File PRO/007/020 #2

0010

EarthFax

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March 11, 1992

Mr. Tom Munson
Utah Division of Oil, Gas & Mining
355 West North Temple
3 Triad Center
Salt Lake City, Utah 84180-1203

Subject: Response to Technical Deficiencies
Blue Blaze Mine

Dear Tom:

On behalf of Blue Blaze Coal Company, we are pleased to submit two copies of the enclosed "Response to Technical Deficiencies, Blue Blaze Coal Company, Blue Blaze Mine." This response addresses the comments raised in the letter from Pamela Grubaugh-Littig to William R. Skaggs dated January 23, 1992.

For ease of review, we have addressed the comments individually. Once approved, this information can be incorporated into the permit application.

We would appreciate the opportunity to meet with yourself and others of the Division staff to discuss the responses. Please contact us at your earliest convenience to arrange a meeting. Thank you for your assistance.

Sincerely,

Kris H. Blauer
Hydrogeologist

cc: Roger Skaggs (with one copy)

RESPONSE TO TECHNICAL DEFICIENCIES
BLUE BLAZE COAL COMPANY
BLUE BLAZE MINE

Prepared For

Blue Blaze Coal Company
Helper, Utah

Prepared By

EarthFax Engineering, Inc.
Midvale, Utah

March 10, 1992

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APPENDICES

Response to Technical Deficiencies (Ground Water), Blue Blaze Coal Company, Blue Blaze Mine, PRO/007/020, Folder #2, Carbon County, Utah

On January 23, 1992, the Utah Division of Oil, Gas and Mining ("UDOGM") submitted comments to Blue Blaze Coal Company ("BBCC") regarding technical deficiencies in the groundwater portions of their application for a permit to mine coal at the proposed Blue Blaze Mine. These comments from UDOGM addressed the adequacy of past submittals with respect to sections R645-301-724.100, -724.500, and -728 of the Utah Coal Mining Regulations.

The purpose of this submittal is to respond to the above-mentioned UDOGM comments. For the sake of clarity, each UDOGM comment is quoted, followed by the BBCC response. These responses were prepared by EarthFax Engineering, Inc. under the direction of BBCC.

UDOGM COMMENT

724.100 Baseline Information: Groundwater The applicant has presented drill hole information from Century Geophysical Corporation stating that, "A Gamma Ray Probe was used by Century Geophysical Corporation in the LMC drill holes to check for fluid in impervious layers" (page 7-6, PAP). The Division cannot accept this information as a valid explanation for the occurrence of formation water, per the requirements of the rules, "Groundwater quantity descriptions will include, at a minimum, approximate rates of discharge or usage and depth to the water in the coal seam, and each water-bearing stratum above and potentially impacted stratum below the coal seam." The applicant must be made aware that Gamma Logs cannot be used to ascertain the depth to water in the coal seam, and each water-bearing stratum above and potentially impacted stratum below the coal seam. For example, hole LMC 1 water level was determined to be found at 232 feet when in reality all the Gamma log was saying was that the water level in the hole following drilling was 232 feet below the surface. Without the driller's

log documenting water occurrence and core data this does not indicate that water occurred at this elevation, but shows that the combination of drill fluids and water rose to this level in the hole.

The applicant must provide, groundwater quantity descriptions that include, at a minimum, approximate rates of discharge or usage and depth to the water in the coal seam, and each water-bearing stratum above and potentially impacted stratum below the coal seam. A verified driller's log documenting water occurrence within each stratum is required.

BBCC RESPONSE

POTENTIAL AQUIFERS

Formations which outcrop within the proposed Blue Blaze Coal Company permit and adjacent areas include the upper Price River Formation, the Castlegate Sandstone member of the Price River Formation, the Blackhawk Formation, the Star Point Sandstone, the Mancos Shale, and Quaternary alluvium. A regionally extensive groundwater system has not been identified in the permit or adjacent areas (Engineering Science, 1984). Detailed descriptions of these formations are presented in Chapter 6 of the permit application. A summary of the characteristics of these formations, and their potential to serve as aquifers in the permit and adjacent areas, is presented below.

Upper Price River Formation. The upper Price River Formation consists of interbedded sandstone, shale, and claystone. Due to its limited outcrop extent within the permit and adjacent areas, the presence of claystone and shale with the formation, and drainage of the of the formation by deeply incised canyons, the upper Price River Formation is not considered to be a significant aquifer within the permit and adjacent areas. According to the Cumulative Hydrologic Impact Assessment, recently completed by UDOGM (1989) for the Upper Gordon Creek Area (including the Blue Blaze Mine), "groundwater associated with the Price River Formation may be characterized as occurring within a 'perched' aquifer and represents a relatively insignificant hydrologic resource".

Castlegate Sandstone. The Castlegate Sandstone member of the Price River Formation consists of 150 to 500 feet of white to gray, coarse-grained often conglomeritic sandstone with a few thin interbedded mudstones or shales near the base. Cliff forming along outcrops frequently occurs in the Castlegate Sandstone. Based on the limited area of exposure for surface recharge (due to the steep slopes), the limited potential for recharge from the overlying perched aquifers of the upper Price River Formation (due to the fine-grained nature and resulting low permeability of the formation), and drainage of the sandstone by the deeply incised canyons of the area, this formation is not considered to be a significant aquifer.

Blackhawk Formation. The Blackhawk Formation underlies the Castlegate Sandstone and consists of several hundred feet of interbedded sandstone, siltstone, shale, and coal. The Castlegate A and Hiawatha coal seams (to be mined by BBCC) are located near the base of the Blackhawk Formation. The Blackhawk Formation has a mixed lithology of sandstones, shales, and coals which produces alternating perched aquifers and impermeable beds (Doelling, 1972). Four springs were identified in the area by the 1989 Cumulative Hydrologic Impact Assessment with "all springs discharging from the Blackhawk Formation".

The above-mentioned springs are most likely associated with channel sands that are of limited in areal extent, that contain water perched over shale beds, and that have limited recharge areas. This type of spring commonly has considerable variation in flow because of the limited recharge area and the limited amount of storage in the aquifer (Engineering Science, 1984).

According to UDOGM (1989), mine inflow is insignificant in the area that includes the proposed Blue Blaze mine. Since all mining in the area occurs within the Blackhawk Formation, this indicates that extensive aquifers are not present within the Blackhawk Formation in the permit and adjacent areas. Thus, the Blackhawk Formation is not considered to be a significant aquifer.

Star Point Sandstone. The Star Point Sandstone consists of fine to medium grained sandstone that decreases in grain size with depth. This unit consists of several littoral

sandstone tongues separated by Mancos shales (Doelling 1972). Regionally, recharge to the Star Point occurs primarily from vertical movement of the water through the overlying Blackhawk Formation. Due to the low permeability of the Blackhawk Formation, the magnitude of this recharge is limited.

Lines (1985) identifies the Star Point Sandstone as an aquifer in the region. It is likely that the Star Point Sandstone is the only formation within the permit and adjacent areas that contains groundwater on an aerially-extensive basis.

Mancos Shale. Underlying the Star Point Sandstone is the Masuk member of the Mancos Shale. The Masuk Shale consists of blue-gray fissile claystone or silty claystone which weathers light blue-gray to light tan. Although the Masuk Member of the Mancos Shale may be locally saturated beneath the Star Point Sandstone, it is not considered to be an aquifer. Except where extensively fractured, the low-permeability shales in the Masuk will transmit only relatively small quantities of water (Lines, 1985).

Quaternary Alluvium. Unconsolidated Quaternary deposits are present along streams and generally consist of silts, sands, and occasional gravels. The alluvium deposits receive water from the adjacent bedrock in some of the deeply incised canyons. Water is probably supplied to the alluvium by seepage from the Blackhawk-Star Point aquifer. Discharge from the Quaternary alluvium is to the surface water system. Due to the limited areal extent of alluvium in the area, this unit is not considered to be a significant aquifer.

DEPTH TO WATER

Four exploratory holes were drilled (LMC-1 through LMC-4) within the permit boundary in the late 1970's and early 1980's. Three of these (LMC-1, LMC-3, and LMC-4) were retained as open holes wherefrom water-level data can be collected.

On February 27, 1992, measurements were collected by EarthFax Engineering from the three accessible holes to determine total depth and static water level. Water level and depth measurements were collected by means of a 1500-foot electric water-level indicator manufactured by Solinst. All three wells were found to be dry. Well LMC-1 is completed into the Blackhawk formation above both the Castlegate A and Hiawatha coal seams and was measured to a depth of 599 feet below ground surface without detecting water. Well LMC-3 was drilled to a depth below the Castlegate A coal seam and found to be dry at a depth of 664 feet below ground surface. Well LMC-4 was drilled to a depth below both the Castlegate A and Hiawatha coal seams and was measured to a depth of 217 feet below ground surface without detecting water. Thus, no groundwater was detected in the Blackhawk Formation in any of the holes.

It should be emphasized that each of the drill holes is open (i.e., uncased) from its bottom to the surface. Thus, the measured dry conditions are indicative of not only the bottoms of the holes but also each overlying layer penetrated by the holes. Thus, neither the coal nor the overlying or underlying strata were found to contain groundwater at the hole locations.

In addition to the above measurements, data were collected from wells LMC-1 and LMC-3 by Mr. Roger Skaggs of BBCC in December, 1991. These measurements were collected by attaching two test tubes to the end of a steel cable, lowering the cable into the drill hole until the bottom of the hole was reached, and allowing the test tubes to rest on the bottom for several minutes before retrieving the cable. The length of the cable was measured at the surface while the cable was extracted. Using this method, drill hole LMC-1 was found to be dry at a depth of 600 feet. Well LMC-3 was found to be dry at a depth of 650 feet. Thus, although non-standard methods were used, the December 1991 data corroborate the February 1992 data by indicating that holes LMC-1 and LMC-3 are dry.

