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TECHNICAL ANALYSIS
FOR THE DEER CREEK MINE
UTAH POWER AND LIGHT COMPANY
EMERY COUNTY, UTAH

AUGUST 9, 1985

PREPARED BY:

U.S. OFFICE OF SURFACE MINING
WESTERN TECHNICAL CENTER

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TECHNICAL ANALYSIS
FOR THE DEER CREEK MINE,
EMERY COUNTY, UTAH
April 1, 1985

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. The Deer Creek Mine is presently operating under an approved mining permit issued by the State of Utah, Division of Oil, Gas and Mining (UDOGM) (Act/015/018) issued on May 11, 1978, and with approval under 30 CFR 211 issued by the U.S. Geological Survey on January 23, 1978.

The Deer Creek Mine is one of three separate mining operations 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-LaSal 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 million tons. Total in-place reserves within the Deer Creek Mine boundaries are approximately 186,000,000 tons which includes 51,000,000 tons to be mined from the Hiawatha Seam. Approximately 65 percent 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 2,500,000 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. 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 (including the conveyor) 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 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-044025	40.00 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 permit area (U-06039, SL-051221 and U-024317) are not included in the permit area because the applicant has not obtained the necessary right of entry for these leases (UMC 784.11; correspondence to the applicant from OSM on December 28, 1984; correspondence to OSM from applicant on January 22, 1985).

Owners of fee 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	40.00 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
U.S. Forest Service Special Use Permit	5.9 acres

Description of Operations

The Deer Creek Mine is a multi-seam operation utilizing longwall and room-and-pillar techniques for coal extraction. Two longwall 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 longwall sections. The thickness of coal in the mine area reaches 16 feet, although 10 feet is average.

Geologic Setting

The UP&L mines, including the Deer Creek Mine, are located in the Wasatch Plateau Coal Field. 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 occurs 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 the area and is a prominent cliff former. Above the Castlegate is the Price River Formation, which is sandstone-interbedded shale and conglomerate and is approximately 350 feet thick. Above the Price River Formation 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 2-2 (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 seasonally 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

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. Springs and seeps are shown on Map 2-12 (PAP, Vol. 6). The ground-water section (Chapter III) of this technical analysis (TA) provides a detailed description of the hydrologic characteristics of the springs and seeps (also see the following section, Hydrologic Resources).

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

Hydrologic Resources

The Deer Creek permit area includes tributary drainages to 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	21% 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 overland conveyor system which extends 1.8 miles 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 at various locations in 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 ground water from numerous springs in the upper portions of each basin. Both Meetinghouse Canyon Creek and Rilda Canyon Creek sustain segments of perennial and intermittent streams. 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 convey 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 parameters measured 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 includes 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, and sandstone. A large number of springs are formed in the North Horn Formation where shales form relatively impermeable layers that impede downward migration of the ground water and transport it laterally to the outcrop. An erosionally resistant shale bench just below the Flagstaff Limestone is a notable topographic feature in the Deer Creek and Grimes Wash basins. Faults and fractures in the North Horn Formation provide a ground-water 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 ground water within the formation.

A conceptual model of the ground-water 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. Fluctuations in the shale layers together with faulting and fracturing complicate this conceptual picture. Hydrologic data is continually collected to more fully understand the hydrologic system at East Mountain and the effects that mining may have on it.

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 drained from aquifers in the Blackhawk 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, reference areas were selected (and sampled) from representative locations around the disturbance area.

The main facility area including the conveyor system has disturbed 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 topsoil 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. 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. Sodium adsorption ratios (SAR) were relatively low for most materials analyzed(less than 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-LaSal 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.

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 disturbed 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 topsoil 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, of this document). 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 conductivity 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 prepared designs to increase the carrying capacity of the Deer Drainage culvert. The applicant proposes the installation 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 (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).

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 Section IV, Probable Hydrologic Consequences, of this document.

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 Ground-water 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), the applicant 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 install the 54-inch culvert in Deer Drainage or submit an equally effective alternative for review and approval (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 protection 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 provides 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 specified 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 4).

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 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. The requirements of UMC 817.72(d) call for diversions to be routed away from fill material with no provisions for variance. However, the applicant's proposal has been determined to be of sound engineering design with less environmental impact than any other feasible alternative. Therefore, the applicant's September 13, 1985, request to designate the proposed design as experimental practice under UMC 785.13 is acceptable. Condition number 5 has been added to ensure compliance with the experimental practice regulations as required by UMC 785.13(h)(4).

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 revegetated 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. Topographic constraints at the spillway location make standard practice design requirements impossible. Given the stability of the dam as built and the topographic constraints including increased environmental disturbance to accommodate the larger dam requirements, OSM has determined that the applicant's design is the most environmentally sound option to meet the requirements of SMCRA.

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.

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).

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.

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 longwall 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 TA) may cause a uniform lowering of the land surface of approximately 10 to 12 feet. While it is possible that alteration of the channel shape, profile, or surface cracking may occur, because of the uniform nature of longwall mining, no major change in channel shape is anticipated. Single seam longwall 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 longwall 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 TA. The applicant's water monitoring programs will generate recession 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 negligible, and because of steep local topography, the standard 100 feet stream buffer zone is not necessary for the protection of the hydrologic balance for perennial streams on East Mountain (see condition 7, page 44 of this TA).

