerized shrub and tree stock shall be planted in test strips with species located randomly in rows. Basins are to be formed around each seedling and a fertilizer tablet placed in the backfill for each plant. A "Vexar" tube will be placed over each seedling to protect the seedling from browsing. Each seedling will be watered after planting.

Irrigation will be practiced only if a planting failure occurs after the first year. Slopes will be cultivated for two years to eliminate weeds, and rodenticides will be placed by a licensed applicator to reduce rodent populations. Plantings are to be evaluated in August. Permanent line intercept transects shall be employed to record species composition and ground cover. Shrub and tree plantings will be evaluated for species survival rate and vigor. Copies of evaluation reports will be forwarded to Utah Division of Oil, Gas and Mining (UDOGM). Samples shall be taken of seedbed material at five-year intervals to record productivity changes. Standard parameters are to be evaluated.

A wide variety of grass, forb, shrub, and tree species will be evaluated. Most species proposed are considered drought-tolerant. Four introduced species (Artemisia abrotanum, Kochia prostrata, Melilotus officinalis, Medicago sativa) are scheduled for testing. The majority of species to be evaluated are proposed for use during final revegetation.

Final Revegetation Plan - Mine Proper (Vol. II, revised pp 4-22 to 4-30)

Final revegetation shall be initiated the first appropriate season following grading. Three vegetative communities are to be established. These are the pinyon-juniper, mixed conifer, and riparian. Techniques for final revegetation described below may be revised given the results of the "Interim" plan.

Following grading, tops of fills, terrace cuts, and road surfaces will be ripped and disced. Steeper slopes and stream banks shall be hand-raked to prepare the seedbed. Drawing CM-10548-DR (PAP) indicates that the top terrace will be stabilized through revegetation to the Mixed Conifer community. "Soil" developed as a result of "Interim" plantings will be randomly spread over the graded surface to a depth of 6 to 12 inches. Seed mixtures and fertilizer (at rates based on soil test results) will be broadcast onto the seedbed in the fall. On more level sites the soil surface will be turned with a drag to cover the seed and fertilizer. Steeper slopes shall be hand-raked to accomplish this activity. Alfalfa

hay mulch will then be spread over the seedbed at the rate of approximately two tons per acre. Steep slopes are to be covered with "Vexar" matting to anchor the mulch. No mulch anchoring techniques were identified for lesser slopes. In the following spring, con tainerized shrub and tree stock shall be planted. Species will be planted in random clumps to enhance wildlife habitat. During planting, a fertilizer tablet will be placed with the backfill for each seedling. Basins to collect water are to be formed around the seedlings. Each seedling will be hand-watered at the time of planting. Seedlings will be protected by "Vexar" tubes.

The applicant has committed to irrigate the pinyon-juniper and mixed conifer plantings if initial plantings fail. Sprinkle irrigation techniques would be used. Slopes shall be cultivated for two years to eliminate weeds, and roden- ticides placed on revegetated areas by licensed applicators for three years, or as required, to control rodent populations.

The majority of plant species selected for revegetation are either native to the area or are considered to be appropriate additions to species diversity. Melilotus officinalis, Agropyron intermedium, and Poa praetensis are intro- duced species currently proposed for planting.

The applicant has identified the means by which parameters for measuring revegetation success will be obtained. These measures are briefly

described on pages 4-29, 30 (PAP, Vol. 2) and include methods and statistical limits simi- lar to those used when the reference areas were established.

The applicant has also committed to using a "student's t-test" of the sample means to compare sampled parameters for eventual release of bond. This -includes a commitment to re-establish ground cover and woody plant density to within acceptable statistical confidence limits as defined by UMC 817.116 (b.3.iv) and UMC 817.117.

10.2 Evaluation of Compliance

UMC 784.13 Reclamation Plan: General Requirements (Revegetation)

The vegetation data collected from reference areas show that these sites are acceptable areas and representative of the floral community which existed prior to mining.

The proposed revegetation schedule conforms to accepted standards. Revegetation will be accomplished during recognized planting seasons. Seeding/planting rates and methods are appropriate. Species to be seeded and planted are acceptable. The mulching technique proposed for steeper slopes is in accordance with standard practices. Proposed plans for irrigation, if initial plantings occur, are acceptable. The evaluation of compliance with regard to a soil testing plan is treated under UMC

817.21-.25.

The applicant has complied with the requirements of this section.

UMC 817.111 Revegetation: General Requirements

The applicant has complied with the requirements of this section.

UMC 817.112 Revegetation: Use of Introduced Species

Melilotus officinalis, Agropyron intermedium, and Poa praetensis are introduced species proposed for planting. These species are acceptable in Utah because of their high potential for establishment and wide endemic range.

UMC 817.113 Revegetation: Timing

The applicant has complied with the requirements of this section.

UMC 817.114 Revegetation: Mulching and Other Soil Stabilizing Practices

The applicant has complied with the requirements of this section.

UMC 817.116 and 817.117 Revegetation: Standards for Success and Tree and Shrub Stocking for Forest Land

The applicant has compiled with the requirements of this section.

Reclamation Feasibility

The proposed disturbed area receives from 16 to 18 inches of precipitation annually. Grading will result in a relatively high percentage of steep slopes (@ 2:1) approximating the original slopes. No soil is available for redistri- bution over regraded areas. The majority of fill and construction materials available for use as seedbed materials have been shown to be non-toxic. Materials of poor quality will be diluted and/or buried under four feet of non-toxic cover. Grass, forb, shrub, and tree species proposed for planting either occur adjacent to the existing mine site and are assumed to have occurred as part of the pre-disturbance vegetation communities, or are adapted to expected site conditions. All disturbed areas will be mulched following seeding. Shrub and tree species will be established using transplants as opposed to seed. The applicant has committed to using sprinkler irrigation on pinyon-juniper and mixed conifer planted areas if initial plantings fail. In addition, the applicant has committed to revegetate existing fill slopes at the mine site to evaluate proposed revegetation techniques, among other objectives.

Revegetation is considered feasible, though difficult, on steep slopes. The quality of the planting medium, coupled with the low average annual precipita- tion, support this premise. It is likely that several years will be required before vegetative cover approaches assumed premining levels. However, the applicant has proposed to use plant species and

employ revegetation techniques which are appropriate, given projected post-grading conditions, for attaining revegetation goals. The commitment to irrigate if initial plantings fail significantly increases the feasibility of revegetation. Results of test plot studies will aid in determining the potential success of revegetation and, through appropriate modifications where necessary in the final revegeta- tion plan, increase the feasibility of revegetation.

