Cumulative Hydrologic Impact Assessment

Summit Coal Company
Boyer Mine
PRO/043/008 #2
Summit County, Utah

and

Summit Minerals, Inc.
No. 1 Coal Mine (Blackhawk Mine)
Reclamation Plan
PRO/043/001
Summit County, Utah

5/87

I. Introduction

This report is a Cumulative Hydrologic Impact Assessment (CHIA) of the mining area encompassing Summit Coal Company's Boyer Mine and Summit Minerals Inc.'s # 1 Mine (Blackhawk) Reclamation Project in Summit County, Utah. This assessment depicts the probable cumulative impacts of the proposed coal mining activities on the hydrologic regime encompassing the general area of the above mentioned operations. The operations are designed to prevent damage to the hydrologic balance outside the proposed mine plan areas. The Permit Application Packages (PAP) submitted by the mining companies and this report comply with federal legislation promulgated under the Surface Mining Control and Reclamation Act (SMCRA) and subsequent Utah and federal regulatory programs outlined under UMC 786.19(c) and 30 CFR 784.14(f).

Mining activities currently taking place in the Coalville Field consist of a coal exploration operation being conducted by Summit Coal Company at the Boyer Mine and a mine reclamation operation proposed by Summit Minerals, Inc. at the Blackhawk minesite. No other operating mines or mining prospects exist in the Coalville Field at this time.

Mining has taken place in the Coalville Field since 1854. Doelling (1972) lists several abandoned minesites within the Coalville Field (Table 5, page 350) which were mostly small operations around the turn of the century. Two mines, the Wasatch and Chappell Mines, were substantially larger mines that operated until 1934 and 1970 respectively. These two mines lie approximately 7 miles west of the Boyer and Blackhawk minesites.

In 1879 the N. B. Morby Shaft was sunk near the present Blackhawk mine site. Additional entries were opened by subsequent operators and developed into the old Blackhawk mine. The old Blackhawk Mine workings encompassed about 16 acres. The mine was closed in the mid-1950's. A new Blackhawk Mine was developed east of the old site by Utah Coal and Energy, Inc. The old Blackhawk mine openings were buried during face preparation of the new mine site.
The Boyer and Blackhawk minesites are located approximately 12 miles east of the town of Coalville and about 30 miles northeast of Salt Lake City, Utah (Figure 1).

The mine sites are physiographically located near the western edge of the Central Rocky Mountains. The area is bounded on the west by the Wasatch Mountains and on the east by the Uinta Mountains. This transition zone reflects a topography characterized by high mountainous hills and well developed drainages. Relief in the vicinity of the proposed mines range from 6200 feet at Chalk Creek to 8270 feet on the crest of Porcupine Ridge. Bedrock structure in combination with faulting, erosion and landslides have created irregular drainage patterns and topographic features in the surrounding area.

The climate of the mine area is typically semiarid and continental. Average monthly temperatures vary from 32° in January to 79° in July. The temperatures are predominately cool with an average length of freeze-free period at the site of about 80 days each year (Jeppson et al., 1968). Most precipitation in the region of the mines occurs due to frontal activity during the winter months. Two-thirds of the annual average precipitation occurs during the months of October through April. Two periods of peak precipitation activity take place. During the fall months high precipitation occurs mainly in the form of snow, and in the spring precipitation occurs as mixed rain and snow events (Figure 2). Annual rainfall averages about 20 inches.

Two oil wells shown in Plate 1 ("S" #1 and "S" #2) have been drilled east of the CHIA on the axis of the Dry Canyon Anticline by AMOCO Production Co. The wells are located in T. 3N. R. 7E. Section 30. Well "S" #2 (in CIA) was drilled after part of the drill stem was lost in "S" #1 (east of CIA). Total depth in well "S" #2 was 13,041 feet. Neither well contacted oil or gas.

II. Cumulative Impact Area (CIA)

The Cumulative Impact Area encompasses approximately 1580 acres and is shown in Plate 1. The CIA was established to incorporate potential mining areas adjacent to current proposed operations.

III. Scope of Mining

The proposed operations are 1 mile east of Upton, Utah on the hillsides adjacent to the valley of Chalk Creek. The Boyer Mine is located on the south facing slope. The Blackhawk reclamation site and the proposed No. 1 Coal Mine are located on the north facing slope (Plate 1).
Figure 1. Boyer-Blackhawk CIA vicinity map.
Figure 2. Average monthly precipitation and temperatures at the Coalville weather station.
The mines are being developed in the Wasatch Coal Bed of the Frontier Formation in an area where sporadic mining activities have occurred over the past 90 years.

