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

Michael O. Leavitt
Governor
Kathleen Clarke
Executive Director
Lowell P. Braxton
Division Director

1594 West North Temple, Suite 1210
PO Box 145801
Salt Lake City, Utah 84114-5801
801-538-5340
801-359-3940 (Fax)
801-538-7223 (TDD)

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TO: File

THRU: Daron Haddock, Permit Supervisor DRH

FROM: Michael Suflita, Reclamation Hydrologist MS.

RE: 150 Acre Addition/Incidental Boundary Change, Canyon Fuel Company, LLC, SUFCO Mine, ACT/041/002-98-2, File #2, Sevier County, Utah.

SUMMARY

On December 7, 1998, the Division received an application to amend the existing Mining and Reclamation Plan by adding 150 acres to the current permit boundary. The same application was sent to the BLM to expand the lease.

This lease addition has been under review by the U.S. Forest Service through the NEPA process resulting in development of the Pines Tract Project, Final Environmental Impact Statement (FEIS). On January 28, 1999, the Forest Service issued a Record of Decision (ROD) regarding this proposed action. As the Surface Management Agency, the Forest Service must concur with DOGM approval of this action, and the ROD, page 8, indicates that they do concur. This process, along with meeting with the mine Operator, has delayed the DOGM evaluation. This Technical Memo is a hydrologic review of the proposed amendment that was prepared using the Division's Hydrology Working Group.

This 150-acre addition is part of a substantial study area of a large region east of the existing SUFCO Mine known as the Pines Tract. In fact, several studies have been undertaken and this TA has drawn from all those known to have been developed. The format presented here will be to first review the mine Operator's Application and then draw from the following:

- Pines Tract Project, Final Environmental Impact Statement, U.S. Forest Service (FEIS)
- Evaluation and Prediction of Potential Surface Subsidence Impacts from Longwall Mining under the Box Canyon Area, Sufco Mine, Agapito Associates, Inc.(AGAPITO)
- Hydrology and Effects of Mining in the Quitchupah and Pines Coal-Lease Tracts, Central Utah, U.S.G.S. Report 90-4084, by Thiros & Cordy (USGS)

- Probable Impact From Longwall Coal Mining at the SUFCO Mine to the Hydrologic Balance of Box Canyon Creek, Sevier County, Utah (MAYO)

- The January 8, 1999 meeting with DOGM and the Operator (OPERATOR)

OPERATION PLAN

HYDROLOGIC INFORMATION

Regulatory Reference R645-301-731

Analysis:

Basic Situation

Several plates, such as 7-3, Hydrologic Monitoring Stations, show the 150-acre addition located at the northeast corner of the existing lease. A new water monitoring point, designated Pines-206, is added to the monitoring program. It's a spring in the Blackhawk formation and appears to be in the same location as a spring of the same number in the FEIS. This spring is located about 100 ft. below the canyon rim and 325 ft. above the canyon bottom and flows about three gallons per minute. It's just outside the area to be mined and is an appropriate choice for determining possible mining impact. Its protocol is quarterly discharge and water chemistry lab measurements typical for the rest of the monitoring plan. Additional monitoring is anticipated in the Pines Tract to the east if the mine is awarded that lease.

Possible hydrologic consequences of mining the 150 acres are described in an addition to Appendix 7-17, Probable Hydrologic Consequences, (PHC). This describes the Blackhawk formation underlying the Castlegate Sandstone which forms the rim and plateau above Box Canyon. The Upper Price River formation overlies the area to the east of the canyon and some portions of the 150-acre addition. Attachment A of the amendment includes Fig. 3-4 (a topographic map) and Table 3-1 from the FEIS. These show the location of several springs in Box Canyon and tabulate their origin according to geologic formation.

There are 12 springs which are potentially affected by mining the 150-acre area. Nine are in the Blackhawk Formation and three are in the Castlegate. According to the FEIS, three in the Blackhawk show seasonal flow variations. In addition to these springs, there are numerous smaller seeps which contribute to the base flow of Box Canyon Creek. According to the FEIS and USGS, springs are the primary source of base flow to the perennial stream in box Canyon with little base flow contribution from surface runoff. Also, "field observations indicate that much of the riparian vegetation of these stream reaches depends upon shallow

subsurface waters issuing from the stream side colluvium rather than the in-channel surface flows themselves" (FEIS).

