Redline Strike Out

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January 31, 2006 Submittal

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524.748 The type and length of the stemming will be recorded on the blasting record.

524.749 Mats or other protections used will be recorded on the blasting record.

524.750 Since all structures are either owned by the permittee and not leased to another person or are located over six miles distance from the permit area a record of seismographic and airblast information is not required.

524.760 Since a blasting schedule is not required this section does not apply.

524.800 The operator will comply with the various appropriate State and Federal laws and regulations in the use of explosives.

525. Subsidence: The permittee will comply with the appropriate R645-301-525 requirements.

525.100 Subsidence Control Plan

525.110 Plate 5-3 shows the location of State appropriated water and 5-3 (Confidential) shows the eagle nests that potentially could be diminished or interrupted by subsidence.

525.120 SUBSIDENCE POTENTIAL (See also Section 5.4 of Part "A")

A review of renewable resources in and adjacent to the permit area found resources consisting of ground water, grazing, timber, and water supply. Subsidence from underground coal mines has been believed to affect overlying forest and grazing resource lands in the following ways:

- Formation of surface fissures which intercept near surface soil moisture thus draining the water away from the root zone with deleterious effects.
- Alterations in ground slope and destabilization of critical slopes and cliffs.

- Modification of surface hydrology due to the general downward migration of surface water through vertical fractures.

- Modification of groundwater hydrology including connection of previously separated aquifers and reduction in flows of seeps and springs which rely upon tight aquitards for their flow.

- Emissions of methane originating from the coal seam through open fissures to the surface or at least the base of the surficial soil which has been known to have deleterious effects on woody plants.

Because these renewable resources exist with and adjacent to the permit area, a subsidence control plan is required. This plan is presented in Section 525.400.

A great deal of baseline data is available from many mining settings to develop subsidence damage criteria for surface structures (Bhattacharya et al. 1984). The ~~SME Mining Engineering Handbook suggests a limiting extension strain value of 5×10^{-3} for pasture, woodland, range or wildlife food and cover.~~

~~The~~ formation of cracks and fissures are the general effects of subsidence and can ~~also~~ have minor deleterious effects on groundwater resources without any fissuring to the surface. In the arid areas of Utah, impacts ~~of~~to and modification of the groundwater regime can be disruption of flow from natural seeps and springs which rely on the permeability contrast of interbedded sandstones and shale for their flows. These water resources are generally near surface occurrences and are essentially surface waters and subject to the same limiting damage criteria as surface water bodies. Subsidence damage to surface water bodies has been studied by a number of workers including Dunrud (1976), Wardell and Partners (1976), and U.S. Bureau of Mines (1977~~), and Engineers International (1979)~~. The results of the Wardell and Partners studies of subsidence effects in a number of countries indicates that the limiting strain for the onset of minor impacts to surface waters is approximately 5 x

10^{-3}.

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~~Dr. Roy Sidle found in his study of Burnout Creek that subsidence impacts to streams are temporary and self healing. A Executive Summary of is study and published~~ The SME Mining Engineering Handbook also suggests a limiting extension strain value of 5 x 10^{-3} for pasture, woodland, range or wildlife food and cover.

Table 10.6.19 in the Mining Engineers Handbook suggests that the minimum safe cover required for total extraction of the coal resources under surface waters is approximately 60 times the seam thickness for coal beds at least 6 feet thick or approximately 450 feet. In their review of the foregoing, Singh and Bhattacharya (1984) recommended that the same limiting safe strain values and cover thickness ratios be used for protecting groundwater resources over coal mines. Where extension strain is greater than this limiting value, it is likely that surface fissures and cracks may develop. As the strain value decreases below the limiting value, the potential for surface damage decreases.

Figure 1 in Appendix 7-3 shows a typical subsidence profile. As shown in Figure 1, the zones are: a caved zone that occurs in the 6 to 10 times the thickness of the coal seam, a fractured zone which occurs 10 to 30 times the thickness of the coal seam, and deformation zone which occurs 30 to 60 times the thickness of the coal seam, and finally, a soil zone which occurs on the ground surface.

The longwall panels in the Lila Canyon Mine will have dimensions of approximately 950 feet wide and up to 7,000 feet long and 2,000 feet deep. Using the methods described in the National Coal Board's *Subsidence Engineers' Handbook*, the S/m ratio for this geometry would be 0.38 where "S" is the maximum subsidence and "m" is the seam extraction thickness. For an average seam extraction thickness of 10.5 feet, the total subsidence would be 4.0 feet. However, as described above, the major impacts of this subsidence are due to extension strains and not total vertical subsidence. The prediction of average extension strain is accomplished with the use of the formula:

$+E = 0.75\ S/h$ where S=subsidence, and h=depth of cover

The solution of this equation for the Lila Canyon Mine configuration discussed above produces a predicted, average extension strain of 1.5 x 10^{-3} which is less than the limiting strain of 5 x 10^{-3} for protecting surface waters, groundwater sources, pasture, woodland, range or wildlife food and cover. Thus, it is unlikely that the gradual compression expected over much of the subsidence area will have any deleterious effects on the overlying renewable surface resources. The cover thickness of 1,000 to over 2,000 feet, over most of the mine area is also much greater than the limiting thickness of 630 feet recommended by International Engineers Inc. (1979) (10.5' x 60). The table below shows the expected subsidence amount and expected extension strain for longwall panels at various mining depths. These calculations were done for a flat multiple seam mining. There are adjustments for single seam mining and for dipping seams. However, these adjustments are minor and are not expected to result in significant changes in values.

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Maximum Subsidence & Expected Extensive Strain (NCB 1975)

	Feet	Meters
Panel Width =	900	274
Seam Height =	10.5	3

Depth of Cover		Width to Depth (a)	Maximum Subsidence(S)		Extension Strain (E)
Feet	Meters	Ratio	Feet	Meters	x 10-3
500	152	0.9	9.5	2.9	14.2
1000	305	0.75	7.9	2.4	5.9
1100	335	0.71	7.5	2.3	5.1
1200	366	0.68	7.1	2.2	4.5
1300	396	0.65	6.8	2.1	3.9
1400	427	0.59	6.2	1.9	3.3
1500	457	0.54	5.7	1.7	2.8
2000	610	0.38	4.0	1.2	1.5
2500	762	0.28	2.9	0.9	0.9

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The most favored technique until recently has been the use of the empirical charts developed by the National Coal Board (NCB). The above calculations were obtained using the empirical charts developed by the National Coal Board (NCB). Comparisons, as stated in the SME handbook, of US subsidence data with NCB predictions highlight the following differences between coalfields in the US and UK: Most of the studies in the US are limited to the Eastern US coalfields with a very limited data base applicable to western conditions.

With the exception of Illinois, maximum subsidence factors observed in US coalfields are less than predicted by NCB.

The limit (draw angles in the US coalfields tend to be less then the 35 degree value generally accepted by NCB.

The points of inflection of the subsidence profiles over US coal mines are generally closer to the panel centerline compared to the NCB profile. This effect is dependent not only on the percentage of competent strata in the overburden but also on their locations relative to the ground surface and their thickness.

Surface strains and curvatures observed over US longwall panels have been shown to be significantly higher then NCB predictions, almost four times larger in many cases.

The pace at which subsidence occurs depends on many controls including the type and speed of coal extraction, the width, length and thickness of the coal removed, and the strength and thickness of the overburden. Observations of subsidence by Dunrud over the Geneva and Somerset Mines indicate that subsidence effects on the surface occurred within months after mining was completed, and the maximum subsidence was essentially completed within 2 years of the completion of retreat mining.

Dr. Roy Sidle found in his study of Burnout Creek that subsidence impacts to streams are temporary and self healing.