XI. ROADS

11.1 Description of Applicant's Proposal

There are three facility roads at the Deer Creek Mine operation, identified as follows: (1) mine access road, (2) coal facilities access road, and (3) mine fan access road.

The mine access road is asphalt-surfaced, and extends approximately three miles from State Highway 31 in Huntington Canyon. This road is owned and operated by the Emery County Board of Commissioners (February 6, 1985 letter from Clyde Conover, Chairman, Emery County Board of Commissioners, to Melvin Shilling, OSM/WTC; decision document concurrences). All road maintenance and repairs are the responsibility of the Emery County Road Department. A general road plan is shown on Drawings 3-18 and 3-19 (PAP, Vol. VII). The road width averages 20 feet, with an average road gradient of approximately eight percent until it nears the facility

area. A 1,000-foot length of road from the truck loadout to the parking lot has a gradient of 18 percent. Steep, narrow canyon terrain allows no leeway for a more gradual gradient. Within the disturbed area, runoff is collected in open ditches, slot drains, and catch basins and routed through the sediment pond. Road drainages outside the portal area beyond the mine gate are maintained by the Emery County Road Department. The County has authorized UP&L's use of this road for ~~the~~ mine access.

The coal facilities access road is a 1,000-foot-long winding gravel road up Elk Canyon which provides access to major components of the coal handling cir- cuit. It has variable width and a grade up to approximately 25 percent; the overall grade is approximately nine percent. The road is utilized daily at low speeds by coal handling facilities labor and service personnel. Road construction was limited mainly to shallow blade work in the existing canyon soils. Runoff from this road is collected in open ditches and carried to the sediment pond. The road is defined as a Class II road.

The mine fan access road is a 1,500-foot-long gravel road winding up Deer Creek Canyon behind the office-bathhouse to the mine ventilation fan. Road gradient averages approximately 20 percent. Travel on this road is limited to once a day at low speed. The road width averages 12 feet. Drainage from the mine fan access road is collected in an open ditch in the "disturbed" drainage system. The road is defined as a Class II road.

11.2 Evaluation of Compliance of Proposal

UMC 817.150 Roads: Class I: General

The applicant has complied with the requirements of this section.

UMC 817.151 Roads: Class I: Location

The applicant has complied with the requirements of this section.

UMC 817.152 Roads: Class I: Design and Construction

The applicant is in compliance with this section.

UMC 817.153 Roads: Class I: Drainage

The applicant is in compliance with this section.

UMC 817.154 Roads: Class I: Surfacing

The applicant is in compliance with this section.

UMC 817.155 Roads: Class I: Maintenance

The applicant is in compliance with this section.

UMC 817.156 Roads: Class I: Restoration

The applicant is in compliance with this section.

UMC 817.160 Roads: Class II: General

The applicant has complied with the requirements of this section.

UMC 817.161 Roads: Class II: Location

The applicant has complied with the requirements of this section.

UMC 817.162 Roads: Class II: Design and Construction

Steep canyon terrain allows no leeway for a more gradual gradient. Based on topographic and other information submitted by the applicant, it appears that major construction of a complying roadway would increase environmental degradation. Its limited use at low speeds satisfies safety considerations, and the additonal benefit associated with upgrading of the road does not justify the potential environmental damage. The applicant is therefore granted a variance under part (a) of this section.

The applicant meets all other requirements of this section.

UMC 817.163 Roads: Class II: Drainage

The applicant is in compliance with this section.

UMC 817.164 Roads: Class II: Surfacing

The applicant is in compliance with this section.

UMC 817.165 Roads: Class II: Maintenance

The applicant has complied with the requirements of this section.

UMC 817.166 Roads: Class II: Restoration

The applicant meets the requirements of this section.

UMC 817.170 - 817.176 Roads: Class III

These are no existing or proposed Class III roads at the Deer Creek Mine site.

XII. ALLUVIAL VALLEY FLOORS

12.1 Description of Applicant's Proposal

The facilities of the Deer Creek Mine are situated in narrow canyons with steep sides and valley slopes. The canyons lack topsoil and do not contain irrigible land which could be used for agriculture purposes. The canyons in which the surface facilities are located contain colluvial deposits from mass movements, slope wash, debris erosion, and sheet runoff. The area is classified as an upland nonirrigible area, and therefore is not an alluvial valley floor. Disturbance or interruption of aquifers within the underground mine complex will have no effect on downstream alluvial valley floors, inso- much as the water will eventually reach the downstream portions of the drainage system [redacted]. Both surface- and ground-water quality at the Deer Creek Mine is good, as well as water discharged from the mine (Probable Hydrologic Consequences; and Cumulative Hydrologic Impact Assessment Summary, Attachment A of this document).

12.2 Evaluation of Compliance of Proposal

UMC 785.19 Underground Coal Mining Activities on Areas or Adjacent to Areas Including Alluvial Valley Floors in the Arid or Semiarid Areas of Utah

As there are no alluvial valley floors on or adjacent to the permit area, and underground disturbance of aquifers will not affect downstream alluvial valley floors, the applicant is in compliance with this section.

XIII. POSTMINING LAND USE

13.1 Description of Applicant's Proposal

Premining use of the permit area was for livestock grazing and wildlife habi- tat. Cattle now graze the lower portions of the permit area in the spring and the upper portions (East Mountain) during the summer months. The permit area provides habitat for elk, deer, and raptors during various seasons throughout the year.

The applicant intends to return the disturbed portions of the Deer Creek mine permit area to its premining land use of livestock grazing and wildlife habi- tat. Following cessation of mining, the disturbance areas will be recontoured to blend into the existing topography and revegetated as described in the Reclamation Plan (pp 4-1 through 4-36, PAP, Vol. II). Vegetation will be re- established and will be comparable to species diversity, cover, density, and productivity of the established reference areas.

13.2 Evaluation of Compliance of Proposal

UMC 817.133 Postmining Land Use

The applicant has complied with the requirements of this section.

XIV. AIR RESOURCES

14.1 Description of the Applicant's Proposal

The applicant is currently using several fugitive-dust control practices at the Deer Creek Mine. The applicant proposes to continue these practices throughout the life and subsequent reclamation of the mine site.