A. Boyer Mine

Summit Coal Company received a coal exploration permit for the Boyer Mine on August 1, 1985. The permit entitled Summit Coal Company to extract 10,000 tons of coal for testing purposes. The permit was later modified (September 25, 1986) to allow another 15,000 tons or a total of 25,000 maximum tons of coal to be extracted for test purposes.

Recently, Summit Coal Company submitted a permit application to expand their mine workings to an area of about 170 acres. The mine is projected for room and pillar mining utilizing a continuous miner. The layout is typical with mains driven down dip and panels developed on the strike. The layout has been modified to parallel property boundaries and avoid old workings. The submains will be driven at 45 degrees to the dip to reduce the mine grade from the average dip grade of 17 degrees to 12 degrees. Mining projections show that mining will be limited to development of submains for the first two years through 1989 before the first panel will be driven southwest along the strike toward the outcrop.

B. Blackhawk Mine

Summit Minerals, Inc. is in the process of obtaining a Reclamation Permit for the Blackhawk Mine which consists of 17.7 acres of surface disturbance and a small amount of underground activity (Plate 1). Plans have also been submitted by Summit Minerals, Inc. to establish a new mine called the No. 1 Coal Mine which will encompass about 480 acres in the south 3/4 of Section 36, T.3N., R.6E. (Plate 1).

IV. Study Area

A. Geology

The CIA is located near the eastern border of the Coalville Coal Field. The Coalville Coal Field lies within the southern portion of the Idaho-Wyoming-Utah overthrust belt. Folds related to eastward thrusting associated with Cretaceous organic events are the dominant feature. The Coalville anticline is the largest feature within the Coalville Coal Field. It is an asymmetrical anticline 10 miles long and 6 to 8 miles wide. The axis trends northeast. The west limb is badly faulted and three predominately north striking normal faults have been mapped. The east limb of the anticline dips steeply and is sometimes vertical or overturned. About 1.5 miles to the east is the Clark Canyon syncline. Its east limb dips 15 to 25 degrees and forms the west limb of the Dry Canyon anticline, the structural feature of the CIA area.
The geology in the vicinity of the CIA consists of stratigraphic units of consolidated rock ranging in age from Late Cretaceous to Tertiary (Figures 3 and 4). The exposed Cretaceous formations were deposited during the Albian through Campanian Ages and consist of resistant sandstones, conglomerates, shales and interbedded coal seams. Angularly overlying all other beds are the redish conglomerates and variegated shales of the Knight Formation, Tertiary in age. Erosion has created long deep canyons that are filled with Quaternary alluvial gravels and remnant terraces.

The Cretaceous and Tertiary rocks make up at least 18,000 feet of strata in the vicinity of the coal field. There are three coal zones within the limits of the coal field, the Dry Hollow seam in the Wanship Formation and the Wasatch and Spring Canyon. All coal seams exist in the Frontier Formation.

Major disconformities exist in the area due to thrust faulting. These faults do not appear near the surface of the CIA, but exist several thousand feet below the surface and are the source of some oil reserves a few miles east of the property in the Pineview Oil Field. Folded Cretaceous strata and deposition of fluvial Tertiary strata (Wasatch Formation) created a significant unconformity seen on the mining property.

Faulting is prevalent in the coal field as a result of structural deformation from eastward thrusting. One fault is noted to the east of the Boyer Mine. Its throw is estimated to be from between 50 to 150 feet. Its presence should not have an influence on the current mine plan.

V. Hydrologic Resources

A. Ground water

Ground water exists in confined and unconfined states in the vicinity of the CIA. Snowmelt at higher elevations provides most of the source of ground water recharge, particularly where permeable lithologies are exposed at the surface. Vertical migration of ground water occurs through permeable rock units and/or along zones of faulting and fracturing. Lateral migration initiates when groundwater encounters impermeable rock and flows laterally until either the land surface is intersected creating a perched spring or until vertical movement can continue.

Unconfined aquifer conditions occur in the alluvial sediments that fill the valleys of Chalk Creek, Huff Creek and Josh Hollow adjacent to the mine plan areas. Other unconfined aquifers, actually a perched aquifers, exists within the nearly horizontal Knight Formation where shale beds act as aquatards to impede downward groundwater movement.
Figure 4. Geologic cross-sections showing structure south an
While drilling a monitoring well on the Boyer Mine property Summit Coal Company contacted a confined aquifer in a gravel bed about 100 feet below the Wasatch coal seam (Figure 5).

The alluvium of Chalk and Huff Creeks comprises the major ground water source for the area. The water source that supplies these aquifers comes from the stream itself. The stream originates high up in the mountains from springs or direct runoff from snowmelt. The alluvium is quite permeable and can yield up to 2000 gallons per minute (gpm) in some areas. Only a few wells in the vicinity withdraw water from the alluvial aquifer at low rates (2 to 10 gpm) for culinary purposes.