2.3 Conditions

1. Within 30 days of the permit effective date, 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. Prior to June 1, 1986, 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 1986 calendar year, the permittee must increase the capacity of the Deer Creek Drainage and Elk Canyon Creek 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 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.

5. The permittee shall conduct experimental practice on the final reclaimed Deer Creek channel only according to the designs approved by the Utah Division of Oil, Gas and Mining and the Office of Surface Mining. If the experimental practice should prove to be inadequate to meet the standards of Subchapter K as determined by the regulatory authority, the applicant shall submit detailed plans for approval of an alternative environmental protection method as directed by the regulatory authority in accordance with UMC 785.13(h)(4)(i) and (ii). The permittee shall conduct additional monitoring requirements in association with the approved experimental practice as the Division of Oil, Gas and Mining or Office of Surface Mining may require according to UMC 785.13(h)(4)(iii).

III. HYDROLOGIC BALANCE - GROUND WATER

3.1 Description of Applicant's Proposal

The applicant proposes and commits to monitor the quantity and quality of ground water 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 ground water. 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 ground-water 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 and the overall hydrologic balance is unaffected. Anomalies in the fluvial channels, such as a vertical sag (referred to as a channel roll) or faulting, leads to even larger inflows. 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 marked 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 Ground-Water 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 ranged from 107 acre feet 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 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 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 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 currently proposed by the applicant.

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

No diversion of water into 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

Considerable data is currently being gathered to more fully assess the surface impacts of mining based upon pre-law and current mining progress. Adverse impacts to the hydrologic balance are unlikely; however, in a worse case situation 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 is 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 springs to better understand their mode of occurrence and the potential impacts of mining.

4.2 Evaluation of Compliance

Cumulative Hydrologic Impact Assessments have been prepared for Huntington and Cottonwood Creeks. 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 ground water intercepted during mining. The volume of ground water 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 ground water 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 seasonally 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

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 6).

In accordance with the requirements of BLM and Forest Service leases and the State's determination, and the post-mining land use requirements of UMC 817.124, the applicant must propose a plan to ensure the protection of the hydrologic balance should subsidence disrupt the discharge of these springs. A provision for developing a suitable water replacement plan must be part of the overall hydrologic protecion plan. (Condition 6).

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) plus condition 6 indicate that the application is designed to prevent material damage. 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

6. 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

5.1 Description of Applicant's Proposal

By letter correspondence of August 3, 1978, UPL proposed a sign and markers system to the UDOGM. The applicant submitted a Resource Recovery and Protection Plan to BLM for approval. The applicant's blasting plans are discussed in Appendix VI of the permit application package. Cessation of operations are discussed on page 4-1 of the permit application package. Transportation facilities are discussed on pages 3-34 through 3-38 of the permit application package. Support Facilities and utilities are discussed on page 3-15 of the permit application package.

5.2 Evaluation of Compliance

UMC 817.11 Signs and Markers

UDOGM approved the applicant's signs and markers system by letter of August 31, 1978.

UMC 817.59 Coal Recovery

By memo to OSM dated October 31, 1984, BLM recommended that the applicant's Resource Recovery and Protection Plan be approved.

UMC 817.61 through 817.68 Blasting

No surface blasting is being conducted at the Deer Creek Mine. Therefore, the performance requirements of these rules do not apply.

UMC 817.131 and .132 Cessation of Operations

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

UMC 817.180 Other Transportation Facilities

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

UMC 817.181 Support Facilities and Utility Installations

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

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. 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 47 years of waste will be generated. Because of this additional reject material, 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 percent 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 (PAP, p. 3-63). Inspection reports will be submitted to UDOGM 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 be mixing 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 UMC 817.85.

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 (MSHA) (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 Section II, Hydrologic Balance, 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 associated with removal of the fill.

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 kilovolt (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 TA.

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, 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 important than direct loss of habitat include (1) human harassment of all wildlife, (2) mule deer road-kills, and (3) the potential effects of subsidence on springs and raptor cliff nesting habitat.

The effects of human harassment on wildlife, either inadvertent or purposeful, 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 shown, in a study on the effects of the 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. 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 permit, 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

7. Existing raptor nests adversely affected by mine related subsidence shall be replaced or otherwise mitigated by the permittee in consultation with the USFWS 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 perennially. 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 Section VI, Disposal of Underground Development Waste, of this document.

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 pre-law fill and 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 indicate that waste rock with high sodium adsorption ratios could be included in the rock waste. These samples are not indicative of most of the waste to be generated. The applicant has committed to sample and dilute waste having high SAR values with waste rock exhibiting low SAR values during grading.

Several other potentially toxic and acid-forming materials have been identified by the applicant. Provisions for disposal have been provided. All coal waste and any highly pyritic material will be diluted with low-sulfur rock and will be buried under four feet of fill. Sediment from the sediment pond and asphalt road base will be buried under four feet of non-toxic fill.

