



State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

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March 13, 1998

TO: File 2

THRU: Daron Haddock, Permit Supervisor *DGRH*

FROM: James D. Smith, Reclamation Specialist *JDS*

RE: Technical Analysis of Permit Application, Canyon Fuel Company, Dugout Canyon Mine, ACT/007/039, File 2, Carbon County, Utah

SUMMARY

Coastal States Energy Company submitted a Permit Application Package (PAP) for the Dugout Canyon Mine, including a Mining and Reclamation Plan (MRP), in March 1996. Deficiencies in the geology and hydrology sections were identified in a TA dated April 22, 1996. Revisions and corrections were submitted by Canyon Fuel Company, the successor to Coastal States Energy Company, on May 1997. This second submittal provided adequate response to most of those deficiencies identified previously, but several deficiencies remained, so a second TA, dated July 16, 1997 was prepared. Responses to the second set of deficiencies were received September 9, 1997. This September submittal provided adequate response to the Geology and Ground-water Hydrology deficiencies identified previously, and no further deficiencies were identified in a TA dated September 22, 1997 in the sections covering Geology and Ground-water Hydrology.

The PAP has undergone several revisions since the September 22, 1997 TA, the latest, and it is hoped the last, of which was received at DOGM on March 4, 1998. The following is the TA of the sections on Geology, Ground-water Hydrology, and Surface- and Ground-water Monitoring.

TECHNICAL ANALYSIS

ENVIRONMENTAL RESOURCE INFORMATION

GEOLOGIC RESOURCE INFORMATION

Regulatory Reference: 30 CFR Sec. 784.22; R645-301-623, -301-724.

Analysis:

Geologic information includes a description of the geology of the proposed permit and adjacent areas down to and including the stratum immediately below the lowest coal seam to be mined and the aquifer below the lowest coal seam to be mined that may be adversely impacted by mining. This description includes the areal and structural geology of the permit and adjacent areas, and other parameters that influence the required reclamation. It also shows how areal and structural geology may affect the occurrence, availability, movement, quantity, and quality of potentially impacted surface and ground water. The description is based on maps and plans required as resource information for the plan, detailed site specific information, and, geologic literature and practices.

Descriptions of the stratigraphy and lithology of strata from the Mancos Shale up to the Colton Formation and of Quaternary pediment gravels and alluvium are in Section 624.100. That section also contains a discussion of geologic structure and a very brief description of the nature, depth, and thickness of the coal seams and the interburden between the Sunnyside, Rock Canyon, and Gilson seams. Plate 6-4 is an isopach map of the Rock Canyon seam overburden thickness and Plate 6-5 is an isopach map of the Rock Canyon to Gilson seam interburden thickness. Plates 6-6 and 6-7 in the Confidential binder are, respectively, isopach thickness maps of the Rock Canyon and Gilson seams.

The Gilson and Rock Canyon seams are both sufficiently developed to allow for economic mining in the proposed permit area but only the Rock Canyon seam is to be mined under the proposed MRP. Minable coal in the Rock Canyon seam ranges from five to eight feet in thickness (p. 6-15). Although the current permit application does not include federal acreage, an R2P2 for the logical mining unit that includes Soldier Canyon and Dugout Canyon Mines and federal lease U-07064-027821 is included in the Confidential binder.

Appendix 6-1 (Confidential binder) contains cutting and core logs for drill holes 3-1, 9-1, 9-2, 10-1, 11-1, 13-1, 13-2, 14-1, 15-1, 15-2, 15-3, 19-2, HCC-4 (H-4), KCC-A and KCC-E. Collar or ground elevations are included in Appendix 6-1. Drill hole locations and elevations are shown on Plate 6-1.

Some bore holes have been logged from the surface to total depth, for others only the coal seams and adjacent strata have been logged. Together, the logs describe lithologic characteristics and thickness of each stratum from the surface to below the coal seams. Ground water occurrence was not marked on these logs at the time the holes were bored (p. 6-

17). Bore hole logs were used to construct the cross sections on Plate 6-3, which show the interval from the Sunnyside coal zone to below the Gilson coal zone. Figure 6-1 is a more general cross section from the surface to the Mancos Shale.