The main service road and parking lots are asphalt. Service roads to the mine fan and coal handling facilities are gravel. Vehicular traffic on these roads is controlled to minimize contribution of fugitive dust. Vehicle speeds on the main service road are restricted to 35 mph; speed limit signs are posted. Travel on the mine fan service road is limited to once a day at low speed. The service road to the coal handling facilities is used daily at low speeds for access by service and labor personnel. The steep natural terrain restricts unauthorized travel on other than established roads.

Revegetation procedures have been implemented on all areas adjacent to roads or travel ways. The applicant states that reseeding is repeated until vegetation is established. Revegetation is applied on all disturbed and regraded surfaces as soon as season and weather permit.

Fugitive-dust control procedures are implemented throughout the coal handling process. All frequently used belt conveyors are covered and equipped with belt scrapers to prevent coal dust generation. Transfer points are enclosed and chute inlets and outlets are rubber curtained to minimize open areas.

The high moisture content of the coal at Deer Creek Mine aids in the fugitive dust control throughout the coal handling process. Analysis of samples taken during processing shows an average of 9.4 percent inherent and surface moisture content in 248 samples.

Because the Deer Creek Mine product is transported directly to the Huntington Power plant for use, the possibility of spontaneous combustion conditions developing is eliminated. Long-term stockpiling within the permit area is unlikely.

14.2 Evaluation of Compliance of Proposal

UMC 817.95 Air Resources Protection

The applicant is in compliance with the requirementsa of this section.

XV. BONDING

15.1 Description of Applicant's Proposal

Estimated costs are in 1984 dollars and include lands having been disturbed for the purpose of handling, crushing, storing, and transporting coal extracted through the Deer Creek mine. The applicant has identified one bonding increment. Cost estimates are based on engineering analyses and stan- dard references such as the Caterpillar Performance Handbook and Rental Rate Bluebook for Construction Equipment. A summary of the applicant's estimated costs is shown below:

	Category	Amount ($)
1.	Surface facilities removal	335,832
2.	Portal sealing	26,520
3.	Hauling, backfilling, compaction and grading	99,395
4.	(Not used in applicant's estimate)	0
5.	Install riprap drainage channels	181,641
6.	Temporary sedimentation control facilities	40,152
7.	Soil sampling and seed bed preparation	15,434
8.	Fertilizng and mulching	25,237
9.	Seeding and planting	94,002
10.	Plant monitoring and disease and pest control	19,984
11.	Soil stabilization - rills and gullies	17,265

12.	Contingent seeding and planting	8,260
13.	Revegetation inventory for bond release	5,417
14.	Sediment-control structure removal	24,135
15.	Overland conveyor belt revegetation	19,877
	Mobilization	10,000
	10% Contingency	91,315
	TOTAL (1984 Reclamation Cost)	1,014,466
	Escalation at 6.78% for 5 Years	1,408,274

Therefore, the amount of $1,408,274 has been proposed by the applicant as the bond amount sufficient to cover reclamation costs should the operator default at any time through the Year 1989.

15.2 Evaluation of Compliance of Proposal

UMC 800.11 Requirements to File a Bond

1. a. The applicant has requested a permit term of five years.

   b. The revegetation liability period pursuant to UMC 817.116(b) shall be ten years as permit area precipitation is substantially less than 26 inches.

UMC 800.12 Requirements to File a Certificate of Liability Insurance

The applicant has compiled with the requirements of this section.

UMC 800.13 Regulatory Authority Responsibilities

The regulatory authority has analyzed the bond estimate and supporting calculations provided by the applicant. The estimates have been found to be generally adequate. A calculation mistake was apparently made by the applicant on ITEM 3-J; based on information provided, the amount for this section should be $8,965, not $7,942. With this change, the following summarizes the bond requirement for this operation:

Subtotal of all Reclamation Activities	$ 924,174

10% Contingency	92,417
TOTAL (1984 Reclamation Costs)	1,016,591
Escalation at 3.79 percent per year for 5 years	1,224,402

The required bond amount is therefore rounded to $1,224,000. This figure is sufficient to insure funds through 1984.

ATTACHMENT A

Cumulative Hydrologic Impact Assessment Summary
Deer Creek Mine

Surface Water Hydrology

The Deer Creek Mine is located at the junction of Deer Creek Canyon and Elk Canyon. The permit area lies within the Cottonwood Creek and Huntington Creek drainages (Figure 1). Deer, Meetinghouse Canyon and Rilda Canyon Creeks are tributaries of Huntington Creek. North Cottonwood Creek, Left Fork and Right Fork of Grimes Wash are tributaries of Cottonwood Creek. Deer Creek and Left Fork of Grimes Wash are perennial streams within the mine permit boundary. The base flow of these streams is sustained by springs that arise within the permit boundary. The other drainages are classified as intermittent except for Meetinghouse Creek which is considered perennial below Elk Springs, and Rilda Canyon Creek which is considered perennial below the confluence of the left and right forks. However, more flow records are needed to substantiate the character of these latter two creeks.

Approximately 65 percent of the streamflow in the creeks occurs during the April-June snowmelt runoff period. Average annual precipitation ranges from 17 inches at the Deer Creek Mine portal area to over 20 inches per year on East Mountain. The water is a calcium-bicarbonate type and reflects the influence of the carbonate rocks which cap the ridges and peaks in the basin. Total dissolved solids (TDS) concentrations range from 200 to 500 milligrams per liter (mg/l). Downstream of the cumulative impact area (CIA), water-quality is degraded by natural runoff and irrigation return-flows which pass over Mancos Shale-derived soils. The gypsiferous Mancos Shale contributes substantial concentrations of salts to the surface-water system. TDS concentrations in the San Rafael River, 28 miles southeast of Deer Creek Mine, typically average 2,000 to 4,000 mg/l.

Mine discharge water contains approximately 590 mg/l TDS. All water leaving the mine is used at the Huntington Power Plant. This water is used in exchange with water rights that UP&L has on Huntington Creek.

Geologic Setting

The lowermost stratum of importance in the area is the Masuk Shale Member of the Mancos Shale Formation, which crops out downstream of the Deer Creek Mine. Above the Masuk Shale are: the Starpoint Sandstone; the coal-bearing Blackhawk Formation; the Castlegate Sandstone; the Price River Formation; the North Horn Formation; and the Flagstaff Limestone. All but the Masuk Shale crop out within the permit area boundary. Faults known to exist within the permit boundary include the Deer Creek, Pleasant Valley, and Roans Canyon faults. No igneous intrusions are known to exist within the permit area.