Discussions with Mr. Joseph A. Harvey, who was present at the time the holes were drilled, further corroborate the absence of groundwater within the coal seams as well as strata which lie both above and below the coal seams. According to Mr. Harvey, who was under

contract with C & W Coal Producers Corp. at the time the holes were drilled, each hole was dry during drilling and upon completion. Completion dates were September 1976 for LMC-1, November 1976 for LMC-3, and January 1980 for LMC-4. Hole LMC-2 (completed in October 1976) was also dry during drilling.

A review of records on file with UDOGM, as well as discussions with former mining personnel, indicate that the Gordon Creek #2 Mine (operated by Beaver Creek Coal Company in the Castlegate A seam) immediately southwest of the proposed permit area was a dry mine with only sporadic occurrences of groundwater inflow that dried up within a short time. The Gordon Creek #3 Mine (operated by Beaver Creek Coal Company in the Hiawatha seam immediately east of the proposed permit area) was dry until a 12-foot graben was encountered in the northeast portion of the mine. Groundwater from the graben was produced from the floor of the mine at a rate of up to 400 gallons per minute. During retreat mining, the same faulted zone was dry, either as a result of previous dewatering, or as a result of elevation differences. It is possible that groundwater was stored in the fault zone and when dewatered, there was insufficient recharge from overlying strata to maintain the groundwater discharge.

Based on the LMC drill-hole water level measurements and information concerning the adjacent mines, it is concluded that both the Castlegate A and Hiawatha coal seams as well as the immediately underlying and over lying strata, are dry. The long history of mining in the area and the periodic measurements from the drill holes suggest that these seams and strata are not seasonally saturated. The occurrence of groundwater while mining in the Castlegate A and Hiawatha coal seams will depend primarily on whether a faulted zone is encountered that contains groundwater in storage or that is hydraulically connected with an overlying perched zone. Based on the dry nature of previous mine workings in the area, as well as observations and measurements obtained from the LMC drill holes, the probability of significant sustained inflows to the Blue Blaze mines is considered minimal. This conclusion is in agreement with Cumulative Hydrologic Impact Assessments prepared for the area by Engineering Science (1984) and UDOGM (1989).

APPROXIMATE RATES OF DISCHARGE OR USE

Three springs located within the proposed permit area are monitored by BBCC. Data collected from these sources are presented in Chapter 7 of the permit application package. These data indicate that one of the monitored springs (Station No. 1) discharges at a typical rate of 5 to 15 gallons per minute. The remaining two monitored springs (Station Nos. 2 and 4) discharge at rates of 1 to 2 gallons per minute.

Data contained in Appendix 1 of the permit application package indicate that water rights have been filed on a limited number of springs in the permit and adjacent areas. These include monitoring Station No. 4 and downstream from monitoring Station No. 1. Usage of these springs is for stock watering. Legal rates of usage of spring water generally vary from 0.06 to 0.37 acre-feet per year (all less than 0.25 gallon per minute).

No water rights exist within the permit and adjacent areas for water wells. One right exists for the use of water encountered in underground coal mining operations (File No. 330 with Sweet Coal Company-see Appendix 1 of the permit application package). Since this mine is not active, the right is not currently in use.

All groundwater associated with the above discharges issues from the Blackhawk Formation. As noted above, this formation is not considered an extensive aquifer within the permit and adjacent areas. Thus, the water issues from perched aquifers of limited areal extent. This explains the low flows and usage rates for the springs.

DRILL-HOLE INFORMATION

LMC drill-hole data are summarized in Table 1. Lithologic logs were prepared for the LMC drill-holes from information taken from the Bureau of Land Management stratigraphic coal database and other information provided by Mr. Roger Skaggs of BBCC. Stratigraphic logs can be found in Appendix A.

TABLE 1
MONITORING WELL SUMMARY

Well Number	Total Drilled Depth (ft)	Elev. Top of Casing (ft)	February 1992 Depth (ft)	Casing or Boring ID (in)	Static Water Level (ft below ground surface)	Formation Monitored
LMC-1	900	unknown	599	2" casing at surface	Dry	Blackhawk Fm. (above coal seams)
LMC-2	568	8420	Sealed	4 3/4" boring (approx)	Sealed	Sealed
LMC-3	836	8290	663.9	4 3/4" boring (approx.)	Dry	Blackhawk Fm. (below Castlegate A)
LMC-4	430	7800	217	4 3/4" boring (approx.)	Dry	Blackhawk Fm. (below Hiawatha)

UDOGM COMMENT

724.500 Supplemental Information The applicant has chosen to use data collected in September 1976 from four logged drill holes to describe groundwater conditions on the Blue Blaze permit area. This information is referenced on pages 7-6 and shown on Figure 1. This information is considered the supplemental information necessary to evaluate the probable hydrologic consequences of mining on groundwater but is inadequate.

Such supplemental information may be based upon drilling, aquifer tests, hydrogeologic analysis of the water-bearing strata, flood flows, or analysis of other water quality or quantity characteristics. The applicant must submit site-specific data so that an assessment of the Probable Cumulative Impacts of all anticipated coal mining and reclamation operations on the hydrologic balance in the cumulative impact area can be made. A determination that the proposed operation has been designed to prevent material damage to the hydrologic balance outside the permit area must also be made using site-specific groundwater information.

The applicant must provide a survey that shows whether aquifers or areas for the recharge of aquifers exist within the permit and adjacent area and whether subsidence, if it occurred, could cause material damage or diminution of reasonably foreseeable use of aquifers or areas for the recharge of aquifers. Renewable resource survey information must be incorporated into the subsidence control plan as required by R645(R614)-301-525.

BBCC RESPONSE

RECHARGE

Snowmelt and rain are the main sources of recharge to the groundwater system in the permit and adjacent areas. Normal annual precipitation in the area is approximately 20 inches per year (Waddell et al., 1981). Approximately 65 percent of this precipitation normally falls during the months of October through April (Waddell et al., 1981), mostly as snowfall.

Infiltration from precipitation and snowmelt "provides most of the groundwater recharge, particularly where permeable lithologies are exposed at the surface. Vertical migration of groundwater occurs through permeable rock units and/or along zones of faulting and fracturing. Lateral migration initiates when groundwater encounters impermeable rocks and continues until either the land surface is intersected (and spring discharge occurs) or other permeable lithologies or zones are encountered that allow further vertical flow" (UDOGM, 1989). This condition creates the perched aquifers in the Price River and Blackhawk Formations discussed previously.

In a study of a geologically-similar area approximately 10 miles southwest of the proposed permit area, Danielson et al. (1981) concluded that most, if not all, groundwater in the area is derived from snowmelt. In areas that are capped by the Price River Formation and the Blackhawk Formation (such as occurs within the proposed permit and adjacent areas), Danielson et al. (1981) indicated that "steep slopes promote rapid snowmelt runoff and reduce recharge to the groundwater system." This condition is intensified by the relatively low permeability of the Price River and Blackhawk Formations. The limited amount of recharge in the area is reflected by the small number of springs as well as the dry conditions encountered by previous mine workings in the permit and adjacent areas and the LMC drill holes.

SUBSIDENCE

According to the Cumulative Hydrologic Impact Assessment prepared for the area by UDOGM (1989), "Subsidence impacts are largely related to extension and expansion of the existing fracture system and upward propagation of new fractures. Inasmuch as vertical and lateral migration of water appears to be partially controlled by fracture conduits, readjustment or realignment in the conduit system will inevitably produce changes in the configuration of groundwater flow. Potential changes include increased flow rates along fractures that have been 'opened', and diverting flow along new fractures or within permeable lithologies. Subsurface flow diversion may cause the depletion of water in certain localized aquifers and

potential loss of flow to springs that will be undermined. Increased flow rates along fractures would reduce groundwater residence time and potentially improve water quality.

"Mining has occurred beneath and adjacent to two springs. No impacts have been detected. In addition, mining has occurred beneath a portion of Beaver Creek. Pillars were sized to maintain channel integrity and water monitoring has not identified impacts" (UDOGM, 1989).

As noted in the above-referenced Cumulative Hydrologic Impact Assessment, mining in the area adjacent to the proposed Blue Blaze permit area has not resulted in hydrologic impacts due to subsidence. Given the lack of extensive aquifer systems in lithologic units that overlie the coal within the permit and adjacent areas (see the BBCC response to UDOGM comment 724.100), groundwater is not considered to be a significant renewable resource in areas that may be affected by subsidence. Thus, subsidence caused as a result of mining by BBCC will not cause significant groundwater impacts within the permit or adjacent areas.

STRUCTURES AND RENEWABLE RESOURCE INFORMATION

Information regarding structures and renewable resources within the permit and adjacent areas is provided in Section 3.4.8 of the permit application package. The subsidence control and monitoring plan is also presented in that section.

UDOGM COMMENT

728. Probable Hydrologic Consequences (PHC) Determination The applicant has not provided accurate groundwater information from drill holes LMC 1-4 explained in the deficiency of R-614-301-724.100. Until this information is submitted, the PHC cannot be considered complete and accurate and, therefore, cannot be reviewed.

BBCC RESPONSE

Groundwater information has been provided for drill holes LMC-1, LMC-3, and LMC-4 in the discussion of UDOGM comment 724.100. A summary of the LMC drill-holes is presented here.

Hole LMC-1 was drilled to a depth of 900 feet in September 1976. A log of this hole is provided in Appendix A. LMC-1 was drilled into the Blackhawk Formation through the Castlegate A coal seam with the bottom subsequently being sealed to a depth of approximately 600 feet and remaining open above that depth. On February 27, 1992, the depth of this hole was measured by EarthFax using an electric water-level indicator. The hole depth was determined to be 599 feet below ground surface without detecting water. Personal communication with Mr. Joseph A. Harvey indicates that LMC-1 was dry during drilling.