Analysis reports on coal, floor, and roof samples from the Rock Canyon and Gilson seams are found in Appendix 6-2 (Confidential binder). Floor and roof samples of the Rock Canyon seam were collected from one of the portals of the abandoned Rock Canyon seam mine in Dugout Canyon (portals shown on Plate 5-1) and a sample of coal was taken from a fresh coal outcrop located a few-hundred feet inside. The location where the coal, roof, and floor samples were collected for the Gilson seam is shown on Figure A1 in Appendix 6-2 in the Confidential binder.

Samples were analyzed for acid- or toxic-forming and alkalinity-producing materials, including total sulfur but not pyritic or other specific forms of sulfur. BTU, ash, and sulfur content of the Rock Canyon coal are briefly summarized at the end of Section 624.100. No unacceptable values were reported for the parameters listed in Table 2 of UDOGM's "Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining".

Data from one location are probably insufficient to determine the potential for acid- and toxic-forming materials for the entire proposed mine. However, waste material from the mine is not to be used in reclamation. (Although not part of this permit submittal, future development of a waste-rock disposal site has been contemplated.) Limited topsoil will be available for reclamation, so selected overburden materials from the facilities area and B and C horizon soils from the sediment pond area will be used as substitute topsoil and growth media during reclamation. Current information indicates these materials are within acceptable acid- and toxic-forming parameters (Table 2-1). Data from the adjacent Soldier Creek Mine and other operations in the Book Cliffs support the determination of low potential for acid- and toxic-forming or alkalinity-producing material. The MRP contains a commitment (p. 2-29) that where overburden materials are used to supplement topsoil, they will be used only after it has been demonstrated that the resultant soil is suitable for supporting revegetation.

Clay content was determined for the roof and floor rock samples. The sample from the roof of the Gilson seam contained twenty percent clay, but clay content of the other roof and two floor samples was less than ten percent. Drill-hole logs indicate lithology of strata immediately above and below the minable coal varies within the permit and adjacent areas. Several factors, such as thickness of overburden, use of a 35° angle of draw in formulating the subsidence control plan, anticipation that most of the land within the permit area will eventually be affected by subsidence, and the low potential for material damage from subsidence indicate additional determination of engineering properties of roof and floor rock would be of little value. No additional determinations of thickness and engineering properties

of clays or soft rock are needed prior to approval of the proposed MRP.

Rock Canyon coal thickness in the proposed permit area ranges from 5 to 8 feet, except for a want in the north-central part of the proposed permit area, where coal thins to under three feet (Plate 6-6). Maximum subsidence can be projected as 3.5 to 5.6 feet, based on the assumption that the surface will subside up to 70% of the thickness of the extracted coal. Overburden thickness ranges from 600 feet in the south part of the proposed permit area to over 2400 in the north. Overburden consists of the upper Blackhawk Formation, the Castlegate Sandstone, and the Price River, North Horn, and Flagstaff Formations, which are described in Section 624.100. Gilson to Rock Canyon interburden thickness is 30 to 80 feet over most of the proposed permit area, and up to 100 feet at the west edge (Plate 6-5), and Rock Canyon to Sunnyside thickness is 140 to 180 feet.

The application includes geologic information in sufficient detail to assist in determining the probable hydrologic consequences of the operation upon the quality and quantity of surface and ground water in the permit and adjacent areas, including the extent to which surface and ground water monitoring is necessary; and determining whether reclamation as required by the R645 Rules can be accomplished and whether the proposed operation has been designed to prevent material damage to the hydrologic balance outside the permit area.

At this time the Division does not require the collection, analysis, and description of additional geologic information to protect the hydrologic balance, to minimize or prevent subsidence, or to meet the performance standards.

The applicant has made no request the Division to waive in whole or in part the requirements of the bore hole information or analysis required of this section. However, the applicant has requested, within the text of the PAP, that the information in Appendices 6-1 and 6-2 be kept confidential. The Applicant should provide this information in a folder or binder separate from the rest of the PAP and marked "Confidential".