There are two minable coal seams in the area, the Hiawatha seam at the base of the Blackhawk and the Blind Canyon seam averaging 70 to 80 feet above the Hiawatha seam.

There is some overlap of the mining operations between the Deer Creek Mine in the Huntington Creek basin and the Wilberg Mine in the Cottonwood Creek basin. The Wilberg Mine operates in the lower coal seam, the Hiawatha, and the Deer Creek Mine operates in the upper coal seam, the Blind Canyon. The mining operations of the Deer Creek Mine partially overlie the operations of the Wilberg Mine. The overlap of these mining operations occurs at the boundary between the Hungtington Creek and Cottonwood Creek drainages (Figure #). As discussed later in this CHIA summary, the surface-water drainage boundary is assumed to be the same as the groundwater basin divide. Mine inflows from Wilberg will be discharged in the Cottonwood Creek drainage and mine inflows from the Deer Creek Mine will be diverted to the Huntington Power Plant. For purposes of the groundwater analyses performed in the CHIA documents for Cottonwood Creek and Huntington Creek, the effect of this overlap was considered to be approximately equal and opposite for the two mines; therefore the net effect of the overlapping nature of these two mines is considered to be hydrologically insignificant.

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Groundwater Hydrology

Groundwater occurs under perched, water table, and confined conditions in the general area of the Deer Creek Mine. Numerous springs have been identified, ranging from ephemeral seeps to perennial springs. Most of the springs originate in the North Horn Formation as perched springs.

At present, groundwater enters the Deer Creek Mine at flow rates of 275 gpm with the potential for more water to be encountered intermittently as mining operations extend further and intercept fault zones and saturated fluvial channel-sandstones.

Groundwater quality is characterized as a calcium-magnesium-bicarbonate type, and is similar to that of surface water in the area. TDS concentrations measured from springs range from 66 to 790 mg/l and consistently average around 300 to 350 mg/l. Such values are similar to concentrations observed in surface waters.

A more detailed discussion of the groundwater resources of the Deer Creek Mine area is presented in the introductory chapter of the Technical Analysis.

Anticipated Mining

Coal mining operations have been in existence in the Deer Creek area since the 1890's. All anticipated mining within the Huntington Creek cumulative impact area is shown in Table 1.

Table 1. Existing and Anticipated Mining within the Huntington Creek Cumulative Impact Area.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Year	Crandall Canyon	Bear Canyon	Deer Creek	Bellna #1	Rilda Canyon	Skyline	King Complex	Huntington Canyon	Wild Horse Ridge	Star Point(1)	Star Point(2)	Total Mined Acreage Within Basin	Mined Acreage Discharging to Basin	Mined Acreage Discharging Outside Basin
1975							0							0
1976							125					125		125
1977							250					250		250
1978			0				375					375		375
1979			1,500				450					1,950		1,450
1980			1,800				600					2,400		2,400
1981			2,000				675					2,675		2,675
1982		0	2,200				800					3,000		3,000
1983		26	2,500				900	0				3,426	26	3,400
1984		51	2,600				1,000	198				3,849	249	3,600
1985	0	69	2,700		0		1,125	370	137			4,401	576	3,825
1986	22	103	2,900		75		1,250	568	431			5,349	1,199	4,150
1987	46	129	3,000		150	0	1,375	752	705			6,157	1,782	4,375
1988	68	146	3,100		225	230	1,500	950	979			7,198	2,368	4,600
1989	56	172	3,378		300	400	1,600	1,122	1,273	0		8,301	2,923	4,978
1990	0	197	3,941	0	376	600	1,250	1,320	1,527	200		9,410	3,419	5,391
1991		223	4,274	90	450	800	1,050	898	1,821	350		9,956	3,392	5,674
1992		249	4,616	170	525	1,000	750	462	1,625	550		9,947	2,861	5,916
1993		274	5,066	260	600	1,200	500	0	979	700		9,579	1,853	6,266
1994		300	5,517	335	675	1,375	250		313	850		9,615	1,288	6,617
1995		317	6,080	420	750	1,650	0		0	1,100	0	10,317	1,067	7,180
1996		343	6,418	500	825	1,800				982	268	11,136	1,168	7,668
1997		369	6,755	570	900	2,000				755	545	11,894	1,269	8,055
1998		394	7,318	370	975	2,200				68	832	12,157	1,369	8,218
1999		420	7,881	200	1,050	2,300				9	641	12,501	1,470	8,531
2000		446	8,219	0	1,125	2,600				0	0	12,390	1,571	8,219
2001		472	8,669		1,200	2,700						13,041	1,672	8,669
2002		489	9,007		1,275	2,300						13,071	1,764	9,007
2003		523	9,345		1,350	1,800						13,018	1,873	9,345
2004		540	9,795		1,425	1,500						13,260	1,965	9,795
2005		566	10,358		1,500	1,150						13,574	2,066	10,358
2006		583	10,696		1,575	750						13,604	2,158	10,696
2007		617	11,259		1,650	375						13,901	2,267	11,259
2008		634	10,471		1,485	0						12,590	2,119	10,471
2009		660	9,570		1,320							11,550	1,980	9,570
2010		686	8,669		1,155							10,510	1,841	8,669

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Year	Crandall Canyon	Bear Canyon	Deer Creek	Belina #1	Rilda Canyon	Skyline	King Complex	Huntington Canyon	Wild Horse Ridge	Star Point(1)	Star Point(2)	Total Mined Acreage Within Basin	Mined Acreage Discharging to Basin	Mined Acreage Discharging Outside Basin
2011		712	7,881		990							9,583	1,702	7,881
2012		737	6,755		825							8,317	1,562	6,755
2013		755	5,967		660							7,382	1,416	5,967
2014		789	5,066		495							6,350	1,284	5,066
2015		815	3,941		330							5,086	1,145	3,941
2016		832	3,152		165							4,149	997	3,152
2017		857	2,027		0							2,884	857	2,027
2018		806	1,126									1,932	806	1,126
2019		729	0									729	729	0
2020		677										677	677	
2021		626										426	626	
2022		557										557	557	
2023		514										514	514	
2024		454										454	454	
2025		386										386	386	
2026		343										343	343	
2027		283										283	283	
2028		223										223	223	
2029		172										172	172	
2030		111										111	111	
2031		43										43	43	

Notes:

For mines which partially extend into Huntington Creek basin, only the area lying within the basin is shown.