The Sidle Study is representative of the conditions found in the Lila area because:

- the lithology is very similar between the Book Cliffs and the Wasatch Plateau

- the cover thickness ranges from **500 -15000** feet which falls within the rage expected at Lila, and

- the seam thickness of **6-8 feet** is in the same range expect at Lila.

An Executive Summary of his study and published findings follows:

Title : Stream response to subsidence from underground coal mining in central Utah

2. Authors: Sidle-RC Kamil-I Sharma-A Yamashita-S

Short-term geomorphic and hydrologic effects of subsidence induced by longwall mining under Burnout Creek, Utah were evaluated. During the year after longwall mining, 0.3-1.5 m of subsidence was measured near impacted reaches of the mountain stream channel. The major channel changes that occurred in a 700-m reach of Burnout Creek that was subsided from 1992 to 1993 were: extent glides; (2) increases in pool length, numbers and volumes; (3) increases in median particle diameter of bed sediment in pools; and (4) some constriction in channel geometry. Most of the changes appeared short-lived, with channel recovery approaching pre-mining conditions by 1994. In a 300-m reach of the South Fork drainage that was subsided from ~~served~~1993 to 1994, only channel constriction was observed, although any impacts ~~an~~on pool morphology may have been confounded by heavy grazing in the riparian reaches during the dry summer of 1994. Similar near-channel sedimentation and loss of pool volume between 1993 and 1994 were noted throughout Burnout Creek and in adjacent, unmined James Creek. Subsidence during the 3-year period had no effect on baseflows or near- channel landslides.

~~Engineers International (1979) concluded that the minimum safe cover required for total extraction of the coal resources under surface waters is approximately 60 times the seam thickness for coal beds at least 6 feet thick or approximately 450 feet. In their review of the foregoing, Singh and Bhattacharya (1984) recommended that the same limiting safe strain and cover thicknesses be used for protecting groundwater resources over coal mines.~~

The longwall panels will have dimensions of approximately 950 feet wide and up to 7,000 feet long and 2,000 feet deep. Using the methods described in the National Coal Board's *Subsidence Engineers' Handbook*, the S/m ratio for this geometry would be 0.38 where "S" is the maximum subsidence and "m" is the seam extraction thickness. For an average seam extraction thickness of 10.5 feet, the total subsidence would be 4.0 feet. However, as described above the major impacts of this subsidence are due to extension strains and not total vertical subsidence. The prediction of average extension strain is accomplished with the use of the formula:

+E = 0.75 S/h where S=subsidence and h=depth of cover

The solution of this equation for the Lila Canyon Mine configuration discussed above produces a predicted, average extension strain of 1.5×10^{-3} which is less than the limiting strain of 5×10^{-3} for protecting surface waters, groundwater sources, pasture, woodland, range or wildlife food and cover. Thus it is unlikely that the gradual compression expected over much of the subsidence area will have any deleterious effects on the overlying renewable surface resources. The cover thickness of over 2,000 feet is also much greater than the limiting thickness of 450 feet recommended by International Engineers Inc. (1979). The table below shows the expected subsidence amount and expected extension strain for longwall panels at various mining depths.

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The pace at which subsidence occurs depends on many controls including the type and speed of coal extraction, the width, length and thickness of the coal removed, and the strength and thickness of the overburden. Observations of subsidence by Dunrud over the Geneva and Somerset Mines indicate that subsidence effects on the surface occurred within months after mining was completed, and the maximum subsidence was essentially completed within 2 years of the finishing of retreat mining.

No major impacts of subsidence to the surface, caused by the underground mining methods proposed during the permit term are anticipated.

The coal seam is approximately 12.5 feet thick with only about 10.5 feet being extracted, and the depth of cover ranges from 0' to approximately 2,300'. The rocks overlaying the coal seam are sandstones and mudstones with some thin bands of coal. Due to the strength of the overburden, and depth of workings, even with full seam extraction, only minimal subsidence, if any, is anticipated.

Some surface expressions of tension cracks, fissures, or sink holes may be experienced but should be insignificant. The chances of subsidence-- -related damage to any perceived renewable resource is minimal.

All dirt roads above the mine are in areas in excess of 1,000 feet of cover or in areas where mining will not take place. The chance of subsidence negatively effecting these dirt roads is minimal. However, in the unlikely event that cracks, fissures or sink holes are observed as a result of subsidence, the road will remain accessible by regraded,regrading and filling in the cracks, fissures or sinkholes.

The unnamed ephemeral channel in the southwest corner of the permit area is located in an area where no mining is planned or over the top of a bleeder system that will not be second mined. The chance of subsidence negatively effecting this ephemeral channel is minimal. However, in the unlikely event that cracks, fissures or sink holes are observed as a result of subsidence the channel will be regraded, filling in and the cracks, fissures or sinkholes will be filled in by hand methods due to its inaccessibility.

A small portion of Little Park Wash, which is ephemeral, has less than 1,000 feet of cover in the southwest corner of the permit area. The portion with less than 1,000 feet of cover runs diagonally across one longwall panel and then parallel to the bleeder system in the second longwall panel. In the unlikely event that cracks, fissures or sink holes are observed as a result of subsidence the channel will be regraded, filling in the and cracks, fissures or sinkholes will be filled in. Since this stream channel is accessible and is traversedtraversible by 4 wheel drive, access for repairs would not be a problem. If any subsidence repairs cannot be fixed using hand methods, a small pieces of earth moving equipment could be used.

DWR and BLM wWildlife Biologists, in consultation with the Division, have determined that any loss of snake dens to subsidence would be random and a minor impact to the population of snakes.

525.130 A survey was conducted within the proposed permit area and adjacent area and it was determined that limited renewable resource lands exist within the area surveyed. Limited areas were found which contribute to the long-range productivity of water supply or fiber products. No structures exist ~~with in~~within the permit area in which subsidence, if it occurred, could cause material damage or diminution ~~or~~for reasonably foreseeable use. See ~~p~~Plates 5-5 and 5-3 for areas of potential subsidence. Identification and data for the State appropriated water supplies can be found in chapter 7 section 727.

All State Appropriated water rights within the maximum limit of subsidence~~,~~ that could be ~~effected~~affected, ~~is~~are either owned by the Operator or by the BLM. The BLM has been notified of the water rights survey by means of the submittal of the permit application.

According to Mark Page (State Water Rights), there is not a water conversation district associated with Lila Canyon Mine.

525.200. Protected Areas

525.210. Since there are no public buildings or other facilities such as churches, school or hospitals, and since there are no impoundments with a storage capacity of more than 20 acre-feet, this section does not apply.

525.220. Since R645-301-525.210 does not apply, this section does not apply.

525.230. Since there are no planned operations under urbanized areas, cities, towns, and communities, or adjacent to industrial or commercial buildings, major impoundments, or perennial streams this section does not apply.

525.420 Plate 5-5 shows the underground workings and depicts areas where first mining or partial mining will be utilized to protect the escarpment and raptor nests that may exist on the escarpment, and to insure that subsidence remains within the permit area. State-appropriated water rights are shown on Plates 5-3, 5-5 as well as Plate 7-1.

525.430 No major impacts of subsidence to the surface caused by the underground mining methods proposed during the permit term are anticipated.

The coal seam is approximately 12.5 feet thick with only about 10.5 feet being extracted, and the depth of cover ranges from 0' to approximately 2,300'. The rocks overlaying the coal seam are sandstones and mudstones with some thin bands of coal. Due to the strength of the overburden~~,~~ and depth of workings, even with full seam extraction, only minimal subsidence if any is anticipated.

