



Michael O. Leavitt
Governor
Ted Stewart
Executive Director
James W. Carter
Division Director

State of Utah

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

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

September 11, 1998

To: File

Thru: Joe Helfrich, Permit Supervisor, Compliance *JH*
Daron Haddock, Permit Supervisor, Permitting

From: Peter Hess, Reclamation Specialist III *PHH*

RE: Undermining Box Canyon, Canyon Fuel Company, LLC, SUFCO Mine, ACT/041/002-98D, Folder #2, Sevier County, Utah

SUMMARY:

The permittee is proposing to change the mining plan for the 13 Lt and 14 Lt off of 4 East longwall panels by extending the length of these panels by approximately 1500 and 2400 feet, respectively, (13,600 feet, total length). This equates to approximately 2.8 million additional recoverable tons if the revised plan is approved. The revised plan for the 13 Lt panel will allow full extraction longwall mining under approximately 2500 feet of perennial stream and 3500 feet of intermittent stream in upper Box Canyon. Extraction of the 14 Lt panel will undermine about 1700 feet of intermittent stream in the upper left fork of Box Canyon. It should be noted at this point that the present mine plan for the 13 Lt panel allows for full extraction longwall mining under 3300 feet of intermittent stream in the upper middle fork of Box Canyon. The present plan for the 14 Lt panel does not show any extraction under the upper left fork intermittent stream of Box Canyon.

The U. S. Forest Service, Fishlake National Forest is the surface management agency in charge of this area, and as such, has the ultimate authority regarding issues which may impact the surface areas of Box Canyon.

TECHNICAL ANALYSIS:

This submittal essentially consists of the following text or reports:

- 1) Revised text pages to the SUFCO mining and reclamation plan.
- 2) Appendix 4-2, USFS and SHPO Correspondence Regarding Box Canyon Cultural Resources.
- 3) Appendix 5-10, AERC's and Agapito Reports on Box Canyon Cultural Resources.



- 4) Mayo and Associates Report, "Probable Impacts From Longwall Coal Mining at the SUFCO Mine to the Hydrologic Balance of Box Canyon Creek," Sevier County, Utah.
- 5) Agapito Associates, Inc. Report, "Evaluation and Prediction of Potential Surface Subsidence Impacts from Longwall Mining under the Box Canyon Area, SUFCO Mine."
- 6) Mt. Nebo Scientific's report, "Effects of Subsidence to Riparian Communities Caused by Underground Coal Mining in Box Canyon."
- 7) AERC's report, "Cultural Resource Evaluation of a Potential Mining Subsidence Zone in the Box Canyon Locality of Sevier County, Utah."

Regulatory References:

R645-301-525.210-Adoption of Mining Methods for Planned and Predictable Subsidence
R645-301-525.231-Mitigation of Subsidence Damage to Surface Lands Due to Mining
R645-301-525.260-Suspension of Mining Under Perennial Streams
R645-301-332.-Description of Anticipated Impacts on Renewable Resource Lands

The review of the aforementioned documents has revealed the following; the extraction of the 13 Lt 4 East longwall panel will allow for the complete extraction and even settling (IE., even subsidence) of 1800 feet of the perennial portion of Box Canyon Creek. The section of Box Canyon Creek that crosses the barrier pillar between the 13 Lt 4 East set up rooms and the bleeders will cause the folding of the Castlegate sandstone to intercept an unyielding fulcrum placing shearing stress on the sandstone member at this portion of the drainage. The probability of tension cracks forming in this area is great.

Extraction of the coal in this 930 foot wide pillar will allow four to five feet of settling/bending of the Castlegate to occur parallel to the face, yet this same settling will create incredible stress in the sandstone as the settling tries to adjust the subsidence gradient over the unyieldable pillars in the setup rooms. Once the gradient has adjusted itself, (whether shearing or folding takes place in the area outby the setup room pillars) the shape of the gradient should remain fairly constant as it crosses the unyielding pillar(s) in the setup rooms, the barrier pillar between the setup and bleeder pillars, the bleeder pillars and the solid virgin coal north of the Box Canyon lease. The unyielding pillars which are developed as part of the ventilation bleeder system are purposely designed so that coal dust and methane gas accumulations which are liberated during mining can be vented away from the working section of the mine. Approximately 775 feet of Blackhawk formation (which consists of 60-65 percent sandstone) exists between the bottom of the Castlegate and the immediate mine roof. It is possible that the swell index of this roof material is sufficient to fill the void created by the coal extraction; the Castlegate may merely fold over the fulcrum (set up room pillars). This would be a function of the following:

- 1) the swell index of the roof material;
- 2) the friability of the roof material; and
- 3) the height to which the gob will cave out by the set up rooms.