Areas and sequencing patterns developed from information presented in mining and reclamation plans on file at the Office of Surface Mining, Western Technical Center, Denver, Colorado.

Mined acreage discharging to basin (col. 13) is computed as follows: Col. 13 = Cols. (1 + 2 + 5 + 8 + 9)

Mined acreage discharging outside of basin (col. 14) is computed as follows: Col. 14 = Cols. (3 + 7 + 10 + 11)
(Belina and Skyline mines not included due to their location upstream of Electric Lake.)

Delineation of the Cumulative Impact Area

Surface Water

The furthest downstream location at which potential impacts from mining operations in Huntington Creek can directly be manifest is immediately below the confluence of Fish Creek with Huntington Creek. Therefore, the cumulative impact area for the assessment of material damage has been defined as the drainage area contributing to Huntington Creek above this location. All present and anticipated mining operations with the potential for materially affecting Huntington Creek are located in the lower one-third of the basin. The Huntington Creek cumulative hydrologic impact area and location of mine lease areas are shown on Figure 1.1.

Groundwater

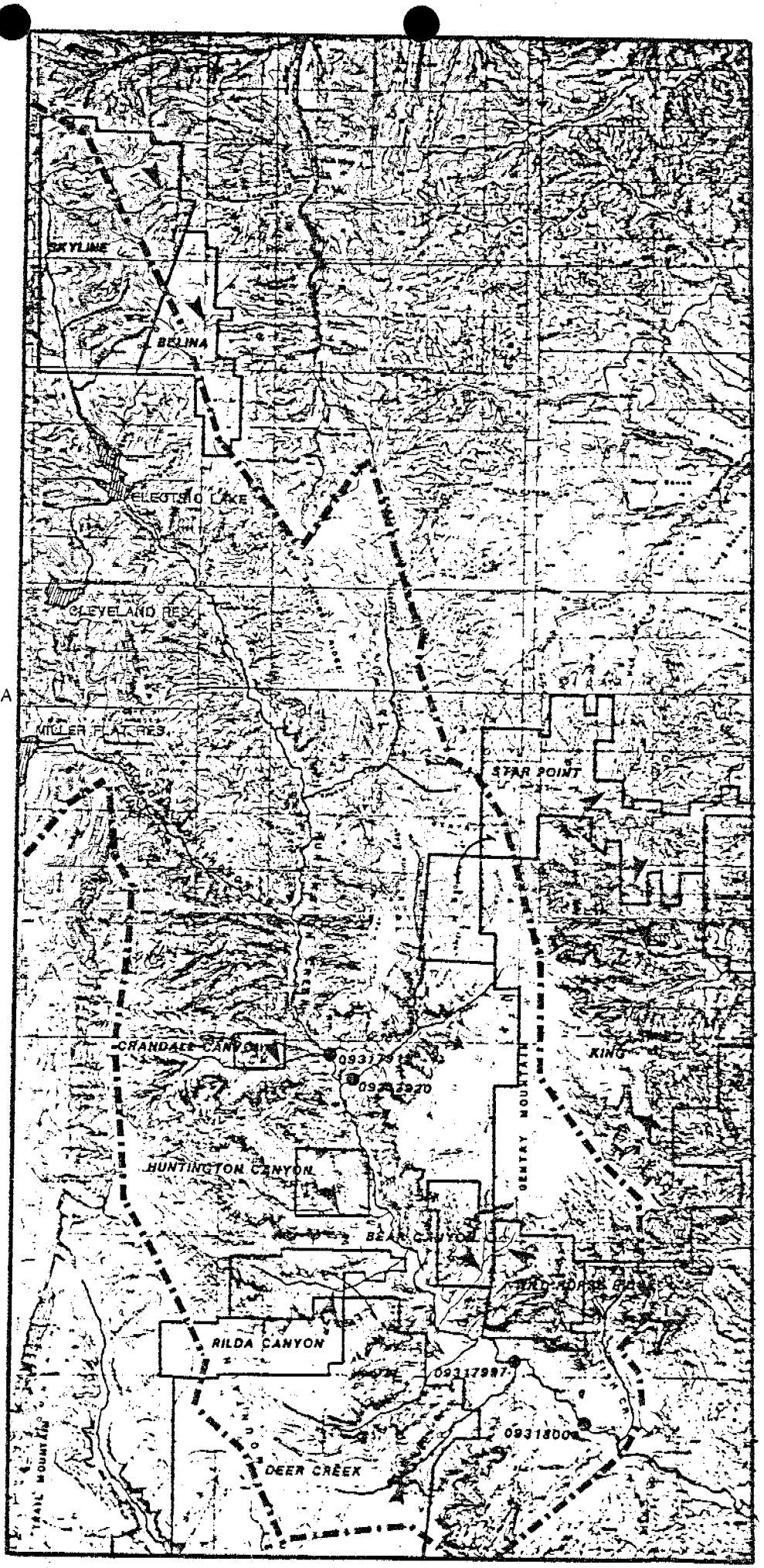
The lack of piezometric data in the various water-bearing units within the Huntington Creek basin does not allow precise determination of groundwater divides in the area. However, the assumption that the groundwater basin coincides with the surface water basin is well within the limitations and accuracy of available data and assumptions inherent in this analysis. The Pleasant Valley, Joe's Valley, Roans Canyon and Trail Canyon Faults may act as conduits for interbasin movement of groundwater into or out of Huntington Creek basin, although there is little evidence to support this concept. Lines and Morrisey (1981) state that potentiometric surface data from the Emery area, approximately 35 miles south of Huntington Creek basin, indicate that the Ferron sandstone member of the Mancos Shale is recharged mainly by subsurface flow from the Wasatch Plateau along the Joe's Valley fault system. Additionally the regional dip of permeable strata (less than four degrees to the south) may cause the groundwater divide to be offset from the topographic divide slightly. However, for purposes of the following analysis these effects are considered to be negligible. The massive Masuk Shale member of the Mancos Shale underlies the Star Point Sandstone and crops out within the downstream limits of the cumulative impact area. The shale effectively limits the amount of groundwater which can leave the basin as underflow. This is the single-most important hydrogeologic control which allows delineation of the groundwater cumulative impact area.