Hole LMC-2 was drilled to the bottom of the Blackhawk Formation in October 1976. A log of this hole is provided in Appendix A. The hole was subsequently sealed to a depth of 50 feet below ground surface. Due to its shallow remaining depth, no groundwater measurements have been collected from this hole. Mr. Harvey indicates that the hole was dry during drilling.

Hole LMC-3 was drilled to a depth of 836 feet in November 1976. This hole was subsequently sealed to a depth of about 665 feet, remaining open above that depth. A log of this hole is provided in Appendix A. On February 27, 1992, Well LMC-3 was measured by

EarthFax and found to be dry below the Castlegate A coal seam at a total hole depth of 664 feet below ground surface. Mr. Harvey indicates that the hole was dry during drilling.

Hole LMC-4 was drilled through the Blackhawk Formation to a depth of 430 feet in January 1980. This hole was subsequently sealed to a depth of approximately 220 feet, remaining open above that depth. A log of this hole is provided in Appendix A. On February 27, 1992 Well LMC-4 was measured by EarthFax below both the Castlegate A and Hiawatha coal seams to a depth of 217 feet below ground surface without detecting water. Mr. Harvey indicates that this hole was also dry during drilling.

Lithologic logs were prepared for the LMC drill-holes from information taken from the U.S. Bureau of Land Management stratigraphic coal database and other information provided by Mr. Roger Skaggs of BBCC. Stratigraphic logs can be found in Appendix A.

Based on the information presented in this response document, previous mine workings in the area have been predominantly dry. In addition, the LMC drill holes were dry at the time they were drilled and remain dry to date. Thus, groundwater resources that may be impacted by mining activities in the permit and adjacent areas are limited. Hence, the probability of impacting these resources is low.

REFERENCES

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Waddell, K.M., P. Kay Contratto, C.T. Sumsion, and J.R. Butler. 1981. Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah. U.S. Geological Survey Water-Supply Paper 2068. Washington, D.C.

APPENDIX A

LMC DRILL-HOLE LOGS

Blue Blaze Coal Company
Helper, Utah

Technical Deficiencies Response
March 10, 1992

WELL LMC-1

EARTHFAX ENGINEERING, INC. DRILLING LOG

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 899' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
0		0 - 100': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	
10			
20			
30			
40			
50			
60			
70			
80			
90			
100			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 899' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
100		0 - 200': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
110			
120			
130			
140			
150			
160			
170			
180			
190			
200			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 899' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
200		0 - 279': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
210			
220			
230			
240			
250			
260			
270			
280		279 - 280.5': COAL: No lithology log. 280.5 - 300': SANDSTONE, SILTSTONE, SHALE: No Lithology log.	
290			
300			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 899' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
300		280.5 - 400': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
310			
320			
330			
340			
350			
360			
370			
380			
390			
400			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: —
Project Number: UC-244	Reference Elevation: — Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: —	Drilling Contractor: HOLLANDER Drilling Method: — Rig Type: —
First occurrence of G.W.: — Static W.L.: — Dates Measured: — —	Boring Depth (ft): 899' Well Depth (ft): — Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
400		280.5 - 500': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
410			
420			
430			
440			
450			
460			
470			
480			
490			
500			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-249	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 899' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
500		280.5 - 600': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
510			
520			
530			
540			
550			
560			
570			
580			
590			
600			

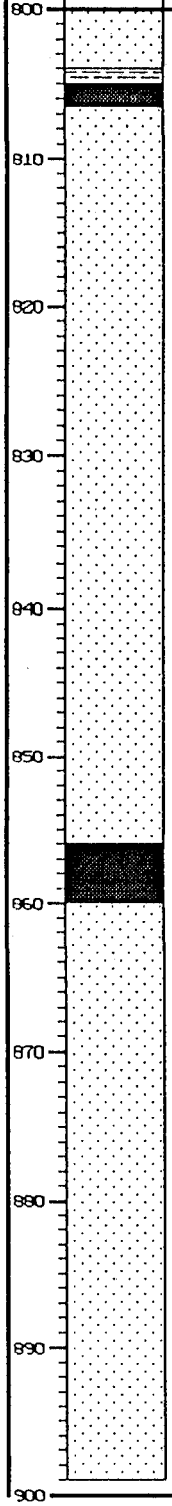
Project Name: BLUE BLAZE COAL Owner/Client: ROBER BKA888	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1975 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 899' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
600		280.5 - 700': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
610			
620			
630			
640			
650			
660			
670			
680			
690			
700			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 899' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
700		280.5 - 750': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
710			
720			
730			
740			
750		750 - 752': COAL:	
		752 - 793: SANDSTONE, SILTSTONE, SHALE: No lithology log.	
760			
770			
780			
790		793 - 798.4': COAL: No lithology log.	Castlegate "A" Upper Split
800		798.4 - 799': SHALE: 799 - 800': COAL: No lithology log.	

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 899' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"



LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
800 - 804' : COAL: No lithology log. 804 - 805' : SHALE: No lithology log. 805 - 806.5 : COAL: No lithology log.	Castlegate "A" Lower Split
806.5 - 856': SANDSTONE, SILTSTONE, SHALE: No lithology log.	
856 - 860': COAL:	Gordon Coal Seam
860 - 899': SANDSTONE, SILTSTONE, SHALE: No lithology log.	

Blue Blaze Coal Company
Helper, Utah

Technical Deficiencies Response
March 10, 1992

WELL LMC-2

EARTHFAX ENGINEERING, INC. DRILLING LOG

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-2 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 568' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
0		SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
10			
20			
30			
40			
50			
60			
70			
80			
90			
100			

Project Name: BLUE BLAZE COAL	Boring/Well Number: LMC-2
Owner/Client: ROGER SKAGGS	Boring/Well Location: --
Project Number: UC-244	Reference Elevation: --
	Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976	Drilling Contractor: HOLLANDER
Logged By: --	Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: --	Boring Depth (Ft): 568' Well Depth (Ft): --
Dates Measured: -- --	Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
100		0 - 169': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
110			
120			
130			
140			
150			
160			
170		169 - 170': COAL Possibly shaley.	Local Coal Group
		170 - 172.5': SHALE Carbonaceous, silty.	Local Coal Group
		172.5 - 173': COAL Shaley.	Local Coal Group
		173 - 194.9': SANDSTONE Massive.	Local Coal Group
180			
190			
		194.9 - 195': COAL	Local Coal Group
		195 - 319': SANDSTONE Shaley.	
200			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER BKA666	Boring/Well Number: LMC-2 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 568' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
200		195 - 319.4': SANDSTONE: Shaley.	BLACKHAWK FORMATION
210			
220			
230		Interbedded massive sandstone at 231 - 244'.	
240			
250			
260			
270			
280			
290		Interbedded massive sandstone at 288 - 312'.	
300			

Project Name: BLUE BLAZE COAL Owner/Client: ROBER BKA888	Boring/Well Number: LMC-2 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 568' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
300		195 - 319.4': SANDSTONE: Shaley. Interbedded massive sandstone at 288 - 312'.	BLACKHAWK FORMATION
310			
320		319.4 - 319.5': COAL: Possibly <0.5% shaley coal present.	Bob Wright Group
		319.5 - 322.9': SHALE: Carbonaceous, silty.	Bob Wright Group
		322.9 - 323': COAL: Possibly <0.5% shaley coal present.	Bob Wright Group
		323 - 343': SHALE: Sandy.	
330			
340			
		343 - 366.5': SANDSTONE: Massive.	
350			
360			
		366.5 - 369.9': SHALE: Carbonaceous, silty.	
370		369.9 - 370': COAL: Castlegate Coals replaced with channel deposit.	Castlegate A
		370 - 380.4': SHALE: Carbonaceous, silty. Castlegate Coals replaced with channel deposit.	Castlegate A
380		380.4 - 380.5': COAL: Castlegate Coals replaced with channel deposit.	Castlegate A
		380.5 - 393.4': SHALE: Carbonaceous, silty. Castlegate Coals replaced with channel deposit.	Castlegate A
390			
		393.4 - 393.5': COAL: Castlegate coals replaced with channel deposit.	Castlegate A
		393.5 - 402': SHALE: Carbonaceous, sandy. Channel deposit?	
400			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-2 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 568' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
400		393 - 402': SHALE: Carbonaceous, sandy. Channel deposit?	BLACKHAWK FORMATION
		402 - 415': SANDSTONE: Shaley.	
410			
		415 - 421': SHALE: Carbonaceous.	
420		421 - 433': SANDSTONE: Shaley. Remnant of Aberdeen Deposit?	Aberdeen Sandstone
430			
		433 - 435': SHALE: Carbonaceous. 435 - 435.1': COAL: Gordon Coal horizon?	Gordon Coal
		435.1 - 456': SHALE: Sandy.	
440			
450			
		456 - 475.5': SANDSTONE: Silty.	
460			
		Shaley zone 467 - 470'.	
470			
		475.5 - 518': SHALE: Sandy.	
480			
490			
500			

EARTHFAX ENGINEERING, INC. DRILLING LOG PAGE 6 OF 6

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-2 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 568' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
500		475.5 - 518': SHALE: Sandy.	BLACKHAWK FORMATION
510		Sandstone roof rock at 510.5 - 518'.	
520		518 - 522': COAL: 4.0' on geophysical log.	Upper O'Conner Coal
		522 - 529.5': SHALE: Carbonaceous, silty. =Floor unit.	BLACKHAWK-STAR POINT GROUP
530		529 - 568': SANDSTONE: Shaley, silty. Lithofacies equivalent of the massive Spring Canyon Sandstone?	Upper Spring Canyon Sandstone
540			
550			
560			
570			
580			
590			
600			