525.440 Aerial subsidence monitoring will be done annually while the significant subsidence is taking place. The subsidence monitoring will be initiated in an area prior to any 2nd mining being done within that area. Initially a 200 foot grid along with baseline photograph will be established prior to any 2nd mining. Approximately 12-16 control points will be needed to cover the total mining area. Six of these points will be located outside of the subsidence zone. The accuracy of this survey will be plus or minus 6" horizontally and vertically. From this data a map will be created that will show subsided areas. Once ~~a~~per year a follow up aerial will be performed to determine the extent and degree of active subsidence. Subsidence monitoring will continue for a minimum of 5 years after the mining ceases. If at the end of the 5 year period the annual subsidence in any of the 3 prior years measures more than 10 percent of the highest annual subsidence amount, subsidence monitoring will continue until there are 3 consecutive years where the annual subsidence amount is less than 10 percent of the highest annual subsidence amount. If for three years in a row the subsidence is measured to be less than 10% of the highest subsidence year, subsidence will be determined to be complete, and no additional monitoring for that area will be required.

A ground survey will be performed in conjunction with the quarterly water monitoring program. During the normal water monitoring program any cracks observed will be noted and reported to DOGM. -

Two areas of the permit have stream reaches with less than 1,000 feet of cover over the coal seam. As discussed in Section 525.120, it is not envisioned that subsidence will negatively impact these areas. However, during and following mining near these areas, special attention will be paid to these areas during the ground surveys.

The ground survey will consist of walking and photographing the various areas of the surface over the mine where subsidence might occur. If evidence of subsidence is identified, the area of subsidence will be surveyed and the extent of the disruption identified. Depending on the extent and location of the damage, mitigation measures will be reviewed and implemented. Due to the fact that mitigation options change with time as new technology and measures are developed, ~~no specific measures are presented~~better options may be implemented in the ~~application~~future.- However, ~~UAE~~UEI provides a commitment that where subsidence damage affects uses of the surface, the land will be restored to a condition capable of maintaining the value and reasonable foreseeable uses which it was capable of supporting before the subsidence. The surface effects will be repairs as described in Section 525.500.

resource is minimal.

525.470. Since no urbanized areas, cities, towns, public buildings, facilities, churches, schools, or hospitals exist within the permit area this section does not apply.

525.480. There are no plans to change or modify the mining plan to protect any springs or seeps. Springs with water rights will be monitored for flow and quality as described in Chapter 7 Section 731.211. UEI has committed to provided for mitigation of any lost water rights as per Chapter 7 Section 727.

525.490. Other information specified by the Division as necessary to demonstrate that the operation will be conducted in accordance with R645-301-525.300 will be provided.

525.500. Repair of damage.

525.510. If ~~the~~ effects of subsidence ~~is~~are confirmed, any material damage to the surface lands will be restored to the extent technologically and economically feasible. The land will be restored to a condition capable of maintaining the value and reasonable foreseeable uses which it was capable of supporting before the subsidence.

525.520. Since no structures exists within or adjacent to the permit area which could be damaged by subsidence, should it occur, this section does not apply.

525.530. The Little Park Road exists in the subsidence zone. In the unlikely event the road is damaged by subsidence, UEI will repair the damage as per Section 525.120.

526. A narrative explaining the construction, modification, use, maintenance and removal of the mine facilities follows. Additional information can be found in Appendix 5-4 and Chapter 8.

526.100 Mine Structures and Facilities.

526.110 The only existing structures are found in Horse Canyon (Part "A" of this permit) and are the remains of the United States Steel operation. Horse Canyon has received phase II bond release and the remaining

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water level is probably representative of the level of water collected in the rest of the mine. Therefore, to be conservative, it is assumed that the Geneva exploration entries driven south from the Horse Canyon Mine into the proposed Lila Canyon mining area do contain water since the tunnels elevation is approximately 5855 feet.

The Horse Canyon Mine has been closed and the surface area reclaimed. With no significant inflow to the old workings, no discharges are occurring from any of the portal areas nor are expected in the future. It is known however, that water has collected in the old entries. As future mining activities, for the proposed Lila Canyon Mine, will be occurring near this area of collected water in the old exploration entry workings, it is likely that some of this water will be intercepted by the proposed Lila Canyon Mine (see Plate 7-1). Water may then have to be pumped from the mine. Because of undulating floor and unknown void areas, it is impossible to determine the amount of water that would be pumped. The rate of pumping, if any, would be determined by the water discharge system design. All water discharged from the mine would be discharged at UPDES Site # 002A which is Site L-5-G, and will meet all UPDES standards. DOGM has specified planning to include a mine discharge of 500 gpm maximum.

An inspection of the Horse Canyon area following mining has shown no diminution of reasonably foreseeable use of aquifers. Since mining ceased in 1983, subsidence should have occurred within two years. However, no deterioration of the aquifers in the area was identified. Mining has not yet begun on the Lila Canyon site; however, since the structure and groundwater regime is similar to the Horse Canyon area, no diminution or deterioration of groundwater resources is expected in this area.

As the mining in the Lila Canyon Mine will be from the same seam and the adjacent strata are the same and the over and underburden are the same, occurrences of ground water in the Lila Canyon Mine are expected to be similar to the Geneva Mine (Horse Canyon). The water quality is expected to be the same as the water encounter in the Horse Canyon Mine. Samples taken underground from the Horse Canyon Mine (MRP part "A" Appendix VI-1) to the north of the Lila Canyon Mine and from well S-32 (MRP part "B" Appendix 7-1) by Kaiser to the south of the Lila Canyon Mine show the water from the level of the coal seam to be a calcium, sodium-sulfate type water. Therefore, it is likely that the water from the strata between these two points from the same strata will be very similar.

Inflows of water encountered while mining are expected to reduce to seeps or dry up in a short period of time. If a significant water inflow is encountered, the water, which is not needed for underground operations, will be collected, treated as necessary, and pumped to the surface for discharge under the terms of the UPDES permit.

Groundwater Systems. In the Lila Canyon Lease area, the groundwater regime consists of two separate and distinct multilayered zones. The upper zone consists of the Wasatch Group which consists of the Colton Formation, the undifferentiated Flagstaff Limestone-North Horn Formation, and the Price River Formation. These formations contain groundwater in perched aquifers. These perched zones are classified as aquifers because they supply groundwater in sufficient quantities for a specific use (as specified by R645-100-200). The lower zone consists of the Blackhawk Formation (where the coal seams are located). This formation consist of low-permeable strata which contain groundwater in isolated saturated zones. Based on the definition in the ~~DOGM~~State coal mine regulations (R645-100-200), there is no aquifer in the lower saturated zone, because the water is not developed for a specific use nor does the strata transmit sufficient water to supply water sources. Additionally, there is no discharge from this zone along any fault or fracture or in any adjacent canyons. The two zones are separated by the Castlegate Sandstone. This zone is a porous, fairly clean sandstone. According to Fisher, et.al. (1960), the Castlegate Sandstone does not have any shales, clays, siltstones, or mudstones. The lower zone is underlain by the Mancos Shale, a very impermeable marine shale.

Geologic conditions in the permit and adjacent areas are described in detail in Chapter 6 of this P.A.P. Though discussed in several publications for the general Book Cliffs area, formal aquifer names have not been applied to any groundwater system in the permit and adjacent areas because the geometry, continuity, boundary conditions, and flow paths of the groundwater systems in the area differ somewhat from the general published discussions. However, the data do suggest that groundwater systems in each of the bedrock groups are sufficiently different from each other to justify the informal designation of groundwater systems based on bedrock lithology. Thus, the informal designation of the Upper zone - Colton, Flagstaff/North Horn, and Price River and the Lower zone - Castlegate, Blackhawk, and Mancos groundwater systems is adopted herein.