Surveys were conducted by EarthFax Engineering, Inc. in June and October 1985 to identify the locations and characteristics of seeps and springs in the vicinity of the Boyer Mine permit area (Figure 6). Five springs are located within the CIA area and a total of thirty-four seeps and springs were found within one mile of the CIA boundary. Most issued near the contact between the Tertiary Knight Formation and the Quaternary alluvial gravels between the 6400 and 6600 foot elevation. During the June survey, 11 of the sources existed as seeps where no measurable flow was occurring, but water was visible. Maximum measured flows were 10 gallons per minute (gpm). By that October, 7 of the seeps and 7 of the springs were dry and flows at the other springs had decreased (Table 1).

There are 10 wells in the vicinity of the CIA (Figure 7, Table 2). Three wells were drilled near the town of Upton, the LDS well, the Boyer-2 well and the Orgill well. The Clark well lies west of Upton and has little bearing on the CIA. The LDS well was drilled to a depth of 517 feet, in a shale bed and did not contact water. The Boyer and Orgill wells are developed in the alluvium of Huff Creek to a depth of 183 feet and 160 feet. Water was contacted in both wells at about the 100 foot level. The Staley well and Old well lie along the southwest edge of the Boyer Mine property. Both wells appear to be developed in the same source aquifer and apparently receive water from a perched aquifer that discharges into the alluvium from the Knight Formation. The Morby and Boyer-1 wells are located on the eastern border of the CIA. The Morby well withdraws water from the alluvial gravels of Chalk Creek that seems to be a mixture of water from the Knight Formation and the alluvial aquifer of Chalk Creek. Whereas, the Boyer-1 well appears to withdraw water from the alluvial aquifer of Chalk Creek. A fault situated between the wells and the mine may obstruct the westward migration of water within the perched aquifer of the Knight Formation and cause it to discharge in the vicinity of the Morby well. This would account for the higher water level readings in the Morby well as compared to the Old and Staley wells. The Jones well is also located in the alluvial gravels of Chalk Creek. Its depth is 58 feet and static water level is 10 feet near the level of the creek. The Utah Coal and Energy well was drilled 325 feet deep and extends into the Frontier Formation. Unfortunately, no other information could be found concerning water levels or quality.
Figure 5. Boyer Mine well log.
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<th>Cond. (a)</th>
<th>PH</th>
<th>Flow (gpm)</th>
<th>Cond. (a)</th>
<th>Flow (gpm)</th>
<th>Cond. (a)</th>
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Table 1. Characteristics of Seeps and Springs in the Permit and Adjacent Areas.
Figure 7. Location of water wells on and adjacent to the CIA.
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Table 2. Selected Information for Water Wells in the Upton Area.
Groundwater quality varies, depending on geology, physiography, and elevation. The best quality usually occurs in or near mountain recharge areas and the poorest quality in lowland areas. Major chemical concentrations in groundwater contained in bedrock near Chalk Creek consist of sodium, calcium and bicarbonate. Closer to the ridges on either side of Chalk Creek ground water contains higher concentrations of calcium, magnesium and chloride. The concentration of dissolved solids in water from the Old well which is thought to discharge from a perched aquifer of the Knight Formation ranges from 2580 to 2870 mg/l. Dissolved solid concentrations in water from the Boyer-1 well and the Morby well range about 380 mg/l and 1000 mg/l which are considered to be alluvial in nature. The higher concentration of dissolved solids in the Morby may be caused by mixing of water from a perched aquifer of the Knight Formation and alluvial aquifer. The dissolved solid concentration in the Mine well located in the Frontier Formation ranges about 370 mg/l.

B. Surface Water

The CIA is located in the Chalk Creek drainage. Chalk Creek is tributary to the Weber River. Their confluence lies near Coalville, Utah.

The Weber River Basin has a drainage area of approximately 2080 square miles (mi²). The Weber River heads in the Uinta Mountains and generally flows northwestward through the Wasatch Range and into the Great Salt Lake. Elevations in the Weber River basin range from approximately 4210 feet to 11,708 feet. There are five major tributaries to the Weber River; Ogden River and East Canyon, Lost, Chalk, and Beaver Creeks.

The CIA, as shown on Plate 1, consists of 1,580 acres of the Chalk Creek watershed. Topography in the area is gently sloping to steep with slopes ranging from 2 to 70 percent.

The CIA is divided by Chalk Creek flowing east to west with ephemeral tributaries that drain into Chalk Creek. Other water resources within or adjacent to the CIA include several low yielding springs and seeps. There are no major ponds, reservoirs or lakes within or adjacent to the CIA.