Blue Blaze Coal Company
Helper, Utah

Technical Deficiencies Response
March 10, 1992

WELL LMC-3

EARTHFAX ENGINEERING, INC. — DRILLING LOG

Project Name: BLUE BLAZE COAL	Boring/Well Number: LMC-3
Owner/Client: ROGER SKAGGS	Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290'
	Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976	Drilling Contractor: HOLLANDER
Logged By: --	Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: --	Boring Depth (Ft): 836' Well Depth (Ft): --
Dates Measured: -- --	Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
0		0 - 10': SOIL: No lithology log available.	QUATERNARY
10		10 - 432.9': SANDSTONE, SILTSTONE, SHALE (interbedded):	BLACKHAWK FORMATION
20			
30			
40			
50		Massive sandstone at 47 - 53'.	
60			
70			
80			
90			
100			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 1,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
100		10 - 432.9': SANDSTONE, SILTSTONE, SHALE (interbedded):	BLACKHAWK FORMATION
110			
120			
130		Massive sandstone at 131 - 143'.	
140			
150			
160			
170			
180			
190			
200			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
200		10 - 432.9': SANDSTONE, SILTSTONE, SHALE (interbedded):	BLACKHAWK FORMATION
210		Massive sandstone at 214 - 226'.	
220			
230			
240			
250			
260			
270			
280			
290			
300			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 1,391,110 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
300		10 - 432.9': SANDSTONE, SILTSTONE, SHALE (interbedded):	
310			
320			
330			
340			
350			
360			
370		Massive sandstone at 370 - 396'.	
380			
390			
400			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 1,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 835' Well Depth (Ft): -- Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
400		10 - 432.9': SANDSTONE, SILTSTONE, SHALE (interbedded):	BLACKHAWK FORMATION
410		Massive sandstone at 412 - 426'.	
420			
430			
		432.9 - 433': COAL:	Local Coal Group
		433 - 441.9': SHALE: Carbonaceous, sandy.	Local Coal Group
440			
		441.9 - 442': COAL:	Local Coal Group
		442 - 455.5': SHALE: Carbonaceous, sandy.	Local Coal Group
450			
		455.5 - 456': COAL: Shaley.	Local Coal Group
		456 - 582.5': SANDSTONE: Shaley.	
460			
470			
480			
490			
500			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER BKA888	Boring/Well Number: LMC-3 Boring/Well Location: 1,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
500		456 - 582.5': SANDSTONE: Shaley.	BLACKHAWK FORMATION
510			
520			
530			
540		Massive sandstone at 539 - 557'.	
550			
560			
570			
580		582.5 - 586.5': COAL:	Bob Wright Group
		586.5 - 594.5': SHALE: Carbonaceous, sandy.	Bob Wright Group
590		594.5 - 595': COAL: Shaley.	Bob Wright Group
		595 - 606': SHALE: Carbonaceous, silty.	
600			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER BKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
600		595 - 606': SHALE: Carbonaceous, silty.	BLACKHAWK FORMATION
		606 - 625.5': SANDSTONE: Silty.	
610			
620			
		625.5 - 630': SHALE: Carbonaceous, silty. carbonaceous silty shale, next 5.5'=silty sandstone.	
630		630 - 635.5': COAL:	Castlegate A
		635.5 - 642': SHALE: Carbonaceous, silty.	
640			
		642 - 648.2': COAL:	Castlegate A
		648.2 - 651.4': SHALE: Carbonaceous, silty. IM FLR=3.2' carbonaceous silty shale, next 3.0'=coal.	
650		651.4 - 654.4': COAL:	Castlegate A
		654.4 - 658.5': SHALE: Carbonaceous, sandy.	
660		658.5 - 667': SANDSTONE: Shaley. Remnant of channel sandstone?	
		667 - 668.2': COAL: Local coal seams of limited extent.	
		668.2 - 671': SHALE: Carbonaceous.	
670		671 - 676.9': COAL: Shaley. Shale parting 673.0 - 674.4'. Shaley coal 674 - 675.5'.	
		676.9 - 691': SANDSTONE: Shaley, silty. Top 3' shaley remnant of channel. Sandstone = Aberdeen Sandstone?	Aberdeen Sandstone
680			
690			
		691 - 701.9': SHALE: Sandy.	
700			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
700		691 - 701.9': SHALE: Sandy.	BLACKHAWK FORMATION
		701.9 - 705': COAL:	Gordon Coal
		705 - 725.5': SHALE: Sandy.	
710			
720			
		725.5 - 734.5': SANDSTONE: Massive.	
730			
		734.5 - 781': SANDSTONE: Shaley.	
740			
750			
760			
770			
780			
		781 - 791': SANDSTONE: Shaley. IM RF = 3.0' carbonaceous shale, next 2.0' = shaley sandstone, next 5.0' = silty sandstone.	
790			
		791 - 798.2': COAL:	Upper O'Conner
		798.2 - 803.2': SHALE: Carbonaceous, silty.	BLACKHAWK-STAR POINT GROUP
800			

Project Name: BLUE BLAZE COAL Owner/Client: ROBER BKA868	Boring/Well Number: LMC-3 Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
800		798.2 - 803.2': SHALE: Carbonaceous, silty.	BLACKHAWK-STAR POINT GROUP
		803.2 - 836': SANDSTONE: Massive.	Upper Spring Canyon Sandstone
810			
820			
830			
840			
850			
860			
870			
880			
890			
900			

Blue Blaze Coal Company
Helper, Utah

Technical Deficiencies Response
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WELL LMC-4

EARTHFAX ENGINEERING, INC. DRILLING LOG PAGE 1 OF 5

Project Name: BLUE BLAZE COAL Owner/Client: ROGER BKAGGS	Boring/Well Number: LMC-4 Boring/Well Location: 4,393,760 N 495,860 E
Project Number: UC-244	Reference Elevation: 7800' Reference Point: GROUND SURFACE
Date Drilled: 1 JAN 1980 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 430' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
0		NO LITHOLOGICAL LOG 0 - 55'	
10			
20			
30			
40			
50			
60		? - 56': SANDSTONE: Massive. Channel sandstone remnant?	BLACKHAWK FORMATION
		56 - 59.9': SANDSTONE: Carbonaceous, shaley. Uncertain.	
		59.9 - 60': COAL: Castlegate Coals replaced with channel dep.	Castlegate A
		60 - 63.9': SILTSTONE: Carbonaceous, sandy. Castlegate Coals replaced with channel deposit.	Castlegate A
		63.9 - 64': COAL: Castlegate Coals replaced with channel deposit.	Castlegate A
		64 - 68.9': SILTSTONE: Carbonaceous, sandy. Castlegate Coals replaced with channel deposit.	Castlegate A
		68.9 - 69': COAL: Castlegate Coals replaced with channel deposit.	Castlegate A
70		69 - 74': SILTSTONE: Carbonaceous, sandy. Red color in log = baked? By what coal?	
		74 - 100': SANDSTONE: Remnant of channel sandstone? BTM 5' = sandy siltstone	
80			
90			
100			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: 1,393,760 N 495,860 E
Project Number: UC-244	Reference Elevation: 7800' Reference Point: GROUND SURFACE
Date Drilled: 1 JAN 1980 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 430' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
100		100 - 100.7': COAL: Shaley.	BLACKHAWK FORMATION
		100.7 - 105.2': SANDSTONE: Carbonaceous, shaley. coal seams of limited extent.	
		105.2 - 112': COAL: Shaley. Shale partinge 108.2 - 109.6'.	Castlegate A
110			
		112 - 128': SANDSTONE: Shaley, silty. Shaley 112 - 119'. Remnant of Aberdeen Sandstone?	Aberdeen Sandstone
120			
130		128 - 139.2': SHALE: Carbonaceous, silty.	
		139.2 - 139.9': COAL:	Gordon Coal
140		139.9 - 140.9': SHALE: Carbonaceous, sandy.	Gordon Coal
		140.9 - 143.3': COAL:	Gordon Coal
		143.3 - 165': SHALE: Carbonaceous, coaly, sandy. Coals at 146.4 - 147'.	
150		Coals at 151.4 - 152.5'.	
		Coals at 159 - 159.7'.	
160		Coals at 162.6 - 163.3'.	
		165 - 175': SANDSTONE: Carbonaceous.	
170			
		175 - 203.1': SHALE: Sandy.	
180			
190			
200			

Project Name: BLUE BLAZE COAL	Boring/Well Number: LMC-4
Owner/Client: ROBER SKA668	Boring/Well Location: 4,393,760 N 495,860 E
Project Number: UC-244	Reference Elevation: 7800'
	Reference Point: GROUND SURFACE
Date Drilled: 1 JAN 1980	Drilling Contractor: HOLLANDER
Logged By: --	Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: --	Boring Depth (Ft): 430' Well Depth (Ft): --
Dates Measured: -- --	Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
200		175 - 203.1': SHALE: Sandy.	BLACKHAWK FORMATION
		203.1 - 205.3': COAL: No gamma response on geophysical log.	Upper O'Conner
		205.3 - 215.3': SANDSTONE: Shaley. IM RF = 5.5' massive	Upper O'Conner
210			
		215.3 - 227': COAL: Old works--top 6.0 - 6.5' mined out ? rubble (old National Mine workings).	Upper O'Conner
220			
		227 - 232': SANDSTONE: Carbonaceous, silty. IM floor = 5'	
230		232 - 233+': SANDSTONE: Massive.	Upper Spring Canyon Sandstone
		LITHOLOGY (CORE) DESCRIPTION ENDS AT 233.0'.	
240			
250			
260			
270			
		274 - 293': SILTSTONE: Shaley.	
280			
290			
		293 - 324.5': SANDSTONE: Massive	Lower Spring Canyon Sandstone
300			