The majority of groundwater in the permit and adjacent areas generally occurs within perched aquifers in the upper zone overlying the coal-bearing Blackhawk Formation. In the lower zone groundwater occurs in isolated saturated zones in the Blackhawk Formation. Hydrogeologic conditions within the permit and adjacent areas are summarized below:

Upper Groundwater Zone

Colton Formation. The Colton Formation outcrops in the northeast portion of the permit and adjacent areas. This formation consists predominantly of fine-grained calcareous sandstone with occasional basal beds of conglomerates and interbeds of mudstone and siltstone. Data presented in Plates 7-1 and 7-1A and Appendices 7-1 and 7-6 indicate that 16 springs issue from the Colton Formation within the permit and adjacent areas.

Waddell et al. (1986) evaluated the discharge of springs in the formation for the period of June to September 1980. The measured discharge rate generally declined during the 4-month period of evaluation. This suggests that the groundwater system has a good hydraulic connection with surface recharge and that most of the annual recharge quickly drains out of the system.

Groundwater issuing from the Colton Formation has a total dissolved solids ("TDS") concentration of 300 to 600 mg/l (as measured by specific conductance and laboratory analyses of TDS). The pH of this water is slightly alkaline (7.5 to 8.1). Insufficient data are available to describe seasonal variations in these parameters.

The water is a calcium-magnesium-bicarbonate type (see Appendix 7-1). The data also indicated total iron concentrations of <0.04 to 4.89 mg/l. Total manganese concentrations ranged from <0.01 to 1.29 mg/l.

Undifferentiated Flagstaff-North Horn Formation. The Flagstaff-North Horn Formation outcrops across much of the northern and central portion of the permit area. This formation consists of an interbedded sequence of sandstone, mudstone, marlstone, and limestone. Most springs and a major portion of the volume of groundwater discharging from the permit and adjacent areas issue from the Flagstaff-North Horn Formation. According to Plates 7-1 and 7-1A and Appendices 7-1 and 7-6, 36 springs issue from the Flagstaff-North Horn Formation within the permit and adjacent areas.

Groundwater discharge rates for springs issuing from the Flagstaff-North Horn Formation are greatly influenced by seasonal variations in precipitation and snowmelt, with most discharge corresponding to the melting of the winter snow pack during the spring months. Discharge is highest following the spring snowmelt and decreases to a trickle by the fall (Appendices 7-1

Springs are considered are from a localized, isolated saturated zone, but not part of a regional aquifer or an extensive saturated zone.

Recharge and Discharge Relations

Recharge in the permit and adjacent areas occurs from precipitation to the exposed strata. Plate 7-1a shows the major zone of recharge. This recharge area corresponds to the outcrop and exposure of the Colton/Flagstaff-North Horn fFormations. No perennial surface water streams or surface water bodies exist within the permit or adjacent areas which contribute water to the groundwater systems. AnyThe majority of infiltration is a near surface occurrence into the alluvial fills within the drainages. The deeper sediments underlying the drainages (Blackhawk and Mancos) consist of low transmissivity strata which would prohibit the vertical movement of groundwater.

Recharge rates were calculated by Waddell and others (1986, p. 43) for an area in the Book Cliffs. Waddell estimated recharge at about 9 percent of annual precipitation. Lines and others (1984) indicate the mean annual precipitation along the Book Cliffs in the area of the Horse Canyon Mines is about 12 inches, indicating a recharge rate of just over 1 inch per year.

The recharge and discharge areas for local perched aquifers in the upper zone (Colton, Flagstaff-North Horn and Price River Formations) generally lie within the drainage areas of Horse and Lila Canyons. These local systems are complex and highly dependent on topography. Recharge water from precipitation or snow meltsnowmelt enters the Colton or Flagstaff-North Horn Formations and moves downward until it encounters low permeability shale or claystone layers in the formations, where almost all of the water is forced to flow horizontally to springs. The springs exhibits substantial variability in discharge in response both to spring snowmelt events and to drought and wet years. Discharge rates as great as 20 gpm have been recorded from the springs during the high-flow season, and discharge rates as low as 1 gpm are not uncommon during late summer. The effects of the drought occurring in the late 1980s and early 1990s are clearly evident in the flow records.

Recharge to the lower zone including the Castlegate Sandstone, Blackhawk Formation, and Mancos Shale is of limited magnitude, due to the limited area of exposure of the formation ons to steep outcrops and the presence of low-permeability units in overlying North Horn and Price River Formations. Additionally, the clay layers in the upper Blackhawk, which contain approximately 80 percent clays, siltstones, mudstones, and shales, are all highly restrictive to vertical groundwater movement (Fisher and others, 1960). Further, no surface water bodies are present to act a supply sources to the deep ground water system.

Surface waters in this part of the Book Cliffs drain to the Price River. The Price River flows to the Green River which, in turn, flows to the Colorado River. It is anticipated that only during extremely long duration, high-intensity thunderstorms that flow from the ephemeral drainages within the permit area would reach the Price River. Due to the length of channel and the limited volume of runoff, the majority of flow is lost to channel losses, as indicated in Appendix 7-9.

Lines and Plantz (1981, p. 33) conducted three seepage surveys of Horse Canyon Creek in 1978 and 1979. The results of the surveys show no consistent trends through time. Mine discharges created difficulties in interpretation of the data because there was no indication of whether the mine was or was not discharging water at the time of the surveys. However, Horse Canyon Creek below the mine is ~~believed to be a~~ losing stream, due to the visual observation of low flows decreasing downstream of the mine (professional observations, Thomas Suchoski, 1979-1980 & 1984-86). Flow in the channel adjacent to the mine facility entry portal on several occasions during mine inspections during the spring period were approximately 4 to 6 inches deep, with a flow width of 15 to 20 feet. Downstream of the mine in the area of the roadside refuse pile, the flow would be 2 to 3 inches deep with a flow width of 10 to 12 feet. Channel slopes in both areas were similar. No diversions are present along this reach of the channel to reduce the flow. Therefore, the channel flow decrease is the result of infiltration and evaporation of the water within the channel.

The Lila Canyon drainage is normally dry, flowing only in response to precipitation runoff or rapid snowmelt. The mine facilities will be located in the Right Fork of Lila Canyon.

In January 2004, an assessment of the geomorphic character of the Lila Canyon channel, downstream of the proposed mine site, was conducted to address DOGM comments. A series of channel cross-section measurements were taken and the bed and bank materials visually observed. During this evaluation, it was discovered that a diversion structure had been installed just above the confluence of the Right Fork of Lila Canyon and Grassy Wash (see Appendix 7-9 and Figure 7-3). This diversion structure will divert all flow from the drainage and convey it by diversion channel to a stock pond located in the SW/4, SW/4 of Section 28, T. 16 S., R. 14 E. Subsequently, it was determined that the improvements were part of a BLM range improvement project. This structure has significantly modified the drainage pattern for this area. Flows that previously would have flowed into Grassy Wash will now be detained in the stock pond.

The closest perennial stream to the permit area is Range Creek. The drainage is located approximately 6 miles east of the proposed Lila Canyon permit area boundary (see Plate 7-1a).

-Range Creek is in a broad, south-southeast oriented drainage that has been eroded into the Roan Cliffs. A western extension of the Roan Cliffs (Patmos Ridge) lies between Range Creek and the Book Cliffs. The proposed Lila Canyon operation is on the west side of Patmos Ridge. The Colton Formation is exposed at the surface from Patmos Ridge east to the main body of the Roan Cliffs, and between these two escarpments Range Creek has eroded into but not through the Colton Formation. Approximately eleven miles southeast of the permit area, just upstream of Turtle Canyon, Range Creek has eroded through the Colton, Flagstaff, and North Horn Formations, but it reaches the Green River without having eroded through the Upper Price River Formation. The nearest Blackhawk outcrop is 10 miles further south, along the Price River.