The submittal refers to the PHC included in the original MRP for a discussion of groundwater occurance and recharge. These are believed to be the same in the 150-acre addition. There is general agreement among the studies that the "recharge to the saturated zones is principally by snowmelt seeping into outcrops . . . Water movement is controlled mainly by fractures, dip of the beds, and hydraulic conductivity of the materials." Also the groundwater movement is regarded as relatively rapid (USGS). It's important to note that the length of Box Canyon Creek immediately to the west of the 150-acre addition has the "highest concentration of springs in the study area" and that "without exception springs in Box Canyon and East Fork Box Canyon issue from the east or northeast canyon wall. This is a result of structural control on groundwater flow (i.e., groundwater flow is in the downdip direction)." Further, "the potential for mining-related impacts to groundwater resources is greater in this area than in any other portion of the Project Area" (FEIS).

Using groundwater chemistry analysis, the recharge to the springs is believed to result primarily from flows in the Castlegate Sandstone as compared to the overlying Price River formation. This appears to indicate that recharge to the springs in Box Canyon is derived primarily from the area "within 100 feet to 1,000 feet of the canyon rims" (FEIS) and (MAYO). Using Plate 5-7, Upper Hiawatha Mine Plan, 5 Year Projection, the escarpment boundary was used to draw a line 1000 feet in from the canyon rim. This shows that slightly more than 50 percent of the area mined in the 150-acre addition lies within this recharge zone. A second chemical analysis "suggests that the recharge locations for groundwaters in the Casltegate Sandstone are different than the groundwaters in the Blackhawk formation, or that the groundwaters recharged under different climatic conditions." This appears to be inconclusive.

The substantial and unique environment in Box Canyon has been well documented and includes a perennial stream with mosses and ferns. The riparian area along the stream and area along the canyon walls is therefore designated as a critical wildlife habitat. Detailed evaluation of the plant and animal considerations can be found in the respective Technical Analysis.

At FEIS designated point 407, the stream flow has been measured quarterly for nearly two years and yet none of that information has been submitted to DOGM for inclusion into the Mining and Reclamation Plan (MRP). One set of flow measurements on October 29, 1997 showed 39 g.p.m. on Box Canyon Creek just above its confluence with the East Fork. The East Fork was flowing 20 g.p.m., and 81 g.p.m. were flowing at Lower Box Canyon (downstream near Muddy Creek) (FEIS). These numbers serve to show the order of magnitude of flows in the streams and the relative contributions of the streams. The MAYO study also showed that Box Canyon Creek was a gaining stream along its upper length. These

data have not been submitted into the MRP either.

Monitoring point 090 is located due west of the proposed addition, just upstream from the center of the 150-acre addition. Review of ten samples of monitoring data submitted by the mine for this point shows an average flow over the last three and one-half years of 39.8 gallons per minute (coincidently, near the flow rate measured as described above). By way of comparison, that's enough water to supply more than six households given the standard water allotment (0.015 cfs) for such purposes. In addition to contributing to the riparian resources, the flow is used by downstream water users, particularly on Muddy Creek which, per Darrel Leamaster, supplies the town of Emery with all of its culinary water.

Overburden and Subsidence Cracking

There is believed to be a definite disconnect between in-mine waters and near-surface groundwaters. This is substantiated by tritium analysis which shows the mine waters to be very old (greater that 7,000 years) as compared to meteoric waters that replenish the near surface waters (MAYO and FEIS). "The cause of this disconnect is attributed to shale and mudstones in the Blackhawk Formation that hinder the downward migration of water" (FEIS). As a result, "groundwater should not be diverted from the Calstlegate Sandstone into the Blackhawk Formation" (FEIS). However, it's important to note that the Blackhawk Formation is interbedded and contains significant sandstone (60-65%) (MAYO) which can fracture and conduct water.