Findings:

Information in the geologic resource section is considered adequate to meet the requirements of this section.

HYDROLOGIC RESOURCE INFORMATION

Regulatory Reference: 30 CFR Sec. 701.5, 784.14; R645-100-200, -301-720.

Analysis:

A potentiometric surface map for the Castlegate Sandstone, based on data from wells 10-2, 11-2, and 24-1, is shown on Plate 7-3. The gradient is to the north, downdip. USGS data indicate that ground water flow in the Blackhawk-Starpoint aquifer also is to the north.

There have been slow, long-term declines of hydraulic head measured in the Blackhawk Formation by monitoring wells GW-5-1 and GW-6-1, located in the Soldier Canyon Mine permit area west of the proposed Dugout Canyon Mine. GW-5-1 was installed in 1977, GW-6-1 in 1989. GW-32-1, also in the Soldier Canyon Mine area, has shown generally increasing water levels since monitoring began in 1990. The nearest Blackhawk outcrop (Plate 6-1) is updip of and over a mile from the three wells. Mine workings have been advanced from the outcrop in Soldier Canyon towards the locations of these monitoring wells since 1906, although most coal removal has been since the mid-1970's. When mining came within 150 feet and 2100 feet, respectively, of GW-5-1 and GW-6-1 in 1993 there was a slight rise of head followed by rapid declines. The non-uniformity of length and placement of screened zones within the strata affect data reliability or continuity (p. 7-29). Based on the data and experience from GW-5-1, GW-6-1, and GW-32-1, Canyon Fuel Company has concluded that mining has had little or no effect on ground water levels in the Blackhawk Formation except very near the mine workings and that it is fruitless to attempt a map of the potentiometric surface of the Blackhawk Formation based on water level data from wells.

Data in the MRP indicate an irregular and probably discontinuous potentiometric surface in the Blackhawk Formation near the Soldier Canyon Mine, a potentiometric surface that is influenced by the outcrop of the Blackhawk Formation in nearby Soldier Canyon, the mine workings, and the lateral discontinuity of the strata.

There are no springs issuing from the Blackhawk Formation in Soldier Canyon or within several miles of the canyon. Three intermittent springs issue from the Blackhawk Formation in the Dugout Creek drainage.

Regional hydrostratigraphy from the Colton Formation down to the Mancos Shale is discussed in Section 724.100. Structural geology is discussed in Section 624.100. Ground water occurs in perched aquifer systems and in the regional system in the Blackhawk Formation and underlying Star Point Sandstone. These systems and ground water occurrence, including ground water in mines, are described and discussed in Section 724.100 and Appendix 7-3.

Sampling and analysis.

Sampling and analysis is addressed on page 7-4, Section 723. This section states that, where feasible, all water-quality analyses performed to meet the requirements of the Coal Mining Rules have been conducted according to the "Standard Methods for the Examination of Water and Wastewater" or the methodology in 40 CFR Parts 136 and 434. Where feasible, water-quality sampling has been conducted according to the methodologies in the same two references.

Baseline information.

Ground-water information.

There are no water-supply wells in the permit or adjacent areas. Locations of ground water monitoring wells are shown on Plate 7-1. Collar elevations, depths, and other information are summarized in Table 7-1. Locations of springs are shown on Plate 7-1 and water rights are shown on Plate 7-2. Ground water is used for wildlife and stock watering. Monitoring locations are shown on Plate 7-1. A hydrologic evaluation of the area, by Mayo and Associates, is in Appendix 7-3.

Data on ground water have been collected by the Soldier Canyon Mine operators from 97 springs, seeps, and mine water inflows in and adjacent to the proposed permit area. An additional 8 dry locations have been monitored. Some data are from as early as 1976. In 1995, 58 spring and seep locations were monitored, an average of twice each: 44 had at least one measured flow, 7 had only seepage, and 7 were dry. In addition, 9 in-mine locations were monitored, once each. Water quality analyses and isotope ratio determinations were performed. Many of these locations had not been monitored previously.