If the void is effectively filled, and the Castlegate can essentially flow over the fulcrum, tension cracks may not even occur in the surface of same. If a worst case scenario occurs and the Blackhawk and the Castlegate shear at or near the fulcrum, (maximum vertical displacement 4-5 feet) a depression would form in the gradient of the Box Canyon perennial drainage. However, from page 5 of the Agapito and Associates, Inc. report "Evaluation and Prediction of Potential Surface Subsidence Impacts from Longwall Mining Under the Box Canyon Area, SUFCO Mine", paragraph two under Impacts to the Stream, indicates the following:

- 1) the estimated natural gradient of the Box Canyon Creek is 0.036 ft/ft from South to North.
- 2) the opposing gradient (-) due to vertical subsidence (based on the modeling) will be approximately -0.008 ft/ft for a distance of about 130 feet on the east flank of the 13 Lt 4 East gate road.
- 3) the resulting gradient = $(+0.036 \text{ ft/ft}) + (-0.008 \text{ ft/ft}) = (+0.028 \text{ ft/ft})$ from south to north still in the direction of natural flow, (new gradient of Box Canyon Creek after subsidence).
- 4) on the west flank of the gate road, the gradient may be increased by +0.008 ft/ft.

The Agapito report indicates that the computer modeling used has been tweaked to adjust the model fit to the inherent subsidence factors over the gate roads and longwall panels "independently".

As real conditions occur over gate roads and longwall panels concurrently, the possibility of the model not accurately predicting what happens, in actuality, to ground conditions is possible. Computer modeling has been used (to what extent is unknown to me) to predict subsidence; the altering of parameters to make these predictions may be an art as compared to a science. The rate of successful subsidence predictions appears to be within the realm of positive probability, as these programs continue to be used, and what they predict appears to be accepted by industry and government.

Tension Cracks Due to Subsidence of Box Canyon

The possibility of tension cracks forming in the surface of the Castlegate sandstone where it exists in the Box Canyon drainage is real, for it is at the surface that the tension of the folding member will be the greatest. The degree of folding will again be a function of the caving factors involved as the 11.7 feet (average mining height, see page 6, paragraph 2, Mayo and Associates

report) of coal seam is extracted. The average thickness of the Castlegate sandstone in the Box Canyon area is 200 feet, (page 12, under 3.3 Stratigraphy, Agapito and Associates). "Only 60-100 feet of Castlegate sandstone is exposed in the Box Canyon area (page 8, Agapito report). Therefore, anywhere from 100 to 140 feet of sandstone are under the surface (i.e., the sandstone in the drainage ranges from 100 to 140 feet thick). The Mayo and Associates reports indicates that "surface flows that intercept cracks in the Castlegate sandstone do not penetrate that member more than several tens of feet". We, therefore, have anywhere from 50 to 90 feet of sandstone that is not conveying any surface water through to the Blackhawk. It is also generally agreed upon that the Castlegate sandstone has low permeability, as it consists of fine to medium grained sands, with a high percentage of cementation. This correlates with the Mayo and Associates report finding (page 21, paragraph 3, "Hydrologic Impacts to Box Canyon Creek") that no hydraulic connection exists between groundwaters near the surface and groundwaters encountered during mining. A vertical distance of 775 feet exists between the base of the Castlegate sandstone and the roof line of the Upper Hiawatha coal seam. It would be necessary for percolating waters to travel at least 825 to 865 feet for near surface ground waters to be encountered during mining. Based on Mayo and Associates wagger age dating, this hydraulic connection does not exist, because waters encountered during mining range in age from 7,000 to 20,000 years. This clearly indicates that surface flows which intercept surface cracks will merely flow (at the worst) several tens of feet into the Castlegate formation.

Once the waters reach the base of the cracks, they hit the unpermeable highly cemented sandstone of the Castlegate. As water will naturally seek the path of least resistance, it will seek adjacent cracks to continue to flow, or be trapped. Since stream gradient will continue to be from south to north, even after subsidence occur, the fact that these flows will resurface farther down channel in Box Canyon Creek is more than likely. Existing springs may increase in flow, or new springs/seeps may emerge. Surface flow quantities will remain the same, but the locations of where the flows make their way to the surface will change. This has the possibility of effecting the riparian ecosystems of the Box Canyon drainage in the vicinity of the longwall setup rooms.