Summary of Cumulative Hydrologic Impacts

The hydrologic impacts of present and future coal mining activity within the Deer Creek Mine CIA have been addressed both quantitatively and qualitatively. Quantitative assessments presented in the CHIA report focus primarily on surface-water impacts which result from the discharge of intercepted groundwater. This analysis utilizes average monthly water quality, groundwater inflow, and discharge records from Huntington Creek and the Deer Creek Mine in combination with anticipated future mine inflows to predict future quality and quantity impacts.

FIGURE 1.1

MINE PERMIT BOUNDARIES, DISCHARGE POINTS, AND USGS GAGING STATION LOCATIONS IN THE HUNTINGTON CREEK CUMULATIVE IMPACT AREA



LEGEND

- MINE DISCHARGE POINT /SURFACE FACILITIES LOCATION
- STREAM GAGING STATION
- MINE PERMIT BOUNDARY
- CUMULATIVE IMPACT AREA BOUNDARY

1 0 1 2 3 4 miles

SCALE

Qualitative analysis of the effect of mine dewatering and subsidence on the groundwater system has been presented in the CHIA, with particular emphasis on the potential for diminution of spring flows. Because of the complex nature of the hydrogeology, the unknown vertical and horizontal extent of subsidence effects, and the complex relationship between spring discharge, precipitation, and lithology, a prediction of future impacts to the groundwater system based on analytical methods was not attempted. However, based on the available data and information, the probable impacts have been predicted.

Impacts to surface-water quality of Huntington Creek are expected to gradually increase over the next 20 years as underground mining operations advance at Crandall Canyon Mine, Huntington Canyon No. 4 Mine, Wild Horse Ridge Mine, Rilda Canyon Mine, and Bear Canyon Mine. The primary impact is associated with the discharge of intercepted groundwater which is expected to reach a maximum between the years 1990 and 2010. Although groundwater is intercepted at Deer Creek Mine, this mine is considered a non-discharging mine because the intercepted groundwater transported to the Huntington Power Plant. At present, no mine discharges groundwater to Huntington Creek on a continuous basis. Impacts are quantified by flow-weighting the estimated TDS concentrations of the mine discharge water with that of the average monthly water quality and discharge of Huntington Creek. The maximum predicted impacts for this period indicates that the highest percentage increase in TDS is predicted to occur during the period from November to March, representing a maximum increase of 13 mg/l over the baseline TDS concentration, or approximately 5 percent. This contrasts with the increase of over 1,500 mg/l TDS resulting from irrigation return flows in the reach of Huntington Creek immediately downstream of the mining area.

The Utah Division of Health specifies a maximum recommended TDS concentration of 1,200 mg/l for agricultural use (irrigation and stock watering). TDS limitations for other uses are adjusted on a case-by-case basis. The U.S. Public Health Service provides guidelines for drinking-water standards which recommend a maximum TDS concentration of 500 mg/l for primary standards and 1,000 mg/l for secondary standards. Additionally, the U.S. Environmental Protection Agency has published recommended limits for various irrigation hazards and industrial uses

As a result of all anticipated mining upstream from the Deer Creek Mine, a maximum increase of 13 mg/l in TDS concentrations in Huntington Creek (yielding a TDS value of approximately 300 mg/l) will not degrade or preclude anticipated uses below the CIA. This is in contrast to the marked degradation which presently occurs downstream of the mined area due to irrigation activity on Mancos Shale soils. This downstream activity increases TDS concentrations to levels which exceed the recommended limits for almost every use.

The maximum increase in the discharge of Huntington Creek can be estimated by assuming that all of the groundwater which is intercepted by mining activities is "new" water to the basin (i.e., that which would not be present normally). The assumption is overly conservative but serves to define an upper limit on the magnitude of the potential increase.

Similarly, the maximum decrease in the streamflow during the hydrogeologic resaturation period following the cessation of mining can be estimated. By assuming that the diminution of natural streamflow during this period is equal to the peak rate of mine dewatering (groundwater recharge and storage components), the upper limit of potential streamflow reduction can be estimated.

The greatest percent in streamflow volume change occurs during the non-irrigation season, November through April. Changes to the average monthly flow of Huntington Creek during the growing season are less than 10 percent. Thus, even if changes to the groundwater system were as great as these conservative estimates indicate, the timing of the impacts within the yearly cycle is such that minimal impacts occur during the period of greatest demand, May through October. This is due to a combination of effects, including the natural hydrologic cycle, regulation of Electric Lake, anticipated amounts of future mine dewatering based on present inflow rates and basin characteristics, and seasonal effects.

After mining is completed, strata dewatered during the mining process will start to resaturate. This will result in a reduction of the base flow in Huntington Creek on the order of 4 cfs. This represents 5 percent of the mean daily flow rate of Huntington Creek, and is a result of the cumulative effect of all mines within the basin (Table 1). Seasonally, the largest percent depletion of discharge during retreat-mining will occur during the non-irrigation period, November through March, when average monthly flows may experience depletions of 12 to 17 percent. Since the Deer Creek Mine will intercept little groundwater, insignificant base flow diminution will be attributable to the mine.

Impacts Associated with Subsidence

The results of a U.S. Bureau of Mines subsidence study above long-wall panels (unpublished) at the Deer Creek Mine, immediately adjacent and overlying part of the Wilberg Mine, indicate that topographic modification due to subsidence can be manifested over 1,500 feet above long-wall-mined areas. Subsidence effects at the study location have been limited to topographic modification in the form of a broad, swale-like trough with no subsidence cracking or mass movement evident. The factors limiting cracking and mass movement are primarily:

a. The presence of the massive Castlegate Sandstone which is resistant to caving and which separates the mine workings from the major spring-bearing strata, and

b. The presence of substantial thicknesses of clay shales in the overlying Blackhawk Formation, which tend to swell and seal internal tension cracks.

Where the thick sandstone layers of the Castlegate Sandstone and Price River Formation do not exist, there is a greater potential for subsidence effects to alter the hydrologic balance of the area. Tension cracks have a greater opportunity to extend to the surface, thus rerouting surface and sub-surface flow into the mine workings. Topographic modification of surface features may

result locally in increased erosion rates, areas of closed drainage or other undesirable surface effects. Risk of damage to the hydrologic system decreases in the direction of increasing overburden thickness.