The estimated annual sediment yield is approximately 0.42 to 1.20 ac-ft/mi² for the Boyer Mine permit area (Earthfax Engineering, 1986). Due to the similarity of soil types over the entire CIA the average annual sediment yield of the CIA is estimated to be 1.09 to 2.96 ac-ft for undisturbed conditions.

Chalk Creek

The headwaters of Chalk Creek are located in the Chalk Creek Basin near the border of Utah and Wyoming. The creek flows for approximately 25 miles generally westward to its confluence with the Weber River near Coalville, Utah.
The Chalk Creek drainage area contains 250 sq. mi. above USGS gaging station 10131000, Chalk Creek at Coalville, Utah, which is approximately 0.3 mile from the confluence of Chalk Creek and the Weber River. The period of record for this station is 1904-1905 and 1927 to present. The extreme flows recorded include a maximum of 1570 cubic feet per second (cfs) on June 1, 1983 and a minimum of less than 1 cfs for several days in 1934. The average annual maximum discharge is 4.9 cfs (U.S.G.S, 1984).

Dissolved solids concentrations in Chalk Creek tend to be significantly higher than in the Weber River (Thompson, 1983). Near their junction, Thompson (1983) reported that the total dissolved solids concentrations of the Weber River varied from 163 to 256 mg/l during his investigations (September 1979 through August 1950), while Chalk Creek water varies from 237 to 446 mg/l. Additionally, the quality of water in Chalk Creek in the CIA is generally of better quality than at the mouth of the stream. Thompson (1983) reported that dissolved solids concentrations approximately three miles upstream from the mining operations varied from 202 to 234 mg/l during his investigation compared with the 237 to 446 mg/l at the mouth of Chalk Creek.

A hydrologic investigation of the Boyer Mine permit area was performed by Earthfax Engineering during 1985 and 1986. Several hydrologic characteristics of Chalk Creek were studied in detail near the permit area. The following discussion of Chalk Creek is based on the investigation performed by Earthfax.

Surface water monitoring stations were established on Chalk Creek at the locations shown on Figure 8. Table 3 contains several hydrologic parameters for Chalk Creek and the Chalk Creek drainage basin. Geomorphic parameters for Chalk Creek before and after spring (1986) runoff are listed in Table 4. These data indicate that selected reaches of Chalk Creek in the CIA underwent degradation (intermediate station and SS-6) while other reaches remained nearly stable (SS-5).

Storage discharge relations were developed for cross sections from Chalk Creek using the Manning equation and the continuity equation

\[ V = \frac{1.486 \, R^{2/3} \, S^{1/2}}{n} \]

and

\[ Q = AV \]

where

- \( V \) = velocity (feet per second)
- \( n \) = Mannings roughness coefficient
- \( R \) = Hydraulic Radius (feet)
- \( S \) = Hydraulic Slope (feet per foot)
- \( Q \) = Discharge (cubic feet per second)
- \( A \) = Flow area (square feet)
Table 3. Selected Characteristics of Chalk Creek Watershed

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Table 4. Selected geomorphic characteristics of Chalk Creek.

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<th>MEAN CHANNEL DEPTH</th>
<th>CHANNEL WIDTH</th>
<th>CROSS-SECTIONAL AREA</th>
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<td>36.9</td>
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By means of the above equations and the cross-sections of Chalk Creek at three sites (Figures 9 and 10) the stage discharge relations provided in Figure 11 was developed. Based on these relations, the flood levels noted were developed.

Results of gradation analysis conducted on the stream bank of Chalk Creek indicate that the bank materials are finer grained than the bed materials. This occurs due to greater velocities along and, therefore, increased scouring of the bed versus the bank in most channels. This scouring removes many of the fines from the channel beds and transports them downstream as suspended sediment.

Average annual flows at SS-6 was computed using equations developed by Fields (1975) for streams in Utah. According to Fields, the average annual streamflow of perennial streams in the Great Basin portion of Utah (e.g., the area including Chalk Creek in the CIA) can be estimated from the equation

$$Q_a = 50W^{1.48}(D+1)^{2.53}$$

Where

- $Q_a =$ average annual streamflow (acre-feet per year)
- $W =$ width of the channel bar cross section (feet)
- $D =$ average depth of the channel bar cross section (feet)

Fields (1975) reported that this equation has a standard error of 34 percent.

Using this equation and the cross sections presented in Figures 9 and 10, average annual flows of 50,940, 53,660, and 63,140 acre-feet per year were calculated for SS-5, the intermediate section, and SS-6, respectively. The mean of these values (assumed to be most representative of the mean annual flow of Chalk Creek adjacent to the permit area) is 55,910 acre-feet per year.

The computed value for the mean annual flow of Chalk Creek in the CIA exceeds the measured mean of the stream at Coalville by 8170 acre-feet per year. Two factors probably contribute to this apparent inconsistency. First, streamflows in the region have been abnormally high during the past few years, resulting in erosion of stream banks and a subsequent increase in the width of channel bar cross sections. This change increases the calculated mean annual flow and affects the overall validity of the equation.