Ground-water monitoring results are summarized in Table 7-2 of the PAP and in Appendices 7-2 and 7-3. Data in Appendix 7-2 are from multiple sources, so not all samples were analyzed following DOGM Guidelines. However, the data are indicative of baseline conditions within the permit and adjacent areas. Manganese data in Appendix 7-3 represent determination for total manganese concentrations (p. 7-6).

Water monitoring that potentially meets the minimum requirements of SMCRA and the Utah Coal Mining Rules appears to have been done at only 13 (6 springs and 7 in-mine locations) of the 97 sites. On average only three samples have been analyzed for these sites, so determination of baseline seasonal quality is problematic.

Wells GW-10-2, GW-11-2, and GW-24-1 (all completed in the Castlegate Sandstone) and springs SP-65 (Colton Formation), SP-20 (Flagstaff Formation), and SC-14 and SC-100 (North Horn Formation) will be used to monitor ground water conditions in the proposed permit area. Locations of wells and springs to be monitored are on Plate 7-1.

Spring SC-80 and the nearby SC-81 are the only identified springs issuing from the Castlegate sandstone in the permit and adjacent areas. They are located outside the proposed permit boundary and updip of the proposed mine. Dugout Canyon, deeply eroded into the Book Cliffs, at least partially isolates these springs and the hydrologic system supporting them from the area to be mined. These springs appear to be a poor choice for monitoring the effects of the proposed Dugout Canyon Mine on the Castlegate aquifer. However, the owner of adjacent lands, the Milton and Ardith Thayn Trust, owns a water right on SC-80.

Springs SC-61, SC-62, and G-100 are identified as issuing from the Blackhawk Formation in the Dugout Canyon area. All three appear associated with local flow systems rather than a regional system. G-100 and SC-61 are intermittent.

Mining operations at the Soldier Canyon Mine intercept ground water stored in the Blackhawk Formation in regional and perched systems. Indications are that ground water from younger, shallower strata is not being affected by the mine. Mine operations at Dugout Canyon are predicted to have a steady-state inflow of up to 220 gpm from sources within the Blackhawk Formation without disturbing ground water systems in the younger, overlying strata.

Ground-water quantity descriptions include approximate rates of discharge or usage and depth to the water in the coal seam and in each water-bearing stratum above and potentially impacted stratum below the coal seam.

The determination of the probable hydrologic consequences (PHC) indicates adverse impacts to the hydrologic balance, on or off the proposed permit area, will not occur. Based on limited analysis of rock within the proposed permit area and on data from the adjacent Soldier Canyon Mine, acid-forming or toxic-forming materials that may result in the contamination of ground-water or surface-water supplies are not present. Waste rock will not be used during reclamation, and soil substitutes will be used only if their chemical and physical properties are adequate. Supplemental information is not needed to evaluate such probable hydrologic consequences and to plan remedial and reclamation activities.

Surface-water information.

Climatological information.

Baseline cumulative impact area information.

Section 725, page 7-40 says that information necessary for the Division to develop a Cumulative Hydrologic Impact Assessment (CHIA) is presented in Chapters 6 and 7.

Most if the necessary data are found in the Probable Hydrologic Consequences (PHC), Section 728 beginning on page 7-41, Appendices 7-2, 7-3, 7-4, 7-5, and 7-7. Additional hydrologic and geologic information for the cumulative impact area, which may be needed to assess the probable cumulative hydrologic impacts of the proposed operation and all anticipated mining on surface and ground water systems, is available from appropriate Federal or State agencies.

Modeling.

Modeling techniques, interpolation, or statistical techniques have not been used in preparing the permit application.

Alternative water source information.

Probable hydrologic consequences determination.

