TECHNICAL MEMORANDUM

Utah Coal Regulatory Program

December 29, 2004

TO: Internal File

THRU: Wayne Hedberg, Permit Supervisor

FROM: Gregg Galecki, Environmental Specialist III - Hydrology

RE: HCI Ground Water Model Report in PHC, Canyon Fuel Company, LLC, Skyline Mine, C/007/0005, Task ID 1961

SUMMARY:

The following is a review of a proposed amendment to the Skyline Mine Mining and Reclamation Plan (MRP) initially received by the Division of Oil, Gas and Mining (DOGM) on October 9, 2003. The amendment was returned with deficiencies to the Operator on January 7, 2004, and modifications were re-submitted to DOGM on March 19, 2004. The DOGM review of Appendix J (modeling summary report) indicated additional information would need to be addressed for the DOGM to accept the conclusions. This is uncommon because appendix reports are not typically subject to DOGM comments. It was decided that Canyon Fuel Company (CFC), their consultant, DOGM and OSM personnel would meet in Denver to discuss improvements to the modeling. The meeting was conducted April 19, 2004. DOGM sent a letter outlining deficiencies and items discussed in the April 19, 2004 meeting on April 23, 2004. The response outlining the April discussions was submitted to the Division June 18, 2004. The June 2004 information included modifications to the MRP and Appendix K—a supplemental hydrologic modeling report that was supplemental to the original hydrologic modeling report, Appendix J.

In early August 2004, DOGM personnel then reviewed the information supplied in June and provided additional comment to CFC concerning the MRP and modeling information via email correspondence. CFC personnel indicated they wanted to incorporate the DOGM August 2004 comments into the current permit modifications being reviewed. Those modifications were received by DOGM on November 19, 2004. The information included modifications to the Mine's Probable Hydrologic Consequence (PHC) section of the MRP, and additional hydrologic modeling information to be added to Appendix K, submitted in June 2004. The submittal proposes modifications to the MRP to include Appendix J, K, and a supplemental November 2004 memo addressing a numeric hydrologic model prepared by Hydrologic Consultants Inc. for

the Skyline Mine. The amendments are currently considered adequate to meet the minimum requirement of the regulations and incorporation into the approved MRP is recommended.

TECHNICAL ANALYSIS:

ENVIRONMENTAL RESOURCE INFORMATION

Regulatory Reference: Pub. L 95-87 Sections 507(b), 508(a), and 516(b); 30 CFR 783., et. al.

GEOLOGIC RESOURCE INFORMATION

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

Analysis:

Plate II of the HCI modeling report has been submitted to illustrate the boundaries of the potential source area of the water being encountered in the Skyline Mine. As outlined in the model, the boundaries are the Pleasant Valley Fault in the east, Gooseberry Fault in the west, Fish Creek Graben in the north, and generally the Left Fork of Huntington Creek in the south. This map provides a much needed regional perspective of the area as it relates to geology.

To help formulate the hydrologic model, considerable geologic research was conducted in finding and studying existing geologic drill logs, primarily deep exploration gas wells penetrating the Star Point Sandstone, and coal exploration wells penetrating the primary sandstone tongues of the lower Blackhawk and Upper Star Point formations. This work was compiled by Kravits Geological Services, LLC., for Canyon Fuels' legal council in November 2003. The geologic study area encompasses three (3) ranges by five (5) townships in area, centered on the Skyline permit area. Significant time was dedicated to creating isopach maps of the Storrs tongue, Storrs to Panther interval, Panther tongue, Panther to Trail Canyon Interval, Trail Canyon tongue, and Panther tongue to the base of the Star Point Sandstone Intervals. Three cross sections were also included; one dissecting the area from north to south, one at the southern portion of the Skyline permit area from east to west, and the third north of the Skyline permit area dissecting the Fish Creek Graben. The study provided valuable information addressing the regional geology surrounding the Skyline permit area.

Findings:

Information provided adequately addresses the minimum requirements of the Geologic Resource Information section of the regulations.

HYDROLOGIC RESOURCE INFORMATION

Regulatory Reference: 30 CFR Sec. 701.5, 784.14; R645-100-200, -301-724.

Analysis:

Modeling

Appendix J – HCI Ground Water Flow Modeling of Skyline Mine and Surrounding Area, Appendix K – Supplemental Report to Appendix J, and a November 2004 memo added to Appendix K has been submitted to be included as part of the Skyline Mine PHC. The modeling report is being adopted into the MRP as supporting evidence for the Skyline Mine PHC determination. Appendix J was not subject to a typical Division technical analysis outlining deficiencies, as it was developed for the law firm Manning, Curtis, Bradshaw and Bednar LLC, of Salt Lake City Utah, and is being considered supplemental information. However, Appendix K and the supplemental November 2004 information was developed with DOGM and OSM input. The Skyline PHC prefaces the model stating, "Several assumptions have been made on the volume, porosity, and transmissivity of the aquifer. It also admits that to construct an accurate groundwater model several groundwater points are needed, but no additional ground-water wells are planned.