The second factor affecting the accuracy of the streamflow estimates is the error associated with the equation. As noted, the above has a standard error of 34 percent which, according to the definition of the standard error (Spiegel, 1961), indicates that the estimated value may vary by as much as 34 percent two out of three times. Thus, a more accurate estimate would require long-term gaging of Chalk Creek at the site.
Figure 11. Stage-discharge relations on Chalk Creek.
Estimates of peak flows in Chalk Creek for the 10-yr and 100-yr streamflow event were made using equations developed by Thomas and Lindskov (1983). The equations developed for the flood region in which Chalk Creek is located are:

\[ q_{10} = 0.071A^{0.1815} E^{2.70} \]

and

\[ q_{100} = 0.078A^{0.795} E^{2.86} \]

where

- \( q_{10} \) = peak flow from the 10 year runoff event (cfs)
- \( q_{100} \) = peak flow from the 100 year runoff event (cfs)
- \( A \) = watershed area (square miles)
- \( E \) = mean basin elevation (thousands of feet)

Chalk Creek has a drainage area of approximately 130.5 square miles above the western boundary of the CIA and a mean basin elevation of 8000 feet. Therefore, peak flow estimates of 1030 cfs and 1430 cfs have been computed for the 10-year, and 100-year events, respectively.

Flow depths corresponding to these peak flows were determined for the Chalk Creek cross sections using the curves provided in Figure 11. These flow depths are plotted on the cross sections contained in Figures 9 and 10. Based on the estimated discharges presented herein, the 100-year flood event will generally exceed the bankfull capacity of Chalk Creek.

The stability of the stream bed materials was examined using the allowable-velocity approach developed by the U. S. Soil Conservation Service (1975). According to this methodology, basic allowable velocities are determined from the gradational characteristics of the bed material. These basic values are then modified to account for flow depth, bank steepness, and stream meandering.

The channel cross sections, stage discharge relations, and gradation curves were examined to determine maximum velocities that Chalk Creek could withstand without excessive erosion.

In Chalk Creek, maximum non-erosive velocities of 5.7 and 6.5 feet per second were calculated for SS-5 and SS-6, respectively. During the 10-year flood event, velocities of 4.3 and 4.1 feet per second will result at the respective stations. Hence, Chalk Creek is considered erosionally stable during the 10-year event. However, as noted previously, sections of the channel are considered erosionally unstable during floods with higher return periods.
Results of field and laboratory analysis of water samples in Chalk Creek performed by Earthfax Engineering during 1985 and 1986 show that calcium and bicarbonate are the primary ions. Total dissolved solids concentrations varied during the period of record from 295 to 450 mg/l, pH levels varied from 6.91 to 7.36 and dissolved iron concentrations varied from less than 0.03 mg/l to 0.46 mg/l. Suspended sediment concentration in Chalk Creek varied from 1 to 150 mg/l.

With one exception, samples collected in Chalk Creek are in compliance with the National Interim Drinking Water standards as promulgated by the U. S. Environmental Protection Agency. In February of 1986 selenium concentrations of 0.011 mg/l at SS-5 and 0.012 mg/l at SS-6 exceeded the selenium standard of 0.01 mg/l.

No consistently definitive seasonal trends in water quality are apparent with any of the constituents. However, the data indicate that dissolved concentrations are generally lower during high-flow periods and higher during low-flow periods. Suspended concentrations are typically directly proportional to flow.

Ephemeral drainages

Four major ephemeral drainages are tributary to Chalk Creek in the CIA (Plate 1). According to definitions provided by Bates and Jackson (1980), the streams that drain each of these watersheds are first order (having no significant tributaries). The stream draining the watershed in the Boyer permit area is ephemeral within most of the watershed but is considered intermittent from a point immediately above the proposed surface facilities to the north of the watershed.

Flows issuing from the intermittent channel in the Boyer permit area are generally more saline than Chalk Creek with total dissolved solids concentrations that varied from 560-600 mg/l during the Earthfax Engineering hydrologic investigation in 1985 and 1986.