"The average mining height is 11.7 feet " (MAYO) and subsidence at the surface is expected to be in the range of three to four feet (Operator & AGAPITO). The ground slope in the recharge area is about 3 to 4% to the northwest and such subsidence would not be expected to result in ponding of surface runoff. The overburden, as indicated in Fig. 3-2 of the FEIS and examination of drill hole log 89-16-1, is a rather uniform depth of slightly more than 900 feet over the entire 150 acres. While this is a significant depth, surface subsidence cracking above the 150-acre addition is expected to occur since that has been documented at numerous locations above the SUFCO Mine with very similar geologic conditions and overburden (AGAPITO). The impact of this cracking has received considerable attention. Several cracks have been observed to have filled in with native soils washed in by natural runoff to the point that there is standing water over the cracks. Other locations have had a bentonite fill put in the cracks repeatedly with water losses still occurring. The FEIS indicates up to two years may be needed to fill cracks naturally. There still appears to be some inconsistency as to the impact of subsidence cracking and how effectively they can be sealed. This is reflected in the differing opinion of recognized professionals who have studied the issue (ROD). This issue is of particular concern on the 150-acre tract since the ground surface is bare sandstone and "soils are thin to nonexistent near the rim of Box Canyon" (AGAPITO). There is no soil cover to ameliorate the cracking.

The submitted plan has no provision for mitigation of possible cracking effects. Specifically, there is a stock pond in the northeast corner of the addition, designated West Pine, 202039 on Figure 3-17 of the FEIS, which could be impacted by the mining. Considerable problems have been encountered with stock ponds over other areas of the mine. Also, subsidence cracks as wide as two feet have occurred in other areas of the mine and have had to be filled in. Commitments to mitigation must be included in this amendment.

Another concern regarding cracking is the possible increased speed of water transmission through the Castlegate Sandstone, which is already regarded as rapidly draining. This could result in loss of water to some of the springs later in the year and the stream no longer being perennial for affected reaches. Also, while the Castlegate Sandstone is presumably disconnected from the underlying Blackhawk Formation, this assumption is based on extrapolating from other areas of these formations to this particular location. This is reasonable, but it's possible that local conditions vary from this assumption. This could result in water flowing by gravity down through the Castlegate Sandstone and being diverted down into the Blackhawk Formation via newly formed cracks rather than flowing horizontally as it does now. The USGS report indicates this mechanism is probable. Some have speculated that groundwater which normally flows directly to Box Canyon could be diverted to other locations further down the canyon. All of these possible scenarios could result in groundwater being directed away from its traditional paths to the Box Canyon springs and being lost through subsurface cracks to previously unwatered regions.

Risk is difficult to quantify for geologic situations. However, based on all the above hydrologic considerations, it's believed that there's definitely some risk that mining the 150-acre tract could result in loss of groundwater flows to Box Canyon Creek during some seasons of the year.

Regulatory Perspective

The R645 regulations (R645-301-731) require that,

- "The plan will be specific to the local hydrologic conditions. It will contain the steps to be taken during coal mining and reclamation operations through bond release to minimize disturbance to the hydrologic balance within the permit and adjacent areas; to prevent material damage outside the permit area";

- "The plan will identify the surface water quantity and quality parameters to be monitored, sampling frequency and site locations. It will describe how these data may be used to determine the impacts of the operation upon the hydrologic balance":

- "The Division may require additional preventative, remedial or monitoring measures to assure that material damage to the hydrologic balance outside the permit area is

prevented. Coal mining and reclamation operations that minimize water pollution and changes in flow will be used in preference to water treatment."

Amendment Enhancements Needed

As with all such operations, it's apparent that mining operations in the 150-acre addition to the lease will have some impact on the hydrologic regime. In order for the operation to receive approval, it will be necessary to establish that those impacts have been minimized and that material damage is not occurring outside the permit area.

The length of Box Canyon Creek that may be affected by mining the 150-acre addition lies entirely outside the expanded lease area. As indicated in the above regulations, the Division is obligated to be concerned with possible impacts outside the permit area. This is especially true in light of the significant scrutiny this project has received. Given the numerous hydrologic factors cited above, and the regulatory requirements, the Division has required the Applicant to provide additional information and additional monitoring before approval can be given. Many of these are derived from recommendations in the MAYO report, page 44. They will also serve as baseline monitoring for the Pines Tract Lease.