EARTHFAX ENGINEERING, INC. DRILLING LOG

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-4 Boring/Well Location: 4,393,760 N 495,860 E
Project Number: UC-244	Reference Elevation: 7800' Reference Point: GROUND SURFACE
Date Drilled: 1 JAN 1980 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 430' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
300			
310			
320			
330		324.5 - 367.9': SHALE: Silty.	
340			
350			
360			
370		367.9 - 368': COAL: 368 - 420': SANDSTONE: Silty. Massive.	Lower O'Conner Storrs Sandstone
380			
390			
400			

EARTHFAX ENGINEERING, INC. — DRILLING LOG

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-4 Boring/Well Location: 4,393,760 N 495,860 E
Project Number: UC-244	Reference Elevation: 7800' Reference Point: GROUND SURFACE
Date Drilled: 1 JAN 1980 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 430' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
400		400 - 430': SANDSTONE: Silty. Massive.	Storrs Sandstone
410			
420			
430			
440			
450			
460			
470			
480			
490			
500			

RESPONSE TO TECHNICAL DEFICIENCIES
BLUE BLAZE COAL COMPANY
BLUE BLAZE MINE

Prepared For

Blue Blaze Coal Company
Helper, Utah

Prepared By

EarthFax Engineering, Inc.
Midvale, Utah

March 10, 1992

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Response to Technical Deficiencies (Ground Water), Blue Blaze Coal Company, Blue Blaze Mine, PRO/007/020, Folder #2, Carbon County, Utah

On January 23, 1992, the Utah Division of Oil, Gas and Mining ("UDOGM") submitted comments to Blue Blaze Coal Company ("BBCC") regarding technical deficiencies in the groundwater portions of their application for a permit to mine coal at the proposed Blue Blaze Mine. These comments from UDOGM addressed the adequacy of past submittals with respect to sections R645-301-724.100, -724.500, and -728 of the Utah Coal Mining Regulations.

The purpose of this submittal is to respond to the above-mentioned UDOGM comments. For the sake of clarity, each UDOGM comment is quoted, followed by the BBCC response. These responses were prepared by EarthFax Engineering, Inc. under the direction of BBCC.

UDOGM COMMENT

724.100 Baseline Information: Groundwater *The applicant has presented drill hole information from Century Geophysical Corporation stating that, "A Gamma Ray Probe was used by Century Geophysical Corporation in the LMC drill holes to check for fluid in impervious layers" (page 7-6, PAP). The Division cannot accept this information as a valid explanation for the occurrence of formation water, per the requirements of the rules, "Groundwater quantity descriptions will include, at a minimum, approximate rates of discharge or usage and depth to the water in the coal seam, and each water-bearing stratum above and potentially impacted stratum below the coal seam." The applicant must be made aware that Gamma Logs cannot be used to ascertain the depth to water in the coal seam, and each water-bearing stratum above and potentially impacted stratum below the coal seam. For example, hole LMC 1 water level was determined to be found at 232 feet when in reality all the Gamma log was saying was that the water level in the hole following drilling was 232 feet below the surface. Without the driller's*

log documenting water occurrence and core data this does not indicate that water occurred at this elevation, but shows that the combination of drill fluids and water rose to this level in the hole.

The applicant must provide, groundwater quantity descriptions that include, at a minimum, approximate rates of discharge or usage and depth to the water in the coal seam, and each water-bearing stratum above and potentially impacted stratum below the coal seam. A verified driller's log documenting water occurrence within each stratum is required.

BBCC RESPONSE

POTENTIAL AQUIFERS

Formations which outcrop within the proposed Blue Blaze Coal Company permit and adjacent areas include the upper Price River Formation, the Castlegate Sandstone member of the Price River Formation, the Blackhawk Formation, the Star Point Sandstone, the Mancos Shale, and Quaternary alluvium. A regionally extensive groundwater system has not been identified in the permit or adjacent areas (Engineering Science, 1984). Detailed descriptions of these formations are presented in Chapter 6 of the permit application. A summary of the characteristics of these formations, and their potential to serve as aquifers in the permit and adjacent areas, is presented below.

Upper Price River Formation. The upper Price River Formation consists of interbedded sandstone, shale, and claystone. Due to its limited outcrop extent within the permit and adjacent areas, the presence of claystone and shale with the formation, and drainage of the of the formation by deeply incised canyons, the upper Price River Formation is not considered to be a significant aquifer within the permit and adjacent areas. According to the Cumulative Hydrologic Impact Assessment, recently completed by UDOGM (1989) for the Upper Gordon Creek Area (including the Blue Blaze Mine), "groundwater associated with the Price River Formation may be characterized as occurring within a 'perched' aquifer and represents a relatively insignificant hydrologic resource".

Castlegate Sandstone. The Castlegate Sandstone member of the Price River Formation consists of 150 to 500 feet of white to gray, coarse-grained often conglomeritic sandstone with a few thin interbedded mudstones or shales near the base. Cliff forming along outcrops frequently occurs in the Castlegate Sandstone. Based on the limited area of exposure for surface recharge (due to the steep slopes), the limited potential for recharge from the overlying perched aquifers of the upper Price River Formation (due to the fine-grained nature and resulting low permeability of the formation), and drainage of the sandstone by the deeply incised canyons of the area, this formation is not considered to be a significant aquifer.

Blackhawk Formation. The Blackhawk Formation underlies the Castlegate Sandstone and consists of several hundred feet of interbedded sandstone, siltstone, shale, and coal. The Castlegate A and Hiawatha coal seams (to be mined by BBCC) are located near the base of the Blackhawk Formation. The Blackhawk Formation has a mixed lithology of sandstones, shales, and coals which produces alternating perched aquifers and impermeable beds (Doelling, 1972). Four springs were identified in the area by the 1989 Cumulative Hydrologic Impact Assessment with "all springs discharging from the Blackhawk Formation".

The above-mentioned springs are most likely associated with channel sands that are of limited in areal extent, that contain water perched over shale beds, and that have limited recharge areas. This type of spring commonly has considerable variation in flow because of the limited recharge area and the limited amount of storage in the aquifer (Engineering Science, 1984).

According to UDOGM (1989), mine inflow is insignificant in the area that includes the proposed Blue Blaze mine. Since all mining in the area occurs within the Blackhawk Formation, this indicates that extensive aquifers are not present within the Blackhawk Formation in the permit and adjacent areas. Thus, the Blackhawk Formation is not considered to be a significant aquifer.

Star Point Sandstone. The Star Point Sandstone consists of fine to medium grained sandstone that decreases in grain size with depth. This unit consists of several littoral

sandstone tongues separated by Mancos shales (Doelling 1972). Regionally, recharge to the Star Point occurs primarily from vertical movement of the water through the overlying Blackhawk Formation. Due to the low permeability of the Blackhawk Formation, the magnitude of this recharge is limited.

Lines (1985) identifies the Star Point Sandstone as an aquifer in the region. It is likely that the Star Point Sandstone is the only formation within the permit and adjacent areas that contains groundwater on an aerially-extensive basis.

Mancos Shale. Underlying the Star Point Sandstone is the Masuk member of the Mancos Shale. The Masuk Shale consists of blue-gray fissile claystone or silty claystone which weathers light blue-gray to light tan. Although the Masuk Member of the Mancos Shale may be locally saturated beneath the Star Point Sandstone, it is not considered to be an aquifer. Except where extensively fractured, the low-permeability shales in the Masuk will transmit only relatively small quantities of water (Lines, 1985).

Quaternary Alluvium. Unconsolidated Quaternary deposits are present along streams and generally consist of silts, sands, and occasional gravels. The alluvium deposits receive water from the adjacent bedrock in some of the deeply incised canyons. Water is probably supplied to the alluvium by seepage from the Blackhawk-Star Point aquifer. Discharge from the Quaternary alluvium is to the surface water system. Due to the limited areal extent of alluvium in the area, this unit is not considered to be a significant aquifer.

DEPTH TO WATER

Four exploratory holes were drilled (LMC-1 through LMC-4) within the permit boundary in the late 1970's and early 1980's. Three of these (LMC-1, LMC-3, and LMC-4) were retained as open holes wherefrom water-level data can be collected.

On February 27, 1992, measurements were collected by EarthFax Engineering from the three accessible holes to determine total depth and static water level. Water level and depth measurements were collected by means of a 1500-foot electric water-level indicator manufactured by Solinst. All three wells were found to be dry. Well LMC-1 is completed into the Blackhawk formation above both the Castlegate A and Hiawatha coal seams and was measured to a depth of 599 feet below ground surface without detecting water. Well LMC-3 was drilled to a depth below the Castlegate A coal seam and found to be dry at a depth of 664 feet below ground surface. Well LMC-4 was drilled to a depth below both the Castlegate A and Hiawatha coal seams and was measured to a depth of 217 feet below ground surface without detecting water. Thus, no groundwater was detected in the Blackhawk Formation in any of the holes.

It should be emphasized that each of the drill holes is open (i.e., uncased) from its bottom to the surface. Thus, the measured dry conditions are indicative of not only the bottoms of the holes but also each overlying layer penetrated by the holes. Thus, neither the coal nor the overlying or underlying strata were found to contain groundwater at the hole locations.

In addition to the above measurements, data were collected from wells LMC-1 and LMC-3 by Mr. Roger Skaggs of BBCC in December, 1991. These measurements were collected by attaching two test tubes to the end of a steel cable, lowering the cable into the drill hole until the bottom of the hole was reached, and allowing the test tubes to rest on the bottom for several minutes before retrieving the cable. The length of the cable was measured at the surface while the cable was extracted. Using this method, drill hole LMC-1 was found to be dry at a depth of 600 feet. Well LMC-3 was found to be dry at a depth of 650 feet. Thus, although non-standard methods were used, the December 1991 data corroborate the February 1992 data by indicating that holes LMC-1 and LMC-3 are dry.