The PHC determination, prepared by Mayo and Associates, is in Appendix 7-2. Previous studies in the vicinity of the Soldier Canyon Mine were reviewed for information on geology, hydrology, and hydrogeology. They were also reviewed for data on discharge, sediment, and other surface and ground water parameters, and seventeen additional ground and surface water samples were collected in 1995 for chemical and isotopic analyses. In spite of a large data base, most of the analyses lack information on the basic parameters required by the Coal Mining Rules and SMCRA, and on seasonal variation. Additional water quality samples were collected and analyzed during 1997 at the operational monitoring points to help provide more complete baseline data.

Potential adverse effects to the hydrologic balance from the proposed mining operations are: decreased stream flows and spring discharges due to capture of surface or ground water by subsidence, bedrock fracturing, and aquifer dewatering; increased stream flows due to increased discharge of ground water from the Blackhawk Formation through the mine workings; and increased ground water recharge to overlying ground water systems.

Chemical and isotopic analyses of ground water, data from hydrographs, and the behavior of ground water systems in and adjacent to the Soldier Canyon Mine indicate that mine has not adversely impacted ground water quantity or quality. Subsidence and surface fracturing have not occurred above the Soldier Canyon Mine. Mining locally dewateres strata immediately adjacent to the Blackhawk Formation but does not appear to draw additional recharge from other overlying or underlying ground water systems. Similar geologic, hydrogeologic, and hydrologic conditions exist at the proposed Dugout Creek Mine and the proposed operations should not adversely impact water quantity or quality in ground water systems overlying and underlying the coal to be mined.

Baseflow in Soldier Creek upstream of the Soldier Canyon Mine and the Blackhawk Formation outcrop responds to seasonal climate variations, low flow in the creek being as little as 5 gpm in drought years and as high as 140 gpm in wet years. Canyon Fuel Company has determined average low flow is approximately 50 gpm. Below the mine, where mine discharge is a major contributor to stream flow - especially during summer and autumn, measured flows for August have been as low as 170 gpm.

Steady-state inflow to the Dugout Canyon mine is expected to be approximately 220 gpm (p. 7-49). Mine consumption is estimated to be 30 gpm, leaving 190 gpm (306 acre-feet/yr) discharge to Dugout Creek, which would represent an increase of approximately 6% over average annual flow of 5,100 acre-feet/year (p. 7-50).

In Appendix 7-3 it is estimated that the maximum discharge from both the Dugout Canyon Mine and the Alkali Tract of the Soldier Canyon Mine will be 800 gpm, and that approximately 400 gpm of the maximum can be attributed to each operation. If this maximum rate were sustained for a full year it would be a 13% increase in the estimated average annual flow of Dugout Creek (p. 7-50).

The potential for mine water discharge and increased flow rates in Dugout Creek are based on the studies of Lines (1985 - see MRP for reference). Actual data that could be used to correlate coal production rates to mine water discharge rates at the Soldier Canyon Mine and to predict mine water discharge rates for the Dugout Canyon Mine are not in the PAP. Annual reports provide some information.

Subsidence, propagation of fractures from mine workings to the surface, and increased infiltration at the surface induced by dewatering of ground water systems have the potential to increase the rate and quantity of recharge to ground water systems overlying the Blackhawk Formation. At the Soldier Canyon Mine, ground water systems in the Blackhawk Formation are hydraulically isolated from ground water systems in overlying strata, and subsidence and fracturing have not altered the hydrologic balance between ground water systems. There has been no observed increase in rate or quantity of recharge at the Soldier Canyon Mine and no increase is expected at the Dugout Canyon Mine.

Findings:

Information in the sections on hydrologic resources that were reviewed for this Technical Analysis, in particular those sections that pertain to ground water resources, is considered adequate to meet the requirements of those sections.

MAPS, PLANS, AND CROSS SECTIONS OF RESOURCE INFORMATION

Regulatory Reference: 30 CFR Sec. 783.24, 783.25; R645-301-323, -301-411, -301-521, -301-622, -301-722, -301-731.

Analysis:

When required by the Coal Mining Rules, cross sections, maps, and plans included in the MRP and have been prepared by or under the direction of and certified by a qualified, registered, professional engineer with assistance from experts in related fields.