In the introduction of the HCI model report - Appendix J the following qualifiers are also stated, "many of the components necessary for the Skyline model are not well-defined." Considerable uncertainty is also mentioned for values of hydraulic conductivity for each of these major hydrogeologic units and the relative permeability of the major structures. The introduction goes on to state, "Although some components such as recharge or stratigraphic thickness can be reasonably well-defined by the available data, other major components such as the vertical hydraulic conductivity of overburden units or the hydraulic characteristics of faults can only be evaluated from the reasonableness of the results of preliminary numerical simulations using assumed values. As such, the Skyline model is still in a heuristic stage in which it is being used to learn about the characteristics of the regional ground-water system."

For the proposed hydrogeologic numeric ground water model to be adopted as an appendix into the MRP, the reader is reminded numerous times in both the PHC section of the MRP and Appendix J of the limiting factors of the model. The surface and ground water hydrology of the Skyline area are poorly understood due to the limited availability of data and the nature of geologic faulting in the area. As stated in the PHC, "One purpose of the model is to help the mine define the recharge and discharge locations of the Star Point Sandstone aquifer and the in determine the potential impacts, if any, to surface waters and their beneficial uses." Due to

limited availability of data, the model needed to make significant assumptions on the volume, porosity, and transmissivity of the aquifer, which affects the accuracy of the model.

Although a comprehensive summary, Appendix J was lacking in documentation. The conceptual portion of the model assumes the water pumped from the fault and mine inflow water is primarily derived from groundwater, the impacts of concern are drawdown, potential subsidence associated with drawdown, and impacts of drawdown on water users in the permit area. Calibration for HCI's model was a process of adjusting the conceptual model parameters and boundaries to reasonably replicate field observed conditions for pre-mining water levels and estimated stream baseflows.

A significant finding in the HCI report (Appendix J) states (Page 44, Section 5.1), "The most significant finding of the model simulations is that it is possible to account for essentially 100 percent of the inflow into the Skyline Mine by depletion of storage in the deep groundwater system." The report also stated (Page 45) that given the conceptual parameters, "the hydraulic conductivity of the fault could not be increased in any portion of the fault other than between the lake and the mine -- an unusual constraint -- without causing significant, unmeasured drawdown in the Blackhawk Formation." This suggests the majority of water, according to the model, could not be supplied from Electric Lake. A second significant and fundamental finding of the model is the ground water gradient of the Star Point sandstone. The model indicates the ground water gradient is from south-southwest to north-northeast with a rate of 0.03 to 0.009 ft/ft. The recharge area is south of the Huntington and Cleveland reservoirs and the discharge area is around Scofield reservoir. However, the 'weighted value or qualifiers' of this statement is subjective based on 1) assumptions made in the conceptual model, 2) a limited understanding of groundwater recharge and discharge in the area, and 3) a lack of model verification.

Information supplied by Appendix K (submitted in June 2004, that was absent in Appendix J include the following:

- Figure 4 illustrates the drawdown differences in the shallow wells and deep wells
- Figures 5-9 illustrate the major layers of the model and the respective nodes in those layers
- Figures 10-12 provide major cross sections
- Figure 13 is a graph illustrating the distribution of the wells used, by formation and compares modeled to measured values
- Figure 14 graphs modeled to measured inflows; unfortunately minimal data was available for verification of modeled values
- Figure 15 graphs modeled to measured performance in the wells used in the model; two (2) of the three (3) graphs provided no data for verification.
- Figures 16-17 illustrate modeled inflow to the mine under different flooding scenarios
- Figure 18 predicts the longer impacts to major streams in the area.

- Tables 1-3 provide detailed water budgets quantifying overall model inflow and outflow from the sources and sinks and impacts to Electric Lake based on three (3) different mine flooding scenarios.

Figure 4 is significant because although there has been over 400-feet of drawdown in the Star Point wells, no or little affect has been observed in wells completed in the Blackhawk formation. Figure 13 illustrates whether there are any modeled drawdown biases toward formation. As an example, if all the Blackhawk formation wells plotted well below the *Perfect Correlation Line*, the model would be biased toward the Blackhawk Formation. Figures 14, 15, 16 and 17 are critical for providing validation of the model in the future as more data becomes available.