C. Soils

Soil description

The soils within the CIA are gravelly, medium textured and neutral in pH. Three soil series have been identified within the Boyer permit area. These series include: 1) Bezzant gravelly loam, 25 percent to 40 percent slopes; 2) Moweba gravelly loam, 2 to 5 percent slopes; and, 3) Richville gravelly loam, 40 to 70 percent slopes. The respective taxonomic classifications are: 1) loamy-skeletal, mixed frigid Typic Calcixerolls; 2) loamy-skeletal, mixed frigid Pachic Ultic Haploxerolls; and 3) fine-loamy, mixed frigid Calcixerollic Xerochrepts. Under native vegetation the erosion hazard is slight to high. These soils are generally well drained and range in texture from sandy loam to clay loam. Permeability is moderate. The available water capacity ranges from 3.5 to 6.5 inches to a depth of 48 to 60 inches, respectively.
The remaining CIA soil series have been identified as: 1) Dunford organic surface—Dunford—Ayoub Complex; 2) Horrocks—Yeates Hollow Complex; 3) Sowcan Loam; 4) Kovich Loam; 5) Toehead Loam; 6) Watkins Ridge Loam 2-5% slopes; 7) Watkins Ridge Loam 5-8% slopes; 8) Watkins Ridge—Dennot Complex 15-35% slopes; and, 9) Richsum—Beguin Family—Gridge Complex. The great group taxonomic classification includes: 1) typic Calcixerolls; 2) Typic Argixerolls; 3) Cumulic Haploxerolls; 4) Cumulic Haploborolls; and, 5) Cumulic Haplaquolls. The Cumulic Haploborolls and Cumulic Haplaquolls may potentially be characteristic of an AVF. These soils have a high water table within 10 to 20 inches from the surface. The potential AVF will be further evaluated at the time that future mining expansion proposed within this area.

The off permit area CIA soils have a slight to severe erosion hazard under native vegetation on gentle and steep slopes, respectively. Texture ranges from loam to clay loam and fine sandy loam. The potential AVF soils are poorly drained while most other soils are well drained. Permeability is moderately slow for all soils. The available water capacity ranges from 5 to 12 inches to a depth of 60 inches.

Underground development waste disposal

The Boyer Mine will maintain a waste disposal site between highway 133 and the powder magazine access road. The waste disposal site has a proposed capacity of 1500 cubic yards. The Acid-Base Potential of the waste material has been analyzed. By comparing the total quantity of bases that would be required to neutralize potential acidity as calculated by pyritic sulfur content, a balance can be determined. The seam floor and roof percent pyritic sulfur and neutralization potential have been reported in Appendix 6D. The percent pyrite for the roof and floor material is 2.08 and 1.12 percent respectively. The respective Acid-Base Potential (ABP) of the roof and floor were calculated to be -64.5 and -22.9 CaCO₃/1000 tons material equivalence. An ABP of less than or equal to -5 tons CaCO₃/1000 tons material equivalence is defined as an acid- or toxic-forming material (ATFM). This material is classified as an ATFM. The ATFM will be disposed in a basin lined with a minimum eight inch layer of impervious material and buried under a minimum four foot soil depth. Disposal of the ATFM will be completed 30 days after it is first exposed on the minesite.

The potential of an ATFM being buried during initial pad construction has not been characterized. The operator has sampled various points within the pad. The operator will submit the acid-base potential of this material as soon as the laboratory results are received.
Due to the variability of the pyritic sulfur found within the roof and floor material the operator has committed to submit to the Division the following information for the roof, mid-seam, and floor geologic materials after every 1000 feet of mine entry for the five year permit term: pH, texture, hot water extract boron, total sulfates, pyritic sulfur, calcium carbonate percentage, acid-base potential, and electrical conductivity. After the five year permit term has expired the Division will work with the Boyer Mine operator to further develop adequate measures for proper waste disposal.

Effects to watershed

No water pollution associated with geochemical alterations within the underground development waste are expected. The surrounding soil does not contain significant quantities of bases required to neutralize the potential pyrite acidity. The soil neutralization potential data was submitted April 16, 1986 and inserted into Appendix 6D. The average neutralization potential is 4.62 Tons CaCO₃/1000 Tons Material equivalence. The underground waste therefore requires 79.6 tons CaCO₃. The soil has equivalence of 6.60 tons CaCO₃. Therefore a total of 73.0 tons of CaCO₃ is required for the 1500 cyd (Bulk Density est. at 90 lb/ft³) of waste material.

A specific neutralization plan cannot be completed to date. The applicant and the Division are currently assessing the median pyritic sulfur content of the underground waste materials and will be working together to develop an effective ATFM waste disposal plan to insure that soil water drainage will not be adversely affected by the ATFM (stipulation 817.48 - (2) - JSL). Two options are being assessed at this time. One would be to incorporate CaCO₃ with each one foot lift. Based on the estimated average acid production potential and soil neutralization potential, 33 tons of CaCO₃ is required to be incorporated in each lift. The second option would require the operator to seal the waste materials from aerobic atmospheric conditions. This would significantly reduce any potential pyrite oxidation.