8.2 Evaluation of Compliance

UMC 817.99 Slides and Other Damage

Specific plans have been provided for reporting slides to UDOGM should they occur. The applicant is in compliance with this section.

UMC 817.100 Contemporaneous Reclamation

Revegetation of a number of existing fill slopes will commence the first appropriate season following permit approval. This revegetation will be in the form of test plots as described on pages 4-13 to 4-22, Vol. 2. The remaining existing disturbed areas are required for mine operation.

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 pre-law 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 empirical evidence of stability. 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 TA and has been found to be adequate. The applicant was granted a variance from the requirements of UMC 817.72(d) which calls for diversions 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 (PAP, p. 4-41) is to utilize complete extraction methods (i.e., primarily longwall 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 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 if there are any subsidence impacts to structures, they will be mitigated. 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 it to its pre-subsidence usefulness.

The applicant has committed to mitigate any adverse subsidence impacts to perennial streams if any occur.

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

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 longwall 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 an east-west direction with Panel 5 East being the northernmost (see Figure 8, Deer Creek Longwall 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 were 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 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. 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 conditions in this area has been observed (over Panel 6 East). However, no second seam 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 longwall 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 continue 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 has undoubtedly 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 in this isolated case 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 UDOGM. 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, which 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 measured over 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 longwall 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 barrier pillars 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 likely be regionally 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 maximum lowering had not yet occurred by the time the most recent annual subsidence monitoring report was submitted.

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 competent 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 longwall-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.

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, UDOGM, 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 150 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 in the 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 portions 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 it 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 longwall 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 longwall 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 second-seam mining under the perennial streams. To ensure protection of these streams, the applicant shall be required to present these data and interpretations prior to second-seam mining (Condition 8).

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 USBM study area after the Bureau has finished (Appendix X of the PAP).

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 precise 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 to protect transmission lines, which can be damaged by even the slightest tilting. In this area, pillars will

be left to prevent surface subsidence. Pillar sizing was based on successful surface protection by the 80 feet by 80 feet pillars used in other portions of the mine where overburden is as much as 2,000 feet. In addition, studies by A.H. Wilson (June, 1972, article in The Mining Engineer, titled, "Research into the Determination of Pillar Size") and C.T. Holland (March, 1963, in Mechanization, titled, "Pressure Arch Techniques") indicate that the proposed pillars are adequate to protect these structures. The applicant has not proposed any buffer zones around the perennial streams across the mine. Accumulation of data regarding the cumulative effects of mining two seams by longwall methods at the Deer Creek Mine is not yet complete.

The steep and narrow characteristics of stream channels in the permit area make the standard application of a 100 foot buffer zone around the perennial streams inappropriate. The resulting buffer zones would incorporate large areas of uplands with no resulting increase in stream protection. Accordingly, condition 8 uses the application of a very conservative angle of draw value of 35 degrees from vertical, measured from the limit of the mined area of the lowest seam to the center of the stream channel to establish an effective buffer zone. Bureau of Mines subsidence studies indicate that actual subsidence in the vicinity of the perennial streams is unlikely to reach 35 degrees; therefore, a buffer zone of no ground movement is built into the 35 degree figure at the stream channel. The condition ensures that the streams will be protected while appropriate information is collected to evaluate the overall effect of second seam mining.

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 seal with sediment and overburden material 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. With the stream protection addressed in Condition 8, the applicant is in compliance with UMC 817.126.

9.3 Conditions

8. Prior to beginning second seam mining inside a perennial stream buffer zone as defined by a 35 degree angle of draw from vertical, measured from the limit of mining in the lowest seam, to the center of the stream channel, 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. 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 the regulatory authority. Samples shall be taken of seedbed material at five-year intervals to record productivity changes.

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, containerized 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.

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 introduced 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 similar 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 fail, 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 or greater) approximating the original slopes. No soil is available for redistribution 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 precipitation, 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 revegetation 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) public road providing access to the mine, (2) coal facilities access road, and (3) mine fan access road.

The mine access road is asphalt-surfaced, and extends 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 letters of concurrence). 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 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 circuit. 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 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.

11.2 Evaluation of Compliance of Proposal

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 meets the requirements of Section 515 (b)(17) of SMCRA concerning access roads.

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, insomuch as the water will eventually reach the downstream portions of the drainage system. 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 habitat. 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 habitat. 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 reestablished 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 not paved. 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 not proposed.

14.2 Evaluation of Compliance of Proposal

UMC 817.95 Air Resources Protection

The applicant is in compliance with the requirements 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. Cost estimates are based on engineering analyses and standard 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:

APPLICANT'S PROPOSAL

	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.	Fertilizing 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 complied with the requirements of this section.

UMC 800.13 Regulatory Authority Responsibilities

OSM 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:

OSM'S DETERMINATION

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

An escalation factor of 3.79 percent per year is the current figure applied to all coal mining bonds in Utah by the Utah Division of Oil, Gas and Mining. The required bond amount is, therefore, rounded to $1,224,000. This figure is sufficient to insure funds through 1990.