Argument has been made that Range Creek receives recharge from a regional aquifer which is likely from the lower saturated zone that the Lila Canyon Mine will be mining or that the overlying perched upper zone might be drained by the mining activities and affect the flows contributing to and in Range Creek.

To address these concerns, the following issues were evaluated. An evaluation of the elevation difference between the saturated ground-water zone in the Blackhawk Formation and stream flows in the Range Creek drainage was conducted, especially for the reaches nearest the permit area. Also, the thickness and composition of the strata between the coal seam and the creek was conducted. Further, the potential for diminishment of ~~the~~ spring and tributary flows to the Range Creek drainage resulting from subsidence impacts within the recharge area to ~~Range Creek~~the overlying strata was evaluated.

If the deeper ground water in the Blackhawk Formation were to flow following either the gradient indicated by the piezometers (see Figure 7-1) or geologic dip (see Plate 7-1B), the water would flow well below Range Creek (800 to 1,200 feet) in the reaches nearest the Lila Canyon Mine and for many miles downstream.

Additionally, the thick section of strata between Range Creek and the Blackhawk Formation would impede hydraulic interaction between any deep ground water and the surface (Plates 7-1A and 7-1B). It is estimated that the vertical separation between the Blackhawk and Range Creek at the base of the Colton would be about 1,200 feet.

Based on the stratigraphic column in the area, the overall percentage of less permeable strata is 47 percent. Looking at the distribution of the less permeable strata, the majority is in the upper lithographic units. The Colton and North Horn-Flagstaff contain about 1940 feet of less permeable units, while the Price River and Blackhawk contain about 480 feet. Therefore, there is little potential for water to move vertically between the upper and lower zones. The main direction of water movement will be horizontally within the strata.

Further, the elevation of Range Creek in the area of concern ranges from 6890 to 5740 feet (see Plate 7-1A). The coal seam exposure along the Book Cliffs ranges from 5,500 to 6,000 feet. Therefore, for water to flow from the coal seam to Range Creek the flow would need to overcome a hydraulic head difference of 200 plus feet, just based on the initial elevation and not accounting for dip of the formations. There is insufficient head and no source of water to provide the driving head for such conditions.

In regard to subsidence affecting the potential recharge to the springs and tributaries to Range Creek, as described in Chapter 5, Section 525, the subsidence limits from the proposed mining are required to be limited to the area of the permit boundary. Therefore, the recharge area to Range Creek that ~~could be affected is~~the mine might affect is limited to that portion of the recharge area within the permit boundary.~~-~~

~~In reviewing the permit~~

To determine the recharge area to Range Creek, a review of the relationship of the proposed permit area, location of Range Creek and the geology in the area, as shown on Plate 7-1A, in the reach nearest to the proposed mine, was conducted. As is evident on Plate 7-1A, the Little Park drainage has eroded through the Colton~~,~~ and North ~~Horn-Flagstaff~~Horn Formations and ~~part of~~into the Price River ~~f~~Formation~~s. W~~, while the Range Creek~~, in the reaches nearest to the proposed mine,~~ drainage has not eroded through the Colton Formation. Based on this and the previous discussion of the high percentage of low permeable strata within the Lower Colton and North Horn-Flagstaff formations, there is limited potential for recharge to the springs and tributaries from areas below the bottom of the Colton Formation. Figure 7-3 presents a representation of the likely characterization of the method of recharge to these springs. The potential impact area from the mine is, therefore, that portion of the permit area that is east of the Horse Canyon and Little Park drainages ~~and that portion~~ which is above the Colton - North Horn-Flagstaff contact within the area of maximum subsidence.

~~Based on a review of Plate 7-1A, the portion of the permit boundary that meets these criteria is approximately 510 acres.~~ Based on a projection of the direction of dip (N68°E), the recharge area of the Range Creek drainage that might be affected by the mine would be from just north of Little Horse Canyon south to Cherry Meadow Canyon. ~~This projection represents~~ Figure 7-4 presents a localized view of the~~e~~is area with recharge potential along the west side of the Range Creek drainage. ~~Thus, the~~The total recharge area to this portion of the Range Creek drainage ~~would be~~is approximately ~~21,100~~18,150 acres.

Based on a review of Figure 7-4, the portion of the permit boundary that meets the potential impact area criteria is approximately 183 acres. Therefore, the percentage of the recharge area that might be intercepted by catastrophic subsidence is ~~2~~1.~~4~~0 percent. As catastrophic subsidence is unlikely due to the cover over the coal seam for most of this area (2,000ft ~~+~~) (see Figure 7-4), this percentage is conservatively high. Such a small percentage would not be measurable within the Range Creek drainage.

If such an occurrence were to happen, based on the hydraulic conductivity (0.1gpd/ft^2) and porosity (0.25) of the formation and the anticipated gradient (0.1ft/ft), the average linear velocity of flow through the formation would be about 0.006ft/day. This results in an estimated duration, for the reduced recharge to move laterally through the Colton Formation and reach the Range Creek drainage, to be about 8,700 to 11,300 years.

As a result of the five to six miles horizontal distance from proposed permit area to Range Creek (see Plate 7-1a) and the isolating effects of the over 1,000 feet of low-permeability, isolating strata between the coal seam and the creek elevation (see Plate 7-1B and Table above) and the limited potential and impact of subsidence damage to the recharge area, it is not likely that the Lila Canyon Mine will adversely effect Range Creek. Due to these conditions, no baseline or other sampling has been gathered nor is anticipated on Range Creek.

Additional concerns have been raised regarding the potential impact that water extracted from the Blackhawk Formation as a result of the mining activities would have on the downstream drainages, specifically the Price and Green Rivers. Initial evaluation indicates that the distance within the Blackhawk Formation between the mine and the Price River is over 12 miles. This distance alone would preclude any significant impact.

As further evidence, as discussed in Appendix 7-3, it is difficult to determine the amount of water that will be extracted by the mining activities. For design purposes, DOGM has required that a value of 500 gpm be used. This is thought to be very conservative. If this volume were extracted, the yearly total would be about 800 ac-ft per year. As there are no significant springs that discharge from the Blackhawk Formation, the loss of this flow would be minimal. Also, as discussed in Appendix 7-3, the addition or loss of this flow would result in a 0.9% flow change to the Price River and a 0.02% flow change to the Green River. In both cases, this flow change would be less than could be measured by standard methods.

The Horse Canyon drainage is monitored in accordance with the approved monitoring plan for the permit. There have been no samples taken in the Lila Canyon or Little Park Wash drainages because no flow has been observed during the monitoring activities. Factors that contribute to the lack of data are: accessibility to the sites during the winter period and immediately after summer rain storm events is generally not possible, due to safety issues and a physical lack of flow.

Access and Safety. Safety issues have hampered field work on several projects in the area. When the soils in the area get wet they become very slick and pose access and safety issues. During the IPA drilling, EarthFax had significant difficulty in getting equipment and vehicles up and down the access road following several small rain storms. In one case, they had one of their vehicles slide into the embankment rocks along the Horse Canyon access road (drop in the area was about 400 feet).

Access during rainstorms through the channels in the area is dangerous. During the avian study for the Westridge mine, Mel Coonrod (EIS) and Frank Howe (DWR) were caught in a channel during a rainstorm and lost their vehicle to flooding. This occurred on nine mile creek at the dry canyon crossing in March or April of 2000. Conditions in this drainages are similar to drainages within the Lila Canyon Permit Area.