The Applicant has made the following additions to the monitoring plan. Some of them comply with Division requirements in the previous TA and others do not:

- Spring monitoring points number Pines-209 and Pines-212 have been added to Plate 7-3, Hydrologic Monitoring Stations. Table 7-2, Water Monitoring Program, however, lists additions of Pines-209 and Pines-210 (NOT 212). This appears to be a simple typographic error. Monitoring point Pines-206 is a newly added monitoring point and is shown on the map and in Table 7-2. In the previous Technical Analysis the Division required the Applicant to, "Submit all information previously gathered at all these points." This submittal does not have any such information for inclusion into the MRP.

- In the previous TA the Division required the Applicant to, "Include FEIS stream monitoring points numbered 407 and 408 and submit all information previously gathered at these points." The points are now included, however, the submittal does not have any of the information previously gathered at these points for inclusion in the MRP.

- In the previous TA the Division required the applicant to, "Perform a gain/loss flow rate survey (similar to that in MAYO, Figure 8) along the length of Box Canyon and along the East Fork of Box Canyon." After discussions with the Applicant, this was revised to include in the Water Monitoring Plan, monitoring points Pines-407 on Box Canyon Creek and Pines-408 on the East Fork of Box Canyon. These are located near

one another at the junction of the two streams. These points will be monitored for stream flows weekly during the months of June through October of 1999 and monthly during the months of July, August, September, and October starting in the year 2000. Flow measurements in the two streams will be taken on the same day and at least five days after the last precipitation event. This monitoring is described in Table 7-2 Water Monitoring Program and Table 7-3 Field and Laboratory Measurement Protocol and on page 7-45. The above agrees with the discussions between the Applicant and the Division. However, the submitttal indicates that the "Monitoring of the stream sites (Pines-407 and Pines-408) will continue until two years after mining ceases in the Box Canyon area or subsidence is deemed reasonable complete, whichever occurs first." This is not consistent with those discussions. The monitoring of Pines-407 and Pines-408 is to continue as an ongoing part of the water monitoring plan. If analysis of the data shows no significant changes after several years, five years would be a minimum, the Applicant can then request a revision to the plan to reduce or eliminate monitoring at these points.

- In the previous TA the Division required the Applicant to, "Monitor the stock watering pond that is on the northeast corner of the 150-acre addition." After a field visit it was determined that the pond was unable to hold significant amounts of water due to sandy soils and the embankment being breached. As such, no monitoring is required at the pond.

- There was confusion regarding monitoring point 089 and the submittal clarifies the issue by designating 089 as a spring pool with depth measurements being reported by the applicant. This is clarified in Tables 7-2 and 7-3. The Division database has been updated to reflect this revision.

- Page 7-43 indicates the Applicant will age date test the underground water intercepted by mining operations to determine if it is of older or of meteoric origin. One sample will be taken as soon as possible after mining begins and another when mining is about half way through the 150-acre area. A map with the location of each sample taken will be submitted.

- In the previous TA the Division required the Applicant to, "Meter the water volumes pumped from the section of the mine in the 150-acre addition." The Applicant has explained that the dip of the mine will result in water draining into the 150 acre IBC and would not be pumped out. This renders the requirement a moot point and is no longer required by the Division.

The original MRP includes commitments to repair and mitigate possible damages done due to subsidence. These are described on pages 5-11, 5-21, and 5-33. Included are roads and ponds in the subsided area.

Several maps, including Plate 5-7, Upper Hiawatha Mine Plan, 5 Year Projection, have been revised to show no mining under upper Box Canyon in the existing permit area. These maps are consistent with the Record of Decision issued by the Forest Service which limited the areas available for mining.

Findings:

In its present form, the application does not meet regulatory requirements. Accordingly, the Applicant must address those deficiencies as found within this Technical Analysis and provide the following, prior to approval, in accordance with the requirements of:

R645-301-731, enhancements to the surface and groundwater monitoring program as detailed above.

RECOMMENDATION

Prior to approval, the requirements of R645-301-731 must be provided as outlined above.

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