Subsidence Effects on The Riparian Ecosystems in Box Canyon Creek

As noted earlier in this analysis, 60-100 feet of the Castlegate sandstone formation are exposed in the Box Canyon area. Surface groundwaters move through the Castlegate through joints and bedding planes near the cliff faces and the soil mantle. Crack/bedding plane flow is much more prevalent than percolation through finely grained, highly cemented sandstone. Although the folding of the Castlegate and Blackhawk formations may cause the loss of waters which nourish specific riparian ecosystems in the Box Canyon drainage (not due to downward percolation, but due to tension surface crack formation/interception), these waters should reappear farther down gradient nourishing other riparian areas. Surface flows from the Box

Canyon plateau should generally run uninterrupted as the massive folding of the Castlegate and Blackhawk formations take place due to subsidence deflection. Should new cracks occur around the perimeter of Box Canyon from the separation of bedding planes in the Castlegate, flows to the riparian vegetation on the canyon walls should be enhanced. If a quantity of flow is capable of reaching the edge of the canyon wall, it will fall directly to the bottom due to the convex shape of the canyon walls. This may cause erosional problems along the canyon's perimeter, depending on concentration characteristics and flow quantities of the subsided watershed(s) contributing to this canyon. The "over-the-edge" flows will immediately increase the flow in Box Canyon Creek, and will, more than likely, have little sustaining effect on the riparian areas along the Creek. It is my opinion that the riparian area in the canyon where the drainage crosses the set up rooms for the 13 Lt 4 E is the one which will be the one to be the most likely impacted. Slabbing off of the canyon walls may destroy some vegetation which exists here, but it is felt that flows within the bedding planes and any new or old cracks will quickly re-establish any vegetation which is destroyed. Mayo reports the vegetation exists anywhere from three to six feet above the canyon floor, and that it is probably sustained by groundwater discharging from the canyon walls rather than by creek flow.

FINDINGS:

Regulatory Reference:

R645-301-525.210-Adoption of Mining Methods for Planned and Predictable Subsidence

The use of computer modeling in conjunction with techniques developed through applied rock mechanics, and practical experience gained over years of longwall mining at SUFCO clearly indicates that the permittee is meeting the requirements of this rule. SUFCO has been a leading coal producer for many years; the implementation of techniques that work is one of the key factors in reaching the productivity levels which are well known at this operation.

Regulatory Reference:

R645-301-525.231-Mitigation of Subsidence Damage to Surface Lands Due to Mining

Page 5-30 of the SUFCO Mine, mining and reclamation plan makes a commitment to address the requirements for correction of material damage resulting from mining induced subsidence to surface lands to the extent such mitigation is technologically and economically feasible. This meets the minimum regulatory requirements of the R645 Rules.

Regulatory Reference:

R645-301-525.260-Suspension of Mining Under Perennial Streams

This R645 rule gives the DOGM the authority necessary to suspend all mining operations

under perennial streams if imminent danger is found to inhabitants of the urbanized areas, cities, towns, or communities. As no inhabited areas exist in or immediately adjacent to the Box Canyon area, this rule is not applicable.

Regulatory Reference:

R645-301-332.-Description of Anticipated Impacts on Renewable Resource Lands

The following reports have been submitted to address this requirement.

- 1) Appendices 4-2, 5-10, and the AERC report, "Cultural Resource Evaluation of a Potential Mining Subsidence Zone in the Box Canyon Locality of Sevier County, Utah", discusses the mining related impacts to the cultural resource areas in the Box Canyon area.
- 2) The Mayo and Associates Report, "Probable Impacts From Longwall Coal Mining at the SUFCO Mine to the Hydrologic Balance of Box Canyon Creek," Sevier County, Utah.
- 3) The Agapito Associates, Inc. Report, "Evaluation and Prediction of Potential Surface Subsidence Impacts from Longwall Mining under the Box Canyon Area, SUFCO Mine", discusses the potential impacts to the surface lands and the stream in Box Canyon.
- 4) Mt. Nebo Scientific's report, "Effects of Subsidence to Riparian Communities Caused by Underground Coal Mining in Box Canyon", discusses biological concerns. It is felt that these discussions adequately address the minimum regulatory requirements of the aforementioned R645 rule.

CONCLUSION AND RECOMMENDATION

The SUFCO Mine uses the latest developments in coal mining technology as well as the latest technology accepted by industry in the prediction of subsidence impacts to surface areas. Should this revised plan not be approved, 2.8 million recoverable tons of coal will be lost. With only 30 years of recoverable tons of coal remaining in the State of Utah, (with today's current technology), the recovery or loss of this amount of tonnage must be seriously evaluated.

The contents of this submittal indicate that the undermining of the Box Canyon perennial drainage will have minimum impact on the drainage, the riparian ecosystems, and the surrounding surface lands.

It is recommended that this amendment be approved, in conjunction with approval from the USFS, Manti Lasal National Forest, who is the lead surface management agency.