Diminution of flow of several springs due to subsidence could occur within the permit area. These springs are located near the upper contact of the Price River Formation with the North Horn Formation or in the Price River Formation (as mapped by Utah Power and Light Company). It is not possible to predict the amount of potential damage which may occur to these springs, if any. The CHIA recognizes only the potential risk to these resources. Because of the complex geological, hydrological, structural, and climatic interdependence, continual monitoring would be required to accurately assess hydrologic damage. The most promising avenue of approach in this regard appears to be the use of discharge recession curves for each spring to document unnatural changes to spring flow characteristics.

Impacts

Increases in TDS (primarily sodium, calcium, magnesium, bicarbonate, and sulfate) and TSS will occur; however, these increases have been determined not to cause damage to the surrounding hydrologic balance.

Possible diminution of spring flow due to subsidence-related effects may occur.

Post-mining base flow diminution will result as the resaturation of dewatered strata occurs once retreat of the mining operations commenses. Diminution of base flow in Huntington Creek will continue until such time that the strata resaturates and the groundwater system has reached an equilibrium. Worst-case base flow diminution is estimated to be about 5 percent of the mean daily flow rate of Huntington Creek. Seasonally, the largest percent depletion will occur during the non-irrigation period from November through April, when this impact will be least felt by downstream users.

Findings

The assessment of the probable cumulative hydrologic impacts with respect to the Deer Creek Mine and all anticipated mining in area has been made. The proposed Deer Creek mining operation and all other anticipated mining have been found to be designed to prevent material damage to the hydrologic balance outside the permit area, over the entire projected life of the proposed mining operation.

diversion culverts to convey the 10-year, 24-hour storm event as required by UMC 817.44. This can be accomplished by implementing the permittee's February 4, 1985 design submittals or by implementing an alternative approach to meet the required performance standards.

If the permittee chooses an alternative approach, the design must be submitted to the regulatory authority within 60 days of the permit ~~issuance~~ effective date for approval.

4. No element of riprap to be placed in reclaimed channels and energy dissipator structures will exceed one-third the channel or structure bottom width.

III. HYDROLOGIC BALANCE - GROUNDWATER

3.1 Description of Applicant's Proposal

The applicant proposes and commits to monitor the quantity and quality of groundwater at flowing springs on East Mountain, within the mine, at two wells away from past and active mining areas, and at the discharge point from the mine (pp. 2-85, 2-85A, Vol. 1, PAP). For the past five years, UP&L has been collecting hydrologic data from the areas above and adjacent to the mine and within the mine. The applicant has collected stratigraphic data on the lateral extent of aquifers present on East Mountain. Data have been collected

from 79 coal exploration drill holes (Map 2-1 PAP, Vol. 4) at 59 springs (Map 2-12 PAP, Vol. 6), and at nine in-mine locations. The hydrogeologic system of East Mountain is described by the applicant as consisting of perched aquifers concentrated in the North Horn and the Blackhawk Formations. The aquifers in the North Horn Formation intersect the surface along the rim of East Mountain. Most of the springs identified by the applicant (39 of 59) occur in the North Horn Formation, with eight occurring in the Flagstaff Limestone above the North Horn and the remaining twelve springs distributed in strata occurring below the North Horn. Only one spring surfaces in the Blackhawk Formation; however, mining in the Hiawatha and Blind Canyon coal seams in the Blackhawk has encountered significant groundwater.

Eleven of these springs are situated over areas of proposed double-seam mining between the Wilberg Mine (Hiawatha Seam) and the Deer Creek Mine (Blind Canyon Seam). In order to describe the source of groundwater inflows to the Deer Creek Mine, the applicant has prepared maps of the perched aquifers. The maps were prepared from exploration drill holes completed both in-mine and from the surface. The applicant has hypothesized that the perched aquifers are located in ancient fluvial channels that formed as a part of the deltaic deposition active during and after the coal-forming peat accumulation. These fluvial channels are shown overlying the Blind Canyon coal seam and trending northeast to southwest. Experience by the applicant with water encountered during mining indicates that the largest influx of water occurs as fluvial channels are first contacted. The flows quickly diminish as the source is dewatered. Anomalies in the fluvial channels, such as a vertical sag (referred to as a

channel roll) or faul[redacted]g, leads to even larger inflo[redacted] A significant continuous source of water flows up into the floor of the Deer Creek Mine from the Pleasant Valley Fault.

Experience with mine dewatering indicates that as workings progress, wet areas show a significant decrease in flow. Data gathered by the applicant to date, exhibit a possible seasonal variation since dewatering volumes are often higher during the snowmelt period of the year. This indicates that the Blackhawk aquifers are not completely isolated and that some of the numerous faults and fractures supply direct recharge to these aquifers.

The Starpoint Sandstone immediately underlying the Hiawatha coal seam, has moderate permeability, yet receives little recharge from above. Mine dewatering has not affected the recharge of this aquifer. Post-mining conditions may provide improved potential for increased recharge to the Starpoint Sandstone due to subsidence effects in the Blackhawk Formation. The magnitude of such a potential change in recharge cannot be determined.

3.2 Evaluation of Compliance

UMC 817.48 Hydrologic Balance: Acid-Forming and Toxic Materials

The applicant proposes to dispose of excess underground development waste from the mining operation at a waste rock disposal site 1,500 feet from the mine portal. The site is located near the base of the Starpoint Sandstone where it interfingers with the Masuk Shale. No springs or seeps are present in the Starpoint Sandstone at this location. The underlying Masuk Shale is the uppermost member of the Mancos Formation which is generally impermeable.

Chemical and physical analysis has been conducted by the applicant on more than 130 samples of rock above and below the mined seams in the Deer Creek Mine. These analyses indicated that the majority of the samples are non-toxic and non-acid forming. One sample from the Blind Canyon floor showed a high SAR value and one sample from the Blind Canyon roof showed a high pyrite/ marcasite content. The applicant considers these samples to be atypical. The applicant states that the occurrence of such potentially toxic materials will be infrequent and that the operations of handling and removal will dilute the concentration of this material without the need for any special mixing. The application is in compliance with this regulation.