Discussions with Mr. Joseph A. Harvey, who was present at the time the holes were drilled, further corroborate the absence of groundwater within the coal seams as well as strata which lie both above and below the coal seams. According to Mr. Harvey, who was under

contract with C & W Coal Producers Corp. at the time the holes were drilled, each hole was dry during drilling and upon completion. Completion dates were September 1976 for LMC-1, November 1976 for LMC-3, and January 1980 for LMC-4. Hole LMC-2 (completed in October 1976) was also dry during drilling.

A review of records on file with UDOGM, as well as discussions with former mining personnel, indicate that the Gordon Creek #2 Mine (operated by Beaver Creek Coal Company in the Castlegate A seam) immediately southwest of the proposed permit area was a dry mine with only sporadic occurrences of groundwater inflow that dried up within a short time. The Gordon Creek #3 Mine (operated by Beaver Creek Coal Company in the Hiawatha seam immediately east of the proposed permit area) was dry until a 12-foot graben was encountered in the northeast portion of the mine. Groundwater from the graben was produced from the floor of the mine at a rate of up to 400 gallons per minute. During retreat mining, the same faulted zone was dry, either as a result of previous dewatering, or as a result of elevation differences. It is possible that groundwater was stored in the fault zone and when dewatered, there was insufficient recharge from overlying strata to maintain the groundwater discharge.

Based on the LMC drill-hole water level measurements and information concerning the adjacent mines, it is concluded that both the Castlegate A and Hiawatha coal seams as well as the immediately underlying and over lying strata, are dry. The long history of mining in the area and the periodic measurements from the drill holes suggest that these seams and strata are not seasonally saturated. The occurrence of groundwater while mining in the Castlegate A and Hiawatha coal seams will depend primarily on whether a faulted zone is encountered that contains groundwater in storage or that is hydraulically connected with an overlying perched zone. Based on the dry nature of previous mine workings in the area, as well as observations and measurements obtained from the LMC drill holes, the probability of significant sustained inflows to the Blue Blaze mines is considered minimal. This conclusion is in agreement with Cumulative Hydrologic Impact Assessments prepared for the area by Engineering Science (1984) and UDOGM (1989).

APPROXIMATE RATES OF DISCHARGE OR USE

Three springs located within the proposed permit area are monitored by BBCC. Data collected from these sources are presented in Chapter 7 of the permit application package. These data indicate that one of the monitored springs (Station No. 1) discharges at a typical rate of 5 to 15 gallons per minute. The remaining two monitored springs (Station Nos. 2 and 4) discharge at rates of 1 to 2 gallons per minute.

Data contained in Appendix 1 of the permit application package indicate that water rights have been filed on a limited number of springs in the permit and adjacent areas. These include monitoring Station No. 4 and downstream from monitoring Station No. 1. Usage of these springs is for stock watering. Legal rates of usage of spring water generally vary from 0.06 to 0.37 acre-feet per year (all less than 0.25 gallon per minute).

No water rights exist within the permit and adjacent areas for water wells. One right exists for the use of water encountered in underground coal mining operations (File No. 330 with Sweet Coal Company-see Appendix 1 of the permit application package). Since this mine is not active, the right is not currently in use.

All groundwater associated with the above discharges issues from the Blackhawk Formation. As noted above, this formation is not considered an extensive aquifer within the permit and adjacent areas. Thus, the water issues from perched aquifers of limited areal extent. This explains the low flows and usage rates for the springs.

DRILL-HOLE INFORMATION

LMC drill-hole data are summarized in Table 1. Lithologic logs were prepared for the LMC drill-holes from information taken from the Bureau of Land Management stratigraphic coal database and other information provided by Mr. Roger Skaggs of BBCC. Stratigraphic logs can be found in Appendix A.

TABLE 1
MONITORING WELL SUMMARY

Well Number	Total Drilled Depth (ft)	Elev. Top of Casing (ft)	February 1992 Depth (ft)	Casing or Boring ID (in)	Static Water Level (ft below ground surface)	Formation Monitored
LMC-1	900	unknown	599	2" casing at surface	Dry	Blackhawk Fm. (above coal seams)
LMC-2	568	8420	Sealed	4 3/4" boring (approx)	Sealed	Sealed
LMC-3	836	8290	663.9	4 3/4" boring (approx.)	Dry	Blackhawk Fm. (below Castlegate A)
LMC-4	430	7800	217	4 3/4" boring (approx.)	Dry	Blackhawk Fm. (below Hiawatha)

UDOGM COMMENT

724.500 Supplemental Information *The applicant has chosen to use data collected in September 1976 from four logged drill holes to describe groundwater conditions on the Blue Blaze permit area. This information is referenced on pages 7-6 and shown on Figure 1. This information is considered the supplemental information necessary to evaluate the probable hydrologic consequences of mining on groundwater but is inadequate.*

Such supplemental information may be based upon drilling, aquifer tests, hydrogeologic analysis of the water-bearing strata, flood flows, or analysis of other water quality or quantity characteristics. The applicant must submit site-specific data so that an assessment of the Probable Cumulative Impacts of all anticipated coal mining and reclamation operations on the hydrologic balance in the cumulative impact area can be made. A determination that the proposed operation has been designed to prevent material damage to the hydrologic balance outside the permit area must also be made using site-specific groundwater information.

The applicant must provide a survey that shows whether aquifers or areas for the recharge of aquifers exist within the permit and adjacent area and whether subsidence, if it occurred, could cause material damage or diminution of reasonably foreseeable use of aquifers or areas for the recharge of aquifers. Renewable resource survey information must be incorporated into the subsidence control plan as required by R645(R614)-301-525.

BBCC RESPONSE

RECHARGE

Snowmelt and rain are the main sources of recharge to the groundwater system in the permit and adjacent areas. Normal annual precipitation in the area is approximately 20 inches per year (Waddell et al., 1981). Approximately 65 percent of this precipitation normally falls during the months of October through April (Waddell et al., 1981), mostly as snowfall.

Infiltration from precipitation and snowmelt "provides most of the groundwater recharge, particularly where permeable lithologies are exposed at the surface. Vertical migration of groundwater occurs through permeable rock units and/or along zones of faulting and fracturing. Lateral migration initiates when groundwater encounters impermeable rocks and continues until either the land surface is intersected (and spring discharge occurs) or other permeable lithologies or zones are encountered that allow further vertical flow" (UDOGM, 1989). This condition creates the perched aquifers in the Price River and Blackhawk Formations discussed previously.

In a study of a geologically-similar area approximately 10 miles southwest of the proposed permit area, Danielson et al. (1981) concluded that most, if not all, groundwater in the area is derived from snowmelt. In areas that are capped by the Price River Formation and the Blackhawk Formation (such as occurs within the proposed permit and adjacent areas), Danielson et al. (1981) indicated that "steep slopes promote rapid snowmelt runoff and reduce recharge to the groundwater system." This condition is intensified by the relatively low permeability of the Price River and Blackhawk Formations. The limited amount of recharge in the area is reflected by the small number of springs as well as the dry conditions encountered by previous mine workings in the permit and adjacent areas and the LMC drill holes.

SUBSIDENCE

According to the Cumulative Hydrologic Impact Assessment prepared for the area by UDOGM (1989), "Subsidence impacts are largely related to extension and expansion of the existing fracture system and upward propagation of new fractures. Inasmuch as vertical and lateral migration of water appears to be partially controlled by fracture conduits, readjustment or realignment in the conduit system will inevitably produce changes in the configuration of groundwater flow. Potential changes include increased flow rates along fractures that have been 'opened', and diverting flow along new fractures or within permeable lithologies. Subsurface flow diversion may cause the depletion of water in certain localized aquifers and

potential loss of flow to springs that will be undermined. Increased flow rates along fractures would reduce groundwater residence time and potentially improve water quality.

"Mining has occurred beneath and adjacent to two springs. No impacts have been detected. In addition, mining has occurred beneath a portion of Beaver Creek. Pillars were sized to maintain channel integrity and water monitoring has not identified impacts" (UDOGM, 1989).

As noted in the above-referenced Cumulative Hydrologic Impact Assessment, mining in the area adjacent to the proposed Blue Blaze permit area has not resulted in hydrologic impacts due to subsidence. Given the lack of extensive aquifer systems in lithologic units that overlie the coal within the permit and adjacent areas (see the BBCC response to UDOGM comment 724.100), groundwater is not considered to be a significant renewable resource in areas that may be affected by subsidence. Thus, subsidence caused as a result of mining by BBCC will not cause significant groundwater impacts within the permit or adjacent areas.

STRUCTURES AND RENEWABLE RESOURCE INFORMATION

Information regarding structures and renewable resources within the permit and adjacent areas is provided in Section 3.4.8 of the permit application package. The subsidence control and monitoring plan is also presented in that section.

UDOGM COMMENT

728. Probable Hydrologic Consequences (PHC) Determination The applicant has not provided accurate groundwater information from drill holes LMC 1-4 explained in the deficiency of R-614-301-724.100. Until this information is submitted, the PHC cannot be considered complete and accurate and, therefore, cannot be reviewed.

BBCC RESPONSE

Groundwater information has been provided for drill holes LMC-1, LMC-3, and LMC-4 in the discussion of UDOGM comment 724.100. A summary of the LMC drill-holes is presented here. DR# 10

/ 599

Hole LMC-1 was drilled to a depth of 900 feet in September 1976. A log of this hole is provided in Appendix A. LMC-1 was drilled into the Blackhawk Formation through the Castlegate A coal seam with the bottom subsequently being sealed to a depth of approximately 600 feet and remaining open above that depth. On February 27, 1992, the depth of this hole was measured by EarthFax using an electric water-level indicator. The hole depth was determined to be 599 feet below ground surface without detecting water. Personal communication with Mr. Joseph A. Harvey indicates that LMC-1 was dry during drilling.