The effects of the strong acids resulting from oxidation and dissolution of the ATFM that has not been neutralized may weather and breakdown adjacent soil colloids. This will cause an increase in available elements. When the solubilized nutrients and metals come in contact with the alkaline soil the nutrients and metals will desolubilize through mineralization. Other available cations will attach to the associated soil cation exchange complex.

Soil placement will be designed to result in the best minesoil properties to effectively neutralize the potential generated acidity before the water has completely permeated the entire soil pedon and entered the surface or ground water transport system. Caruccio and Geidel (1978) found that in neutral to alkaline soils pyritic oxidation is reduced along with the neutralization of the generated
acidity. They have also calculated that an increase in partial pressure of CO₂ by soil mulch may increase the available alkalinity of infiltration waters by a factor of eight, further reducing the potential of any acid drainage from the disposal area. The post mining reclamation vegetation cover will be adequate to control erosion and maintain the high soil atmospheric concentrations of CO₂. While microbiological processes are known to mediate the pyrite oxidation reaction, the acidophilic nature of the organisms involved limit their influence in a neutral to high pH soil environment.

VI. Potential Hydrologic Impacts

A. Ground Water

Dewatering and subsidence related to mining have the greatest potential for impacting ground water resources in the CIA.

Since the Boyer Mine is the only operating underground mine which currently has potential of affecting the ground water regime, and which is not grandfathered under the Surface Mine Control and Reclamation Act, only the impacts from their proposed operations will be discussed as related to the hydrologic balance. This CHIA will have to be revised to incorporate future mining development within the Coalville Coal Field.

Dewatering

It has been observed in some coal mining areas that underground mining removes the support to overlying rock causing caving and fracturing of the overburden. In areas where fracturing is extensive subsidence of the overburden becomes greater. Subsidence-induced caving and fracturing can expose ground water sources to lower pressures creating conduits of less resistance that allow ground water to flow into the mine. Dewatering from fracturing has decreased aquifer storage and flow to streams and springs.

The impacts cited above have been considered and evaluated for this CHIA. Currently, there is no water being discharged from the mine and thus no water is currently being withdrawn from the groundwater system.

It is expected that as mining progresses down dip that water will be contacted in the saturated zone of the regional aquifer. The amount of water should not be so significant as to dewater or effect renewable resources or cause external adverse effects to the surface water sources if mine water should be discharged from the mine.
Water generated while mining should come from the porous areas within the coal seam and the rock adjacent to the mine below the level of the regional water table. Ground water production should be relatively low due to the low intrinsic permeabilities of the adjacent rock matrix which contain interbedded siltstone, shale and sandstone units that overlie and underlie the coal seam.

Mining is not expected to intercept the perched or alluvial aquifers that are the source of wells and springs adjacent to CIA. This particularly refers to the Boyer-2 well, the Orgill well, the Staley well and Old well. The vertical and horizontal distances as well as the existence of shale beds between the coal seam and the aquifer create a buffer that will prevent interception of the ground water. Mining will not have any influence on the Morby well, the Boyer-1 well, the Mine well, the Jones well or the Utah Coal and Energy well, because all of these wells exist upgradient and stratigraphically below the coal seam to be mined.

Upon termination of mining operations any ground water interception will stop, the mine will flood and storage to the surrounding beds will reestablish.

The maximum lag time for mine flooding will depend on the amount of caving and the void space created from caving. Estimates can be made by making certain assumptions, however, without more information the estimates would be confusing. It should be noted that complete flooding may never be achieved because the hydraulic head generated as flooding expands will also increase until the hydraulic properties of the roof, floor and rib are exceeded and flow through the rocks is initiated.

In most mining areas it is unlikely that fractures will reach perched aquifers due to the thickness of the overburden. Dewatering of any aquifers will result in in-mine flow which is discharged to Chalk Creek. Water quality downstream from the mine could improve since water being discharged will be of better quality than natural streamflow.

Summit Coal Company will be required to establish an in-mine water monitoring plan that will be dynamic in nature to allow monitoring new source sites as mining progresses. The proposed groundwater monitoring program for Summit Minerals will, in the future, allow increasing discharge rates to be more precisely characterized and thereby, achieve a more accurate assessment of mining-related dewatering impacts.

B. Surface Waters

The main concern in terms of impact to surface water is water quality deterioration downstream from mining operations. The area influenced by surface disturbance is of limited areal extent and confined to approximately eight acres in the Boyer permit area and
17.7 acres undergoing reclamation at the Blackhawk Mine. Surface sediment controls currently are in place and will continue to be in place during reclamation. The water quality impacts associated with mining at the Boyer Mine and reclamation at the Blackhawk Mine will be minimal or nonexistent due to the fact that all drainage from the areas will be routed through sediment controls and treated prior to any release of water.