During winter and early spring periods, there have been times when the access road has been blocked with several feet of snow making access with the field equipment impossible.

UAE's position is that collection of environmental data is not worth of the loss of life or limb. Therefore, when the conditions are unsafe, the site is labeled inaccessible. At all other times, the sites are visited and if no flow is encountered it is reported as such.

Physical Lack of Flow. The lack of flow data in the sampling effort is not a failure of the sampling effort. The lack of flow at these sample sites is data which documents the normal conditions in the site area. If the streams were flowing 50 percent of the time, it is likely that the sampling efforts would encounter flow on an infrequent basis. However, if the flow for the short return periods is extremely small or none existence, it will be difficult to obtain and provide samples of these events. This lack of flow shows that the drainages do not have a base flow component and there is no regional aquifer discharging to the deeply incised canyons and drainages in the area. The sequence of sampling efforts have demonstrated further, that there ~~is~~are no long-term flow events occurring in the mine permit area or adjacent areas. Also, spring photographs show disturbances in the stream channels from the previous ~~falls~~fall period sampling efforts, indicating that for some years no flow occurred from the fall to spring measurement events. Additionally, the peak flow simulation results show that for small return periods, 2 to 5 year events, runoff flows are not expected and that the duration of any flow events would be of extremely limited duration.

Therefore, a pattern has been identified of a set of drainages that only flow in direct response to precipitation or rapid snow melt. The flow events are localized, sporadic events with no consistent sequence and timing and are extremely limited in duration.

U.S. Steel conducted water quality monitoring of the Horse Canyon drainage. These monitoring efforts were conducted prior to the development of DOGM's present Water Monitoring Guidelines, and as a result the data is quite limited. The most recent results of these water monitoring efforts are presented in Appendix 7-2 and historic results are included in the DOGM electronic database.

The data collected from Horse Canyon follows the same pattern documented by Waddell, et.al. (1986). The pattern shows that the TDS concentrations for surface waters on the lower Blackhawk and out onto the Mancos Shale range from 1000 mg/l and increase to 2,000 to 2,500 mg/l. Additionally, the highest concentrations of suspended sediment will occur during high-intensity runoff from thunderstorms, and the lowest concentrations will occur during low flow or snow melt events.

Therefore, because of the similarity of the water quality data, the water quality expected from the drainages in the area of the proposed mine will be similar to the water quality found in the Horse Canyon drainage.

Monitoring efforts did not include remote or automatic sampling efforts because of inherent problems attempting to implement these methods for this application.

It has been suggested that crest-staff gauges, single-stage samplers, ISCO instruments, etc. could be used to collect samples. These are methods that the USGS uses for developed remote sampling sites. However, none of the UEI sampling sites are developed. In the case of crest gauges, for these methods to be reliable and feasible, the sites need to be developed with concrete or bedrock lined channel sections. For the channel configurations at the UEI sites, the channel bottoms generally consist of movable beds. These are channels that change configuration from storm to storm. As a result of channel erosion and deposition, the stage discharge relationship of the channel changes with each storm event. Therefore, while the crest gauge would indicate that a flow event may have occurred, the ability to determine what the flow rate was is greatly compromised. To be able to overcome this, it would be necessary to construct lined channel sections in remote channel areas. In some cases, this would require the construction of access ways and cement trucks to haul in the materials necessary. This would likely cause more damage than it is worth.

~~For the use of s~~Single stage and ~~ISCO~~automatic samplers~~,~~ have problems with ~~sampling limited to monthly and quarterly readings, the~~ holding time on many water ~~samples would be exceeded~~samples being exceeded and routine clogging of the inlets to the sample bottles or equipment. Holding time exceedence would occur when a storm event occurred immediately after a sampling event and a sample was collected. As discussed in the section on RF sampling, the difficulties with telemetry in the canyons and remote areas generally preclude its use in these conditions. As a result, the sample would remain in an unpreserved and unrefrigerated state for the duration of the period until the site was next visited. In the hot summer conditions, common in the area, the water quality of unpreserved and unrefrigerated samples would not be representative of the water in the drainage during the flow event. Changes to water quality parameters would be expected with changes in temperature of the sample, concentration due to evaporation of the sample, and extended contact of the water with the sediment collected in the sample bottle. Therefore, the water quality data would not be usable for determining the baseline or impact conditions.

Maintenance problems have been common problems with the use of remote samplers. Generally, these samplers work fairly well in perennial sampling environments. However, in ephemeral environments where the flows tend to be "flashy" - short duration events which carry a heavy sediment and debris load, these samplers encounter significant problems.

Several samplers were installed as apart of the Westridge Mine sampling efforts. After several abortive attempts at utilizing them for flow and quality measurements, they were removed because the data was unreliable and suspect.

~~Remote~~Radio Frequency telemetry (RF) sensing equipment has also been considered. However, as most of the monitoring sensors require line of sight and these sites are in remote, incised canyons or drainages, that ~~is~~was not ~~possible~~considered a viable option.

As a result of these difficulties, it was determined that these methods would not provide any better data than was already being collected~~ and~~. The concerns with what conclusions erroneous or questionable data would generate versus limited good data lead to the decision that these methods would not be used.

724.300 Geologic Information Detailed geologic information of the permit and adjacent areas is included in Section 600, with specific strata analyses, as required, in Section 624.

724.310 Probable Hydrologic Consequences. The geologic data indicate that no toxic- or acid-forming materials are known to exist in the coal or rock strata immediately below or above the seam (see Section 624.300). The probable hydrologic consequences of the proposed operation will be discussed in Section 728 and Appendix 7-3 of this application.

724.320 Feasibility of Reclamation. The geologic data in Section 600 provides sufficient detail to allow: the evaluation of whether toxic- or acid-forming materials are expected to be encountered in mining; subsidence impacts; whether surface disturbed areas are designed to be constructed in a manner that will allow for reclamation to approximate original contour; and whether the operation plans have been design to ensure that material damage to the hydrologic balance does not occur outside of the permit area. These issues are evaluated in the R645 rules and discussed in Section 728 of this application.

724.400 Climatological Information

724.410 Climatological Factors

724.411 Precipitation The closest weather recording station to the Lila Canyon Mine is located at Sunnyside, Utah. Based on the relatively close proximity and similar locations (west exposure of the Book Cliffs) holes and other geologic data, appear to be nearly static at elevation 5990 in this area (see Figure 7-1).

Water level in the mine would have to raise approximately 310' to reach the rock slope/coal seam contact and result in a gravity discharge. Water monitoring results and other historical data in the area do not indicate this is likely to occur.

731.522 Surface Entries after January 21, 1981 This is not known to be an acid-producing or iron-producing coal seam; however, proposed portals are located to prevent gravity discharge from the mine (see Section 731.521).

731.600 ~~**N/A - There will be no surface disturbing or reclamation operations within 100 feet of a perennial or intermittent stream.**~~ **Buffer Zones** All streams within the permit area are either ephemeral or intermittent by rule with ephemeral flow. ~~H~~As such, buffer zones are not required; however, to provide additional protection, the Operator will install stream buffer zone signs in locations shown on Plate 5-2~~. Since all streams within the permit area are either ephemeral or intermittent by rule with ephemeral flow. Section 731.600 is not applicable.~~ and maintain the buffer zones during the operation.

731.700 Cross Sections and Maps The following is a list of cross-sections and maps provided in this section of the P.A.P.

Plate 7-1	Permit Area Hydrology Map
Plate 7-2	Disturbed Area Hydrology/Watershed
Plate 7-3	Water Rights Locations
Plate 7-4	Water Monitoring Location Map
Plate 7-5	Proposed Sediment Control Map
Plate 7-6	Proposed Sediment Pond
Plate 7-7	Post-Mining Hydrology

All required maps and cross-sections have been prepared by, or under the supervision of, and certified by a Registered Professional Engineer, State of Utah.