Affected Area Boundary Maps

Archeological Site Maps

Coal Resource and Geologic Information Maps

Surface geology for the permit and adjacent areas is shown on Plate 6-1, a certified map. Elevations (to the nearest 40 feet) and locations of test borings are also shown on Plate 6-1. Coal crop lines are shown on Plates 6-1 and 6-2. Strike and dip of strata at the surface are shown on Plate 6-1 for several locations within and adjacent to the southwest corner of the proposed permit area: dip is also indicated by cross-section A-A' (Figure 6-1). Strike and dip are apparently uniform over a larger area, but explicit information for the larger area would be useful.

Limited information on nature, depth, and thickness of the Rock Canyon seam, which is the coal seam to be mined, is on bore hole logs in Appendix 6-1 (Confidential binder) and on cross-sections B-B' and C-C' (Plate 6-3). Similar information on the overlying Sunnyside seam and the underlying Gilson seam is on cross-sections B-B' and C-C' (Plate 6-3), and also on bore hole logs in Appendix 6-1. Overburden is shown on bore hole logs in Appendix 6-1. Plate 6-4 is an isopach map of the Rock Canyon seam overburden thickness and Plate 6-5 is an isopach map of the Rock Canyon to Gilson seam interburden thickness. Isopach thickness maps of the Rock Canyon and Gilson seams are on Plates 6-6 and 6-7 in the Confidential binder. There is no isopach thickness map of the Sunnyside seam, the principal rider seam.

Cultural Resource Maps

Existing Structures and Facilities Maps

Existing Surface Configuration Maps

Mine Workings Maps

Monitoring Sampling Location Maps

Locations and approximate elevations of bore holes are shown on Plate 6-1. Collar elevations, some estimated from topographic maps, and elevations of cored sections are given in Appendix 6-1 (Confidential binder).

Elevations and locations of monitoring stations used to gather data on water quality and quantity in preparation of the application are on Plate 7-1.

Permit Area Boundary Maps

Surface and Subsurface Ownership Maps

Subsurface Water Resource Maps

A potentiometric surface map for the Castlegate Sandstone, covering the eastern portion of the proposed permit and adjacent areas, is shown on Plate 7-3. There are no maps, plans, or cross-sections showing potentiometric surfaces for shallower or deeper strata. Subsurface water within the proposed permit and adjacent areas occurs mainly in perched aquifers in the Blackhawk Formation, the underlying Starpoint Sandstone, and in overlying strata, so an exact areal and vertical distribution of ground water is not known. There is no map of a potentiometric surface for a regional aquifer. Data in the MRP indicate an irregular potentiometric surface in the Blackhawk Formation, near the Soldier Canyon Mine, that is influenced by the outcrop of the Blackhawk Formation in nearby Soldier Canyon, the mine workings, and the non-uniformity of screen length and placement within the strata, and the lateral discontinuity of the strata (p. 7-29). There is no portrayal of seasonal differences of head in different aquifers on cross sections or contour maps, but hydrographs for several springs and graphs of water levels in four monitoring wells are provided.

The relationship of geology to ground water is discussed extensively in the text, yet there is no map that relates geology to ground water occurrence, in particular the location of springs in relation to surface exposures of stratigraphic units.

Spring 10 in the Soldier Canyon Mine permit area issues from the North Horn

Formation but the water may originate in a deeper formation and reach the surface through a fracture. The chemistry and long-term hydrographs of Spring SP-10 are more consistent with a deep source, rather than a shallow source such as seen in springs issuing from the Flagstaff, North Horn, and Price River Formations. Isotopic and solute compositions are similar to those in ground water from the Blackhawk Formation. There is no fracture mapped but the major water-bearing fracture in the Soldier Canyon Mine coincides approximately with the surface location of this spring.

Surface Water Resource Maps

There are no water-supply intakes for current users of surface waters flowing into, out of, and within the proposed permit and adjacent area. Surface waters that will receive discharges from affected areas in the proposed permit area are shown on Plate 7-1. Location of surface water bodies such as streams, lakes, ponds, springs, constructed or natural drains, and irrigation ditches within the proposed permit and adjacent areas are shown on Plate 7-1.