If large amounts of ground water are encountered during mining operations the discharge of such water into existing surface water may have an effect on the quantity and quality of the surface water. At this time little data is available to determine either the amount or quality of ground water in the area of projected mine workings. Therefore no conclusive predicted impacts can be determined. If large amounts of water are encountered during mining operations, a program to treat and release the water will be required by the Division based on available data at that time.

C. Subsidence

Subsidence impacts are largely related to extension and expansion of the existing fracture system and upward propagation of new fractures (Figure 12). No subsidence has been occurred over the Boyer or Blackhawk mines to date. Overburden thickness ranges from approximately 200 feet to over 1200 feet.

Summit Coal Company plans to mine only the Wasatch Coal Seam in the Chalk Creek Member of the Cretaceous Frontier Formation. The coal seam overburden is carbonaceous sandstone to shale. The mine is projected for room and pillar mining utilizing continuous miners. The layout is typical with mains driven down dip and panels developed on strike. The layout has been modified to parallel property boundaries and avoid the old workings. The submains will be turned off at 45 degrees to the dip to parallel the northern property boundary reducing the grade from 17% to 12%. Mining projections show that mining will be limited to development of submains for the first two years through 1989 before the first panel will be driven south west along strike toward the outcrop. The first pillar extraction will be begin under 200' of cover.

Gradual subsidence is expected over a long term where maximum extraction is planned. The surface land above the mining operation is free and contains no structures. The lands are presently used for grazing and wildlife habitat. No springs are indicated above the mining operation. No known aquifer exists above the immediate coal zone.

Summit Coal Company proposes to mitigate subsidence impacts as they occur including (1) not pulling pillars in selected sensitive areas, and (2) uniform extraction to minimize impacts. Further the applicant includes mitigation to site specific impacts such as road repair and fence repair, conveyance and diversion of flows, filling cracks wider than 6 inches, and revegetation.
Figure 12. Potential effects of mining to overlying aquifers and strata.
Summit Coal Company has established that no known structures, perennial streams or springs exist within the limits of mining, however since the lands are used for wildlife and grazing, the lands subject to subsidence are strictly speaking renewable resource lands. Assuming complete pillar recovery the surface would experience subsidence between 60 and 90% of the seam height. No inflows should be expected from the alluvium of Chalk Creek since this aquifer will not be subsided.

Summit Coal Company's plans are consistent with the standard methods of mining and with the clarifications and stipulations as referenced in the permit the applicant's subsidence control plan will comply to the extent "technologically and economically feasible to prevent subsidence from causing material damage to the surface and to maintain the value and reasonable foreseeable use of surface lands".

D. Alluvial Valley Floors

An Alluvial Valley Floor (AVF) has been identified within the CIA. The valleys of Chalk Creek and Huff Creek exhibit the characteristics to establish the existence of an AVF.

Current mining activities have provided information to affirmatively demonstrate that their proposed operations will not interrupt, discontinue or preclude farming. Nor will they materially damage the quantity or quality of water in surface or ground water systems which supply the AVFs.

Currently the limits of mining do not include the AVF or parts thereof within the proposed mining permits. Expansion of mining in the future could incorporate portions of the AVF. Prior to finalizing such permits a complete analysis will be made of the AVFs and potential impacts that could occur.

VII. Summary

The probable hydrologic impacts are summarized below under the headings entitled First Five Year Permit Term and Future Mining.

First Five Year Permit Term

The rate of dewatering will remain significantly less than the estimated recharge rate during the first five year permit term for the Boyer Mine. Overburden thickness will be sufficient (500-2,000 feet) to restrict surface manifestations of subsidence. The subsurface propagation of fractures is not expected to produce changes in groundwater flow that could affect localized aquifers and springs. Future monitoring will provide data applicable to documenting changes in the groundwater system.
Surface disturbance from mining and reclamation operations will not significantly degrade water quality in Chalk Creek. Sediment control measures have served to reduce contaminants and stabilize water quality at acceptable levels.

Future Mining

Drainage from future surface disturbance will be managed through appropriate sediment controls.

Any rates of dewatering may, in the future, result in depletion of groundwater storage. Depletion of storage should not have any effects on spring flow, recharge to wells and base flow recharge to streams. Upon cessation of mining, any mine water discharge to Chalk Creek via treatment facilities will be discontinued. This affect is considered reasonable because mine flooding will probably result in reestablishment of the preexisting groundwater system.

The operational designs proposed for the Boyer Mine and Blackhawk Reclamation operation are herein determined to be consistent with preventing damage to the hydrologic balance outside the mine plan area based on the accuracy of the information submitted in the mine plans and referenced literature.
REFERENCES


Earthfax Engineering. 1986 Results of Overburden and Hydrologic Investigations of the Boyer Mine, Summit County, Utah, on file at the Utah Division of Oil, Gas and Mining.