Appendix 7-3

Probable Hydrologic Consequences Determination

Updated ~~December~~January 200~~5~~6

UTAH REGISTERED PROFESSIONAL ENGINEER
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development of vegetation along the stream banks aiding in the additional stabilization of the channel banks and bed. While these impacts are not anticipated, the applicant has agreed to monitor the conditions of the channel downstream of the site for geomorphic and erosional change as a result of mine discharges.

All construction and upgrading activities will be undertaken during periods of dry weather, commencing in late spring and lasting through fall. For both the mining and reclamation periods, it is expected that construction, upgrading, or regrading activities would cause an increase in sediment load to the stream. Temporary sediment controls will be used whenever possible to lessen the impact of construction activities.

Stream buffer zones have been delineated upstream and downstream of the disturbed area of the mine facilities. These buffer zones will aid in ensuring that no disturbance occurs within the area of the unprotected channel.

~~Sediment yields may increase locally due to subsidence.~~ Subsidence tends to cause a warping or sagging of the surface in the area of the mined out area. Within the stream channel that crosses a subsided area, at the upstream boundary of the subsidence, the stream channel is steepened, resulting in the potential for additional erosion in the steepened reach. As the stream crosses the sagged subsided area, the channel gradient decreases below the pre-subsided slope. This results in increased glides and extended pools in intermittent and perennial streams or areas of increase deposition in ephemeral streams. Subsidence cracks which intersect stream channels with steep gradients could, for a short period of time, result in a local increase in the sediment yield of the stream. However, this sediment increase would also cause the crack to quickly fill, recreating pre-subsidence stream channel conditions. Thus, the potential impact to sediment yield from subsidence in the permit area would be minor and of short duration.

Various sediment-control measures will be implemented during reclamation as the vegetation becomes established. As discussed in Section 542.200 of this P.A.P., these measures will include installation of silt fences and straw-bale dikes in appropriate locations to minimize potential contributions of sediment to the Right Fork of Lila Canyon. These measures will reduce the amount of erosion from the reclaimed areas, thereby precluding adverse impacts to the environment.

Acidity, Total Suspended Solids, and Total Dissolved Solids. Probable impacts of mining and reclamation operations on the acidity and total suspended solids concentrations of surface and groundwater in the permit and adjacent areas were proposed mine area, as a result of mining, should limit subsidence deformation to those areas where the overburden is less than ~~450~~630 feet.

Where surface disruption or cracks appear, the general mechanism is extension of the soil mantle. Natural processes will heal these crack over time. Runoff and snowmelt will wash sediments into the crack and fill any voids created. As this process progresses, the crack disappear and the surface runoff and snowmelt return to normal courses. In the Wasatch Plateau and Book Cliffs area, the clays in the area are expansive and tend to seal these cracks very rapidly. Sidel, et.al. (1996) found that minor surface changes in the area of Burnout Creek recovered within two years.

As indicated in Figure 7-4 of the PAP, the majority of the identified springs and seeps are located outside of the maximum limits of subsidence. Therefore, the potential impact is significantly reduced.

Several lines of evidence suggest that mining-related subsidence and bedrock fracturing have not resulted in decreased stream flows or groundwater discharge in the vicinity of the nearby Horse Canyon Mine. Although considerable seasonal and climatic variability are noted in the hydrographs of springs in the permit and adjacent areas, data for both Horse Canyon Creek and springs which overlie the Horse Canyon Mine workings do not show discharge declines which may be attributed to either subsidence or bedrock fracturing (see Appendices 7-1 and 7-6).

Active groundwater systems in the Colton, Flagstaff-North Horn, and Price River Formations are separated from the Blackhawk Formation by the Castlegate Sandstone. As discussed in Section 724.100, this formation contains no springs and is not considered to be a major groundwater resource. Past mining in the Horse Canyon Mine has not increased the rate of spring discharge from the Price River Formation, indicating that groundwater is not being diverted into this formation. The absence of increased saturation in the Price River Formation indicates that vertical zones of artificially-increased hydraulic conductivity or secondary porosity do not extend into the Price River Formation and from thence into the overlying active groundwater systems of the North Horn-Flagstaff Formations.

Data presented in Appendices 7-1 and 7-6 and summarized in Section 724.100 indicate that the low-permeability lower groundwater system, in the vicinity of mined coal seams, contains groundwater which is compartmentalized both vertically and horizontally. Coal mining locally dewaters isolated, overlying expected. To date no known depletion of flow and quality of surveyed springs in the Horse Canyon permit area exists, and none are expected in the Lila Canyon area, based on available data from the Horse Canyon Mine. Although pre-mining data is not available for Horse Canyon, depletion problems from subsidence are not known to have been filed and are not indicated by sampling results in Appendices 7-1 and 7-2. Therefore, it is unlikely an alternative water supply will be needed, although they have been identified in Section R645-301-727.

L-16-G and L-17-G are seeps being monitored in Stinky Spring Canyon. ~~These two seeps appear to be an important source of water for~~ Bighorn sheep ~~specifically in the early spring.~~ have been observed within the canyon but have never been observed drinking the water.

Flows from these springs are historically less than 0.5 gpm and show a general seasonal decrease throughout the season. These sites were not identified during baseline surveys and are believed to exist intermittently and are not always evident. The low flow rates and intermittent nature of these springs suggest that they are local in nature.

These springs are located within the Central Graben, which is a block that has been downdropped between 145 and 250 feet relative to the adjacent bedrock. They occur near the contact between the Mancos Shale and the overlying Blackhawk Formation. The fractured nature of the bedrock along the edges of the Central Graben, as a result of the faulting, likely are the limits of the areal extent of the recharge or source area to the springs. The low-permeability of the surrounding Mancos Shale likely isolate the graben block from groundwater in the surrounding bedrock. Thus, the recharge to the springs is likely limited to the area of the consolidated graben block.

As indicated previously, there is no evidence that mining in the Horse Canyon Mine had any influence on the underlying formations. Therefore it is likely that the Lila Canyon Mine would have similar affects. Due to the springs location and lateral separation from the mine, outside the permit area, outside the limit of subsidence, being separated from the mine block by faulting within the Central Graben, and being 500 to 600 feet below the coal seam, there is no potential for Lila Canyon Mine to negatively impact this spring or recharge sources.

Potential for Increased Stream Flows

If sufficient water is encountered in the Lila Canyon Mine workings to require discharge of that water to the surface, the flow of the Right fork of Lila Canyon

L-16-G
Little Stink

Location: Located in what has recently been named Stinky Spring Canyon by the Operator. The seep is located approximately .25 miles to the West of the permit area and within the Central Graben. The seep is located at the top of the Mancos Shale approximately 600 feet below the coal seam in a highly faulted area at an elevation of 5840 feet. The stream reach is intermittent by definition but is ephemeral acting (See Appendix 7-7 & Plate 7-4). The drainage above and below this monitoring location flows only as a result of spring run-off or storm events.

General: Due to its location, outside the permit area, outside the limit of subsidence, within the Central Graben, and being 600 feet below the coal seam, there is no potential for Lila Canyon Mine to negatively impact this spring or recharge sources. This location is used ~~heavily~~ by Rocky Mountain Bighorn Sheep; however, no evidence of the sheep using the poor quality water has been documented. The permittee has never observed amphibians at or near this location.