Vegetation Reference Area Maps

Well Maps

There are no gas and oil wells within the proposed permit and adjacent areas. There are no water wells in the proposed permit and adjacent areas.

Contour Maps

Findings:

Resource hydrologic information presented on maps, plans, and cross sections that were reviewed for this Technical Analysis, in particular information that pertains to ground water resources, is considered adequate to meet the requirements of this section.

OPERATION PLAN

HYDROLOGIC INFORMATION

Regulatory Reference: 30 CFR Sec. 773.17, 774.13, 784.14, 784.16, 784.29, 817.41, 817.42, 817.43, 817.45, 817.49, 817.56, 817.57; R645-300-140, -300-141, -300-142, -300-143, -300-144, -300-145, -300-146, -300-147, -300-148, -301-512, -301-514, -301-521, -301-531, -301-532, -301-533, -301-536, -301-542, -301-720, -301-731, -301-732, -301-733, -301-742, -301-743, -301-750, -301-761, -301-764.

Underground mining and reclamation activities are planned to be conducted to minimize disturbance of the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the permit area, and to support approved postmining land uses in accordance with the terms and conditions of the approved permit and the performance standards of this part. The Division has not required additional preventative, remedial, or monitoring measures to assure that material damage to the hydrologic balance outside the permit area is prevented.

Analysis:

Ground-water monitoring.

Wells GW-10-2, GW-11-2, and GW-24-1 (all completed in the Castlegate Sandstone) and springs SP-65 (Colton Formation), SP-20 (Flagstaff Formation), and SC-14 and SC-100 (North Horn Formation) will be used to monitor ground water conditions in the proposed Dugout Canyon Mine permit area. Locations of wells and springs to be monitored are on Plate 7-1. See the discussion of Ground Water Information under Baseline Information in the Environmental Resource Information section.

Surface-water monitoring.

Acid and toxic-forming materials.

No storage of acid- and toxic-forming materials and underground development waste is planned for the Dugout Canyon Mine. Although not part of this permit submittal, future development of a waste-rock disposal site has been contemplated. Waste rock will not be used during reclamation, and soil substitutes will be used only if their chemical and physical

properties are determined to be adequate through appropriate analyses.

Transfer of wells.

Ownership of wells will be transferred only with prior approval of UDOGM and the conditions of such a transfer will comply with State and local laws. Soldier Canyon Mine will remain responsible for management of the wells until bond release. This is discussed on page 7-61 under Section 731.400.

Discharges into an underground mine.

Gravity discharges.

Water quality standards and effluent limitations.

Diversions.

Stream buffer zones.

Sediment control measures.

Sedimentation ponds.

Exemptions for siltation structures.

Discharge structures.

Impoundments.

Casing and sealing of wells.

Procedures for casing and sealing, capping, backfilling or otherwise properly managing drilled holes, exploration holes and boreholes, and wells are discussed on pages 5-65, 6-18, 7-70, 7-89, and 7-91.

Findings:

Hydrologic operations information that was reviewed for this Technical Analysis, in particular information that pertains to ground water resources, is considered adequate to meet the requirements of this section.

MAPS, PLANS, AND CROSS SECTIONS OF MINING OPERATIONS

Regulatory Reference: 30 CFR Sec. 784.23; R645-301-512, -301-521, -301-542, -301-632, -301-731, -302-323.

Analysis:

Affected area maps.

Mining facilities maps.

Mine workings maps.

Monitoring and sample location maps.

Locations and approximate elevations of bore holes are shown on Plate 6-1. Collar elevations, some estimated from topographic maps, and elevations of cored sections are given in Appendix 6-1 (Confidential binder).

Elevations and locations of monitoring stations used to gather operational water quality and quantity data are on Plate 7-1.

Certification Requirements.

Cross sections, maps, and plans have been prepared by, or under the direction of, and certified by a qualified, registered, professional engineer.