UMC 817.50 Hydrologic Balance: Underground Mine Entry and Access Discharges

The breakout in Meetinghouse Canyon is the lowest-elevation portal in the Deer Creek Mine. During the life of the mine, a large area will be mined below the elevation of the portal. For drainage to occur from the portal the abandoned mine workings will have to fill with water. This will take many years or possibly decades, depending on recharge rate to the Starpoint Sandstone. Since the potential for flooding of the abandoned workings is unknown, the applicant will provide a four-inch diameter drain pipe at the Meetinghouse portal capable of discharging 300 gpm to Meetinghouse Canyon. Because recharge will resume to the local aquifers, this discharge is sufficient to ensure that none of the other portals will discharge. The applicant, therefore, has not provided any drainage for the remaining portals. Any water that might be

discharged is expected to meet EPA effluent limitations without treatment. The applicant will monitor any discharge water quality through bond release period. To date, the water produced at the Deer Creek Mine has been of good quality, and there is no evidence of any adverse mining-related impacts to ether Deer Creek or Huntington Creek. The impact of any future discharges on the existing hydrologic balance should be minimal. The application is in compliance with this regulation.

UMC 817.52 (a) Hydrologic Balance: Surface and Groundwater Monitoring

Water is produced at several locations in the mine and then flows to low areas which act as temporary sumps. These sumps are dewatered and pumped to a main sump in an abandoned area of the mine. Water volume is measured as it leaves the mine. Water produced in the mine is used for dust control and there is an internal loss of water due to evaporation. A complete mass balance of water use in the Deer Creek Mine can be computed based on measured outflows and estimated evaporation. The mass balance equation is:

$$V_t = V_H + V_D + E + dS$$

where V_t is the total volume of water produced in the mine, V_H is the volume of water discharged to the Huntington Power Plant, V_D is the volume of water consumed for dust control, E is the evaporation volume and dS is the change in sump capacity between reporting intervals. The sump volume

is unknown and is assumed to vary little. All other outflow volumes are measured continuously and recorded monthly.

The total yearly domestic use of water by the Deer Creek Mine is approximately 25 acre-feet (eight million gallons), evaporation is approximately 58 acre-feet, and discharge to Huntington Power Plant has from 107 acre feet ranged to 359 acre-feet. Recent estimates of annual in-mine water production are approximately 442 acre-feet for the Deer Creek Mine or an average daily inflow of 275 gpm. There has been substantial variation from this mean over the period of record (1979 to 1982). The operational aspects of the Deer Creek Mine and the seasonal variation in precipitation both contribute to this variation. There is probably an upward trend in the mean in-mine water production due to the expansion of mining operations.

The applicant presently monitors some 59 springs on East Mountain for quantity and quality on an annual basis. Monitoring within the mine includes measurements of quantity and quality of discharge. Direct measurements of water quality are made; water quantity is estimated based on limited information from dewatering operations. This is sufficient to make a relative comparison between water-producing areas in the mine with total inflows based on a mass balance at the main sump. In addition, the monitoring program includes measurement of the discharge recession behavior of 13 of these springs. The purpose of these measurements is to monitor the condition of the aquifers that are the source of the spring flow. The 13 sites provide

monitoring of aquifer conditions over a large area of East Mountain and within strata overlying mining operations. Such monitoring will be extremely useful in identifying the effects of subsidence to existing aquifers.

Two wells located away from past and active mining areas will continue to be monitored. These wells provide baseline ground-water data within the Blackhawk and Starpoint aquifer. The application is in compliance with this regulation.

UMC 817.53 Hydrologic Balance: Transfer of Wells

No transfer of wells is considered by the applicant.

UMC 817.55 Hydrologic Balance: Discharge of Water into an Underground Mine

No diversion of water into other underground workings occurs or is contemplated at the Deer Creek Mine.

UMC 817.13 - .15: Casing and Sealing of Underground Openings

All surface drilled exploration holes have been reclaimed according to the U.S. Geological Survey's published Drill Hole Plugging Procedure. The application is in compliance with this regulation.

IV. PROBABLE HYDROLOGIC CONSEQUENCES

4.1 Description of Applicant's Proposal

Possible impacts to the existing hydrologic balance by the Deer Creek Mine include alteration of ground-water movement in the Blackhawk Formation due to the presence of mine workings and loss of some springs on East Mountain as a result of subsidence. Loss of springs could result in alteration of flow in intermittent and perennial streams [pp. 2-85 (A-D), Vol. 1, PAP]. The applicant states that the majority of springs will be unaffected because of the use of controlled subsidence techniques. It is also stated that the presence of swelling clays in strata above the mine should assist in limiting the movement of ground-water through fractures created by subsidence. The permit states that the applicant could replace any disrupted water supply from surrounding streams, wells, or the mine itself (page 2-99, Vol. 1, PAP).

The water-monitoring program indicates that the quality of water discharged from the Deer Creek Mine has been good. The applicant does not anticipate that surface waters will be degraded by mining activities. The applicant plans to continue hydrologic monitoring of surface- and ground-water flows for the duration of mining operations. The applicant notes that the Emery Water Users Association has developed three springs in Rilda Canyon as a culinary water supply (pp. 2-97 throught 2-97B, Vol. 2, PAP). These springs are not situated above mine workings. The springs discharge from the Starpoint Sandstone and appear to be fracture related. Discharge records of the springs are given on page 2-97B of the PAP (Vol. 2). The applicant has committed to close monitoring of these wells to better understand their mode of occurrence and the potential impacts of mining.

4.2 Evaluation of Compliance

A Cumulative Hydrologic Impact Assessment has been prepared for Huntington Creek. The conclusions of this CHIA and the requirements of UMC 817.41, "Hydrologic Balance: General Requirements," are condensed and discussed below in relation to the applicant's proposal. See Attachment A of this TA document for the CHIA summary.

4.2.1 Surface-Water Impacts

The primary impact on surface waters by Deer Creek mining operations is the discharge of groundwater intercepted during mining. The volume of groundwater intercepted is expected to gradually increase over the next 20 years as underground operations at the Deer Creek Mine advance further underneath East Mountain. The majority of this intercepted groundwater is utilized by the Huntington Power Plant for cooling. In general, the mine water quality is good, averaging 590 mg/l total dissolved solids. The mean annual dissolved solids concentration of the receiving waters (Deer Creek) range from 235 to 533 mg/l. Mining-related increases in dissolved solids concentrations in Deer Creek are not expected to degrade or preclude anticipated uses downstream of the Deer Creek Mine.

4.2.2 Ground-water Impacts