Appendix K submitted and the supplemental information supplied in November 2004 attempt to identify some potential impacts to both the recharge and discharge locations of the Star Point Sandstone. At some point after all pumping of ground water ceases, potential impacts include an estimated 0.2 cfs increase of flow to Mud Creek and an estimated 0.2 cfs decrease of flow to Huntington Creek below Electric Lake. Upper Huntington Creek and the Fish Creek remain essentially unchanged. If the current flooding of the mine remains with the pool elevation at approximately 8290 feet, current impacts to Electric Lake are estimated at 0.2 cfs and would increase to 0.6 cfs through 2013 – the current projection for mining to end. The details of the budgets are available in Tables 1-3 in Appendix K and Table 1 in the November 2004 memo.

Verification of the model as a predictive tool can only be done with additional simulations of the model. To run additional simulations of the model requires more data and often requires potentially time-consuming re-calibration of the model parameters and additional measured data for validation. Canyon Fuel Company commits to running additional simulations in 2006, and potentially every three (3) years thereafter if warranted.

The November 2004 memo addendum to Appendix K provided a numeric model simulation of post-mining conditions once all mining and pumping has ceased. The pool elevations are strongly influenced by the interconnection or increased hydraulic conductivity between the gob and Mine 1, 2, and 3 workings. The pool level or elevation of water within the mine workings is anticipated to stabilize at an elevation of 8,475 feet, or 102 feet below the Eccles Creek portal. Using the model developed in Appendix J, and with only minor modifications, the model predicts: 1) Upper Huntington Creek, Electric Lake, and the Fish Creek basin will return to pre-mining conditions; 2) Huntington Creek below Electric Lake discharge will decrease by 0.2 cfs (~90 gpm); and 3) the Mud Creek basin discharge will increase approximately 0.2 cfs.

Given the conceptual parameters of the model, the building of the numeric model adequately illustrated it is a reasonable scenario that the water can be derived from the deep

groundwater system. However given the limited availability of data, use of the model as a predictive tool is questionable. It is not 'unreasonable' that another model could be constructed using different conceptual constraints that produced different results. Use of the model as areliable predictive tool would be questionable due to the numerous assumptions necessary because of limited data. Additional modeling is not warranted because acquisition of additional, meaningful data is not possible. The model serves to bolster the Mine's PHC assertion that the water encountered in the mine is being sourced from the Star Point Sandstone.

Probable Hydrologic Consequences Determination

The Skyline Mine PHC determination has been modified primarily to the degree that it has incorporated/modified date-sensitive statements relative to the submittal of the HCI modeling information - Appendix J, K, and November 2004 supplemental memo. The modeling information is considered supporting evidence to the Mine's position that the majority of water being encountered in-mine is being sourced from the regional Star Point Sandstone aquifer, outlines potential impacts to the surrounding area caused by long-term drawdown of the aquifer, and outlines probable consequences once mining is complete and mine workings are completely flooded. In Appendix K, Table 2 - Simulated Ground-Water outlines current and projected impacts to the surrounding area based on the current mining conditions; Figure 18 outlines impacts to streams through the next 50 years, and the November 2004 addendum outlines post-mining consequences. The model is not considered by the Division to be conclusive evidence, only supportive evidence suggesting the majority of water encountered in-mine could be sourced from the Star Point Sandstone and long-term affects to the surrounding area have been minimized.

Significant recent events that will potentially affect the inflows being encountered in the Mine are completion of mining in the southern portion of Mine #2 and the resulting flooding of the mine workings up to the 6-Left area. The flooding of the mine workings reached an elevation of 8280 feet (msl) in September 2004, resulting in approximately 240-feet of hydrostatic head on the major inflows being encountered in the mine (10 Left elevation 8040-feet; HCI Table 3). The current mine plan intends on keeping the workings flooded to this level for an extended period of time. This steady-state condition will enable the mine to more accurately monitor changes in overall mine-inflow, and potentially evaluate whether there is a correlation to surrounding surface water. Conditions will continue to be monitored and assessed to determine whether impacts to surrounding areas are minimized.

Findings:

The information provided adequately addresses the minimum requirements of the Hydrologic Resource Information section of the regulations.

MAPS, PLANS, AND CROSS SECTIONS OF RESOURCE INFORMATION

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

Analysis:

Subsurface Water Resource Maps

To monitor the potential drawdown of the Star Point Sandstone due to extensive pumping, additional water monitoring sites have been added in the Star Point Sandstone above an approximate elevation of 8,300 feet; the potential drawdown elevation of the Star Point Formation. It was determined no modifications to drawing 2.3.5.2-1 (Ground Water Rights on and Adjacent to the Skyline Property) are necessary at this time.