Findings:

Hydrologic operations information presented on maps, plans, and cross sections that were reviewed for this Technical Analysis, in particular information that pertains to ground water resources, is considered adequate to meet the requirements of this section.

RECLAMATION PLAN

GENERAL REQUIREMENTS

Regulatory Reference: PL 95-87 Sec. 515 and 516; 30 CFR Sec. 784.13, 784.14, 784.15, 784.16, 784.17, 784.18, 784.19, 784.20, 784.21, 784.22, 784.23, 784.24, 784.25, 784.26; R645-301-231, -301-233, -301-322, -301-323, -301-331, -301-333, -301-341, -301-342, -301-411, -301-412, -301-422, -301-512, -301-513, -301-521, -301-522, -301-525, -301-526, -301-527, -301-528, -301-529, -301-531, -301-533, -301-534, -301-536, -301-537, -301-542, -301-623, -301-624, -301-625, -301-626, -301-631, -301-632, -301-731, -301-723, -301-724, -301-725, -301-726, -301-728, -301-729, -301-731, -301-732, -301-733, -301-746, -301-764, -301-830.

HYDROLOGIC INFORMATION

Regulatory Reference: 30 CFR Sec. 784.14, 784.29, 817.41, 817.42, 817.43, 817.45, 817.49, 817.56, 817.57; R645-301-512, -301-513, -301-514, -301-515, -301-532, -301-533, -301-542, -301-723, -301-724, -301-725, -301-726, -301-728, -301-729, -301-731, -301-733, -301-742, -301-743, -301-750, -301-751, -301-760, -301-761.

Analysis:

Ground-water monitoring.

Wells GW-10-2, GW-11-2, and GW-24-1 (all completed in the Castlegate Sandstone) and springs SP-65 (Colton Formation), SP-20 (Flagstaff Formation), and SC-14 and SC-100 (North Horn Formation) will be used to monitor ground water conditions in the proposed Dugout Canyon Mine permit area. Locations of wells and springs to be monitored are on Plate 7-1. See the discussion of Ground Water Information under Baseline Information in the Environmental Resource Information section.

Surface-water monitoring.

Acid and toxic-forming materials.

Transfer of wells.

Ownership of wells will be transferred only with prior approval of UDOGM and

the conditions of such a transfer will comply with State and local laws. Soldier Canyon Mine will remain responsible for management of the wells until bond release. This is discussed on page 7-61 under Section 731.400

Discharges into an underground mine.

Gravity discharges.

Water quality standards and effluent limitations.

Diversions.

Stream buffer zones.

Sediment control measures.

Siltation structures.

Sedimentation ponds.

Other treatment facilities.

Exemptions for siltation structures.

Discharge structures.

Impoundments.

Casing and sealing of wells.

Procedures for casing and sealing, capping, backfilling or otherwise properly managing drilled holes, exploration holes and boreholes, and wells are discussed on pages 5-65, 6-18, 7-70, 7-89, and 7-91.

Findings:

Reclamation hydrologic information that was reviewed for this Technical Analysis, in particular information that pertains to ground water resources, is considered adequate to meet the requirements of this section.

MAPS, PLANS, AND CROSS SECTIONS OF RECLAMATION OPERATIONS

Regulatory Reference: 30 CFR Sec. 784.23; R645-301-323, -301-512, -301-521, -301-542, -301-632, -301-731.

Analysis:

Affected area boundary maps.

Bonded area map.

Reclamation backfilling and grading maps.

Reclamation facilities maps.

Final surface configuration maps.

Reclamation monitoring and sampling location maps.

Elevations and locations of monitoring stations used to gather reclamation water quality and quantity data are on Plate 7-1.

Reclamation surface and subsurface manmade features maps.

Reclamation treatments maps.

Certification Requirements.

Cross sections, maps, and plans have been prepared by, or under the direction of, and certified by a qualified, registered, professional engineer.

Findings:

Reclamation hydrologic information presented on maps, plans, and cross sections that were reviewed for this Technical Analysis, in particular information that pertains to ground water resources, is considered adequate to meet the requirements of this section.

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