Vegetation description: Habitat immediately below this wet seep monitoring site is a

L-17-G
Big Stink

Location: Located in what has recently been named Stinky Spring Canyon. The seep is located approximately .25 miles to the West of the permit area, .1 mile above L-16-S, and within the Central Graben. The seep is located at the top of the Mancos Shale approximately 500 feet below the coal seam in a highly faulted area at an elevation of 5920 feet. The stream reach is intermittent by definition but is ephemeral acting (See Appendix 7-7 & Plate 7-4). The drainage above and below this monitoring location flows only as a result of spring run-off or storm events.

General: Due to its location, outside the permit area, outside the limit of subsidence, and being 500 feet below the coal seam, there is no potential for Lila Canyon Mine to negatively impact this spring or recharge sources. This location is used ~~heavily~~ by Rocky Mountain Bighorn Sheep; however, no evidence of the sheep drinking the poor quality water has been documented. The permittee has never observed amphibians at or near this location.

Vegetation description: Habitat immediately below this wet seep monitoring site is a mix of grasses and salt desert shrub habitat and invasive tamarisk.

Table 3

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES IN THE LILA CANYON MINE AREA

Watershed ID	Return Period	2yr (cfs)	5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
WS1.1	6 hr	0	0	1.39	5.54	9.98	17.18
	24 hr	0.65	3.22	9.31	22.68	39.50	59.77
WS1.2	6 hr	0	0	1.21	6.43	12.77	22.18
	24 hr	0.86	3.82	9.45	20.66	33.99	49.70
WS1 Total	6 hr	0	0	2.37	11.78	22.68	38.79
	24 hr	1.50	6.62	16.96	39.59	67.46	100.70
WS2.1	6 hr	0	0	0	1.84	4.30	7.79
	24 hr	0.17	0.81	2.54	7.96	14.23	24.90
WS2.2	6 hr	0	0	0	1.43	4.14	8.55
	24 hr	0.18	0.91	2.52	6.47	10.70	17.34
WS2 Total	6 hr	0	0	0	2.98	8.20	16.27
	24 hr	0.32	1.67	4.62	12.41	21.56	36.83
WS7.1	6 hr	0	0	2.23	10.43	19.63	33.75
	24 hr	1.29	6.04	15.85	36.15	60.94	90.24
WS8.1	6 hr	0	0	0.85	3.60	6.59	11.34
	24 hr	0.43	2.09	5.76	13.64	23.46	35.09
WS9.1	6 hr	0	0	3.46	16.17	30.46	52.36
	24 hr	2.01	9.38	24.59	56.08	94.53	139.99

Table 3

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES IN THE LILA CANYON MINE AREA

Watershed ID	Return Period	2yr (cfs)	5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
Little Park 6.1	6 hr	0	0	1.63	6.48	11.66	20.08
	24 hr	0.76	3.76	10.88	26.5	46.16	69.84
Little Park 6.2	6 hr	0	0	0.93	3.70	6.66	11.47
	24 hr	0.44	2.15	6.21	15.14	26.36	39.89
Little Park 6	6 hr	0	0	2.56	10.18	18.33	31.54
	24 hr	1.20	5.91	17.09	41.63	72.52	109.74
Little Park 6.3	6 hr	0	0	0.32	1.21	2.15	3.70
	24 hr	0.14	0.70	2.17	5.47	9.75	14.92
Little Park 5.1	6 hr	0	0	0.31	1.00	1.73	2.93
	24 hr	0.11	0.59	2.41	7.85	15.16	23.59
Little Park 5.2	6 hr	0	0	0.73	2.75	4.87	8.38
	24 hr	0.32	1.59	4.92	12.40	22.10	33.82
Little Park 5	6 hr	0	0	2.82	11.34	20.41	35.22
	24 hr	1.77	8.54	24.80	61.16	107.32	163.42
Little Park 4.1	6 hr	0	0	0.75	2.58	4.47	7.65
	24 hr	0.29	1.49	5.31	14.72	28.04	43.72
Little Park 4.2	6 hr	0	0	0.76	3.01	5.42	9.33
	24 hr	0.36	1.75	5.06	12.32	21.46	32.47
Little Park 6.4	6 hr	0	0	0.23	0.86	1.53	2.64
	24 hr	0.10	0.50	1.55	3.90	6.95	10.64

Table 3

PEAK FLOW SIMULATIONS OF UNDISTURBED DRAINAGES IN THE LILA CANYON MINE AREA

Watershed ID	Return Period	2yr (cfs)	5yr (cfs)	10yr (cfs)	25yr (cfs)	50yr (cfs)	100yr (cfs)
Little Park 6.5	6 hr	0	0	0.90	3.58	6.45	11.10
	24 hr	0.42	2.08	6.02	14.66	25.53	38.63
Little Park 4	6 hr	0	0	6.17	24.81	44.74	77.12
	24 hr	2.93	14.01	40.73	101.08	178.91	269.04
Little Park 6.6	6 hr	0	0	0.87	4.44	8.64	14.92
	24 hr	0.58	2.60	6.58	14.58	24.18	35.52
Little Park 3.1	6 hr	0	0	2.35	8.86	15.72	27.03
	24 hr	1.03	5.13	15.87	40.00	71.27	109.07
Little Park 3.2	6 hr	0	0	1.00	4.65	8.76	15.07
	24 hr	0.58	2.70	7.08	16.14	27.20	40.29
Little Park 3	6 hr	0	0	9.73	42.29	77.65	133.01
	24 hr	5.08	23.46	65.66	162.22	284.24	430.10
Little Park 6.7	6 hr	0	0	1.12	6.47	14.50	26.85
	24 hr	1.14	4.69	10.58	21.76	34.48	49.42
Little Park	6 hr	0	0	10.48	47.97	90.92	152.74
	24 hr	6.19	26.34	70.46	170.78	298.11	448.73

a pump that will be able to meet the sampling requirements.

Additionally, the sampling equipment for this system would make the sampling effort impractical. Access to these wells is limited to the use of ATV to prevent significant disturbance to the site area. The tubing for the sampler is provided on 500 foot rolls each weighing 300 pounds. To be able to sample these wells UAE would need a minimum of 4 rolls with a power winch to be able to lift the pump and tubing into and out of the holes. Based on the weight and bulk of the equipment it would not be practical to utilize this setup to sample the wells.

Thus, pumping to obtain a water quality sample from these wells is not considered a viable option.

Bailer (not an option)

The U.S.G.S. Water-Quality Sampling Protocol (U.S.G.S., 1995 and 1999) recommends that if possible avoid a bailer (see Exhibit G). In the case of IPA #1, the use of a 48" bailer to purge the required volume would be the worst-case situation. The sampling efforts would require dropping and retrieving a bailer 14,658 times at an average depth of 1,420 feet (see Exhibit "D"). This would amount to lifting 21,797 lbs over 1,420 feet. This is impractical for a sampling effort.

Additionally, there are two problems with this method of sampling. First, the use of a bailer in a well that is constructed with steel casing for which you a sampling for iron will

Early in the Lila Canyon Mine sequence, the mine will breach the existing flooded exploration entries. It is from these entries that the mine water will be obtained for use in the mining process at Lila Canyon. The quality of the water in the exploration entries is the same water as was sampled from the in-mine sites. Thus, the water encountered in the Lila Mine, is expected to be consistent with the quality of the underground water found at sites 1E2, 1E-B, 001, 002, and 2E-B.

REFERENCES:

U.S.G.S., 1995. Ground-Water Data-Collection Protocols and Procedures for the National Water-Quality Assessment Program: Collection and Documentation of Water-Quality Samples and Related Data. OFR 95-399. Washington, D.C.

U.S.G.S., 1999. Field Methods for hydrologic and Environmental Studies. Volume 4. Ground-Water-Data Collection. OFR-01-50. Urbana, Illinois.