Surface Water Resource Maps

It was determined that no modifications to drawing 2.3.5.1-1 are necessary at this time.

Findings:

Information provided currently addresses the minimum requirements of the Maps, Plans, and Cross Sections of Resource Information section of the regulations.

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, -300-147, -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.

Analysis:

General

Groundwater Monitoring

Concerning continuing drawdown of the Star Point Sandstone aquifer for an extended period, the Division requested any appreciable springs located in the Star Point Sandstone with elevations above approximately 8,300 feet (msl), that are not included in the current hydrologic

monitoring program to be added. In response, Canyon Fuel has added Sulfur Spring (S24-1) to the water monitoring program. It is located downstream of Electric Lake and east of both the Connelville and O'Connor faults, but is located within the Star Point Sandstone and at the correct elevation. In addition, to help identify the waters entering Electric Lake, springs 8-253 (Flat Canyon), 2-413 (James Canyon), and S15-3 (Upper Huntington Creek) have been officially added to the Water Monitoring program to include tritium analysis for a period of three (3) years. Spring S15-3 is currently on the water monitoring schedule, but tritium is being added. Springs 2-413 and 8-253 have been sampled previously in different age-dating studies.

Surface Water Monitoring

Assuming the Skyline mine continues to discharge water from the Star Point Sandstone aquifer for an extended period of time, affects to the Star Point Sandstone in the proximity of the mine need to be monitored. Generally, stream sites to be considered should be within the Star Point Sandstone, with elevations above approximately 8,300 feet (msl), and preferably be a gaining stream that has flow data prior to 2001.

Plate I of the HCI report identifies Boardinghouse Creek as a stream gage site with current or past continuous monitoring. This information is not currently available in the information Skyline Mine is providing to the Division. It is assumed a majority of the information available comes from the Lodestar – White Oak mine while they were monitoring the site (VC-11). The Division requested this site be added to the Skyline Mine hydrologic monitoring program for flow, and that Skyline Mine provide any flow information not included in the White Oak mine information. The Division also requested the stream located in Finn Canyon (White Oak Mine site VC-12), be added to the Skyline Mine hydrologic monitoring program for flow. Both streams have flow data extending back to 1980, but are no longer monitored as part of the White Oak Mine Plan. Canyon Fuel has added the two sites as requested and also included an additional four (4) stream sites. Sites EL-1 and EL-2 will provide additional monitoring both into and out of Electric Lake. Sites CS-23 (Hughes Creek) and CS-24 (Valentine Gulch) are located down gradient of Electric Lake and are intermittent to perennial streams located predominantly in the Star Point Sandstone.

A considerable amount of focus has been placed on tritium sampling, particularly of JC-1 and the significance of the rising tritium values observed over time. If Electric Lake and the Blackhawk Formation are supplying a portion of this water, a better understanding of the water in Electric Lake and supplying Electric Lake is necessary. Continued sampling of these waters, as outlined in PHC Appendix G, Table 2 is warranted. In response, Canyon Fuel has added tritium analysis to springs 8-253, 2-413, S15-3, streams EL-1, and EL-2 for a period of three (3) years beginning in the Spring of 2004.

Findings:

The information provided adequately addresses the minimum requirements of the Operation Plan – Hydrologic Information section of the regulations.

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.

Monitoring and Sampling Location Maps

The additional ground water and surface water monitoring sites outlined above have been added to Plate 2.3.6-1 (Location of Hydrologic Monitoring Stations) of the currently approved MRP.

Findings:

The information provided adequately addresses the minimum requirements of the Maps, Plans, and Cross Sections of Mining Operations section of the regulations.

CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT

Regulatory Reference: 30 CFR Sec. 784.14; R645-301-730.

Analysis:

Based on the information currently submitted, and information submitted to the Division since the last Cumulative Hydrologic Impact Assessment (CHIA) revision, the Division CHIA is in the process of being updated. The modifications are primarily date-sensitive and do not affect the overall current assessment. The information provided, primarily the HCI numeric ground water modeling reports – Appendix J, K, and November 2004 are considered supporting evidence to indicate the mining operation has been designed to prevent material damage to the hydrologic balance outside the permit area.

Findings:

Information provided adequately addresses the minimum requirements of the Cumulative Hydrologic Impact Assessment section of the regulations.

RECOMMENDATIONS:

The information provided meets the minimum requirements of the regulations and incorporation into the currently approved MRP is recommended pending a commitment to conduct additional hydrologic modeling simulations in the future.

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