Hole LMC-2 was drilled to the bottom of the Blackhawk Formation in October 1976. A log of this hole is provided in Appendix A. The hole was subsequently sealed to a depth of 50 feet below ground surface. Due to its shallow remaining depth, no groundwater measurements have been collected from this hole. Mr. Harvey indicates that the hole was dry during drilling.

Hole LMC-3 was drilled to a depth of 836 feet in November 1976. This hole was subsequently sealed to a depth of about 665 feet, remaining open above that depth. A log of this hole is provided in Appendix A. On February 27, 1992, Well LMC-3 was measured by

EarthFax and found to be dry below the Castlegate A coal seam at a total hole depth of 664 feet below ground surface. Mr. Harvey indicates that the hole was dry during drilling.

Hole LMC-4 was drilled through the Blackhawk Formation to a depth of 430 feet in January 1980. This hole was subsequently sealed to a depth of approximately 220 feet, remaining open above that depth. A log of this hole is provided in Appendix A. On February 27, 1992 Well LMC-4 was measured by EarthFax below both the Castlegate A and Hiawatha coal seams to a depth of 217 feet below ground surface without detecting water. Mr. Harvey indicates that this hole was also dry during drilling.

Lithologic logs were prepared for the LMC drill-holes from information taken from the U.S. Bureau of Land Management stratigraphic coal database and other information provided by Mr. Roger Skaggs of BBCC. Stratigraphic logs can be found in Appendix A.

Based on the information presented in this response document, previous mine workings in the area have been predominantly dry. In addition, the LMC drill holes were dry at the time they were drilled and remain dry to date. Thus, groundwater resources that may be impacted by mining activities in the permit and adjacent areas are limited. Hence, the probability of impacting these resources is low.

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APPENDIX A

LMC DRILL-HOLE LOGS

Blue Blaze Coal Company
Helper, Utah

Technical Deficiencies Response
March 10, 1992

WELL LMC-1

EARTHFAX ENGINEERING, INC. DRILLING LOG

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 899' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
0		0 - 100': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	
10			
20			
30			
40			
50			
60			
70			
80			
90			
100			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 899' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
100		0 - 200': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
110			
120			
130			
140			
150			
160			
170			
180			
190			
200			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 899' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
200		0 - 279': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
210			
220			
230			
240			
250			
260			
270			
280		279 - 280.5': COAL: No lithology log. 280.5 - 300': SANDSTONE, SILTSTONE, SHALE: No Lithology log.	IS THIS THE CASTLE GATE "A" SEAM?
290			
300			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 899' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
300		280.5 - 400': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
310			
320			
330			
340			
350			
360			
370			
380			
390			
400			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 899' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
400		280.5 - 500': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
410			
420			
430			
440			
450			
460			
470			
480			
490			
500			

Project Name: BLUE BLAZE COAL Owner/Client: ROBER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: —
Project Number: UC-244	Reference Elevation: — Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: —	Drilling Contractor: HOLLANDER Drilling Method: — Rig Type: —
First occurrence of G.W.: — Static W.L.: — Dates Measured: — —	Boring Depth (Ft): 599' Well Depth (Ft): — Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
500		280.5 - 600': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
510			
520			
530			
540			
550			
560			
570			
580			
590			
600		MEASURED TO THIS PT. 599'	

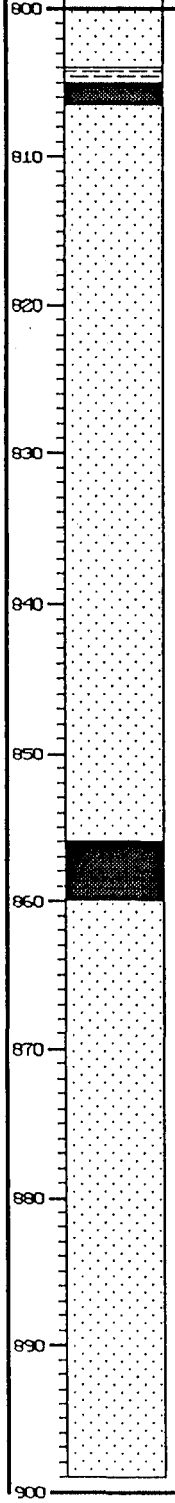
Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 899' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
600		280.5 - 700': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
610			
620			
630			
640			
650			
660			
670			
680			
690			
700			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER BKA888	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 899' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
700		280.5 - 750': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
710			
720			
730			
740			
750		750 - 752': COAL:	
		752 - 793: SANDSTONE, SILTSTONE, SHALE: No lithology log.	
760			
770			
780			
790		793 - 798.4': COAL: No lithology log.	Castlegate "A" Upper Split
800		798.4 - 799': SHALE: 799 - 800': COAL: No lithology log.	

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-1 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: SEPT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 899' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"



LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
800 - 804' : COAL: No lithology log. 804 - 805' : SHALE: No lithology log. 805 - 806.5 : COAL: No lithology log.	Castlegate "A" Lower Split
806.5 - 856': SANDSTONE, SILTSTONE, SHALE: No lithology log.	
856 - 860': COAL:	Gordon Coal Seam
860 - 899': SANDSTONE, SILTSTONE, SHALE: No lithology log.	

Blue Blaze Coal Company
Helper, Utah

Technical Deficiencies Response
March 10, 1992

WELL LMC-2

EARTHFAX ENGINEERING, INC. DRILLING LOG

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-2 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 568' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
0		SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
10			
20			
30			
40			
50			
60			
70			
80			
90			
100			

Project Name: BLUE BLAZE COAL	Boring/Well Number: LMC-2
Owner/Client: ROGER SKAGGS	Boring/Well Location: --
Project Number: UC-244	Reference Elevation: --
	Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976	Drilling Contractor: HOLLANDER
Logged By: --	Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: --	Boring Depth (Ft): 568' Well Depth (ft): --
Dates Measured: -- --	Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
100		0 - 169': SANDSTONE, SILTSTONE, SHALE (interbedded): No lithology log.	BLACKHAWK FORMATION
110			
120			
130			
140			
150			
160			
170		169 - 170' COAL Possibly shaley	Local Coal Group
		170 - 172.5' SHALE Carbonaceous, silty	Local Coal Group
		172.5 - 173' COAL Shaley	Local Coal Group
		173 - 194.9' SANDSTONE Massive	Local Coal Group
180			
190			
		194.9 - 195' COAL	Local Coal Group
		195 - 319' SANDSTONE Shaley	
200			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER BKA888	Boring/Well Number: LMC-2 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 568' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
200		195 - 319.4': SANDSTONE: Shaley.	BLACKHAWK FORMATION
210			
220			
230		Interbedded massive sandstone at 231 - 244'.	
240			
250			
260			
270			
280			
290		Interbedded massive sandstone at 288 - 312'.	
300			

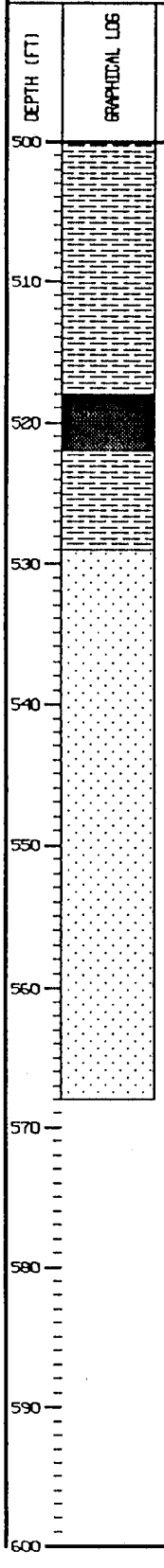
Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-2 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 568' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
300		195 - 319.4': SANDSTONE: Shaley. Interbedded massive sandstone at 288 - 312'.	BLACKHAWK FORMATION
310			
320		319.4 - 319.5': COAL: Possibly <0.5% shaley coal present.	Bob Wright Group
		319.5 - 322.9': SHALE: Carbonaceous, silty.	Bob Wright Group
		322.9 - 323': COAL: Possibly <0.5% shaley coal present.	Bob Wright Group
		323 - 343': SHALE: Sandy.	
330			
340			
		343 - 366.5': SANDSTONE: Massive.	
350			
360			
		366.5 - 369.9': SHALE: Carbonaceous, silty.	
370		369.9 - 370': COAL: Castlegate Coals replaced with channel deposit.	Castlegate A
		370 - 380.4': SHALE: Carbonaceous, silty. Castlegate Coals replaced with channel deposit.	Castlegate A
380		380.4 - 380.5': COAL: Castlegate Coals replaced with channel deposit.	Castlegate A
		380.5 - 393.4': SHALE: Carbonaceous, silty. Castlegate Coals replaced with channel deposit.	Castlegate A
390			
		393.4 - 393.5': COAL: Castlegate coals replaced with channel deposit.	Castlegate A
		393.5 - 402': SHALE: Carbonaceous, sandy. Channel deposit?	
400			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-2 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 568' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
400		393 - 402': SHALE: Carbonaceous, sandy. Channel deposit?	BLACKHAWK FORMATION
		402 - 415': SANDSTONE: Shaley.	
410			
		415 - 421': SHALE: Carbonaceous.	
420		421 - 433': SANDSTONE: Shaley. Remnant of Aberdeen Deposit?	Aberdeen Sandstone
430			
		433 - 435': SHALE: Carbonaceous.	
		435 - 535.1': COAL: Gordon Coal horizon?	Gordon Coal
		435.1 - 456': SHALE: Sandy.	
440			
450			
		456 - 475.5': SANDSTONE: Silty.	
460			
		Shaley zone 467 - 470'.	
470			
		475.5 - 518': SHALE: Sandy.	
480			
490			
500			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER BKA888	Boring/Well Number: LMC-2 Boring/Well Location: --
Project Number: UC-244	Reference Elevation: -- Reference Point: GROUND SURFACE
Date Drilled: 13 OCT 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 568' Well Depth (ft): -- Boring Diameter (in): 4 3/4"



LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
475.5 - 518': SHALE: Sandy.	BLACKHAWK FORMATION
Sandstone roof rock at 510.5 - 518'.	
518 - 522': COAL: 4.0' on geophysical log.	Upper O'Conner Coal
522 - 529.5': SHALE: Carbonaceous, silty. *Floor unit.	BLACKHAWK-STAR POINT GROUP
529 - 568': SANDSTONE: Shaley, silty. Lithofacies equivalent of the massive Spring Canyon Sandstone?	Upper Spring Canyon Sandstone

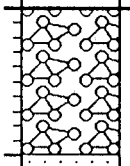
Blue Blaze Coal Company
Helper, Utah

Technical Deficiencies Response
March 10, 1992

WELL LMC-3

EARTHFAX ENGINEERING, INC. DRILLING LOG

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 1,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
0		0 - 10': SOIL: No lithology log available.	QUATERNARY
10		10 - 432.9': SANDSTONE, SILTSTONE, SHALE (interbedded):	BLACKHAWK FORMATION
20			
30			
40			
50		Massive sandstone at 47 - 53'.	
60			
70			
80			
90			
100			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
100		10 - 432.9': SANDSTONE, SILTSTONE, SHALE (interbedded):	BLACKHAWK FORMATION
110			
120			
130		Massive sandstone at 131 - 143'.	
140			
150			
160			
170			
180			
190			
200			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (ft): -- Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
200		10 - 432.9': SANDSTONE, SILTSTONE, SHALE (interbedded):	BLACKHAWK FORMATION
210		Massive sandstone at 214 - 226'.	
220			
230			
240			
250			
260			
270			
280			
290			
300			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
300		10 - 432.9': SANDSTONE, SILTSTONE, SHALE (interbedded):	
310			
320			
330			
340			
350			
360			
370		Massive sandstone at 370 - 396'.	
380			
390			
400			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1975 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (ft): -- Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
400		10 - 432.9': SANDSTONE, SILTSTONE, SHALE (interbedded):	BLACKHAWK FORMATION
410		Massive sandstone at 412 - 426'.	
420			
430		432.9 - 433': COAL:	Local Coal Group
		433 - 441.9': SHALE: Carbonaceous, sandy.	Local Coal Group
440		441.9 - 442': COAL:	Local Coal Group
		442 - 455.5': SHALE: Carbonaceous, sandy.	Local Coal Group
450		455.5 - 456': COAL: Shaley.	Local Coal Group
		456 - 582.5': SANDSTONE: Shaley.	
460			
470			
480			
490			
500			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER BKA668	Boring/Well Number: LMC-3 Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): --

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
500		456 - 582.5': SANDSTONE: Shaley.	BLACKHAWK FORMATION
510			
520			
530			
540		Massive sandstone at 539 - 557'.	
550			
560			
570			
580			
		582.5 - 586.5': COAL:	Bob Wright Group
		586.5 - 594.5': SHALE: Carbonaceous, sandy.	Bob Wright Group
590			
		594.5 - 595': COAL: Shaley.	Bob Wright Group
		595 - 606': SHALE: Carbonaceous, silty.	
600			

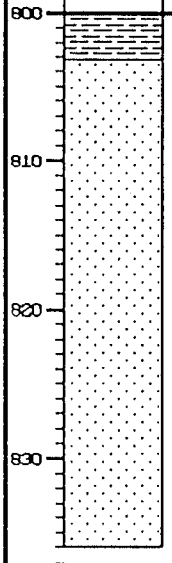
Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 836' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
600		595 - 606': SHALE: Carbonaceous, silty.	BLACKHAWK FORMATION
		606 - 625.5': SANDSTONE: Silty.	
610			
620			
		625.5 - 630': SHALE: Carbonaceous, silty. carbonaceous silty shale, next 5.5'=silty sandstone.	
630		630 - 635.5': COAL:	Castlegate A
		635.5 - 642': SHALE: Carbonaceous, silty.	
640		642 - 648.2': COAL:	Castlegate A
		648.2 - 651.4': SHALE: Carbonaceous, silty. IM FLR=3.2' carbonaceous silty shale, next 3.0'=coal.	
650		651.4 - 654.4': COAL:	Castlegate A
		654.4 - 658.5': SHALE: Carbonaceous, sandy.	
660		658.5 - 667': SANDSTONE: Shaley. Remnant of channel sandstone?	
		SEALED TO 665'	
		667 - 668.2': COAL: Local coal seams of limited extent.	
670		668.2 - 671': SHALE: Carbonaceous.	
		671 - 676.9': COAL: Shaley. Shale parting 673.0 - 674.4'. Shaley coal 674 - 675.5'.	
680		676.9 - 691': SANDSTONE: Shaley, silty. Top 3' shaley remnant of channel. Sandstone = Aberdeen Sandstone?	Aberdeen Sandstone
690			
		691 - 701.9': SHALE: Sandy.	
700			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-3 Boring/Well Location: 4,394,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (ft): 836' Well Depth (ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
700		691 - 701.9': SHALE: Sandy.	BLACKHAWK FORMATION
		701.9 - 705': COAL:	Gordon Coal
		705 - 725.5': SHALE: Sandy.	
710			
720			
		725.5 - 734.5': SANDSTONE: Massive.	
730			
		734.5 - 781': SANDSTONE: Shaley.	
740			
750			
760			
770			
780			
		781 - 791': SANDSTONE: Shaley. IM RF = 3.0' carbonaceous shale, next 2.0' = shaley sandstone, next 5.0' = silty sandstone.	
790			
		791 - 798.2': COAL:	Upper O'Conner
		798.2 - 803.2': SHALE: Carbonaceous, silty.	BLACKHAWK-STAR POINT GROUP
800			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER BKA888	Boring/Well Number: LMC-3 Boring/Well Location: 1,391,410 N 495,640 E
Project Number: UC-244	Reference Elevation: 8290' Reference Point: GROUND SURFACE
Date Drilled: 5 NOV 1976 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 836' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"



LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
798.2 - 803.2': SHALE: Carbonaceous, silty.	BLACKHAWK-STAR POINT GROUP
803.2 - 836': SANDSTONE: Massive.	Upper Spring Canyon Sandstone

Blue Blaze Coal Company
Helper, Utah

Technical Deficiencies Response
March 10, 1992

WELL LMC-4

EARTHFAX ENGINEERING, INC. DRILLING LOG

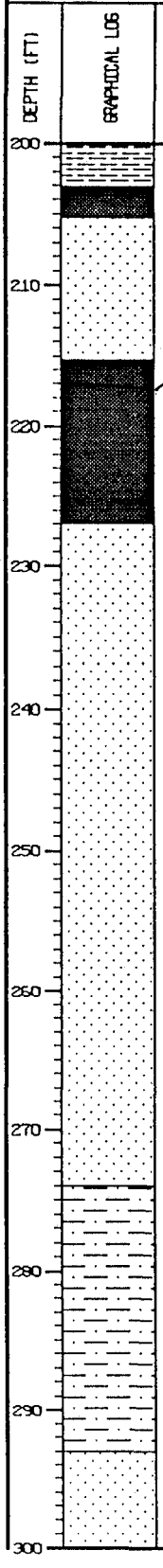
Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-4 Boring/Well Location: 4,393,760 N 495,860 E
Project Number: UC-244	Reference Elevation: 7800' Reference Point: GROUND SURFACE
Date Drilled: 1 JAN 1980 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 430' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
0		NO LITHOLOGICAL LOG 0 - 55'	
10			
20			
30			
40			
50			
60		? - 56': SANDSTONE: Massive. Channel sandstone remnant?	BLACKHAWK FORMATION
		56 - 59.9': SANDSTONE: Carbonaceous, shaley. Uncertain.	
		59.9 - 60': COAL: Castlegate Coals replaced with channel dep.	Castlegate A
		60 - 63.9': SILTSTONE: Carbonaceous, sandy. Castlegate Coals replaced with channel deposit.	Castlegate A
		63.9 - 64': COAL: Castlegate Coals replaced with channel deposit.	Castlegate A
		64 - 68.9': SILTSTONE: Carbonaceous, sandy. Castlegate Coals replaced with channel deposit.	Castlegate A
		68.9 - 69': COAL: Castlegate Coals replaced with channel deposit.	Castlegate A
70		69 - 74': SILTSTONE: Carbonaceous, sandy. Red color in log = baked? By what coal?	
		74 - 100': SANDSTONE: Remnant of channel sandstone? BTM 5' = sandy siltstone	
80			
90			
100			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER BKA668	Boring/Well Number: LMC-4 Boring/Well Location: 4,393,760 N 495,860 E
Project Number: UC-244	Reference Elevation: 7800' Reference Point: GROUND SURFACE
Date Drilled: 1 JAN 1980 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 430' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
100		100 - 100.7': COAL: Shaley.	BLACKHAWK FORMATION
		100.7 - 105.2': SANDSTONE: Carbonaceous, shaley. coal seams of limited extent.	
		105.2 - 112': COAL: Shaley. Shale partings 108.2 - 109.6'.	Castlegate A
110			
		112 - 128': SANDSTONE: Shaley, silty. Shaley 112 - 119'. Remnant of Aberdeen Sandstone?	Aberdeen Sandstone
120			
		128 - 139.2': SHALE: Carbonaceous, silty.	
130			
		139.2 - 139.9': COAL:	Gordon Coal
140		139.9 - 140.9': SHALE: Carbonaceous, sandy.	Gordon Coal
		140.9 - 143.3': COAL:	Gordon Coal
		143.3 - 165': SHALE: Carbonaceous, coaly, sandy. Coals at 146.4 - 147'.	
150		Coals at 151.4 - 152.5'.	
		Coals at 159 - 159.7'.	
160		Coals at 162.6 - 163.3'.	
		165 - 175': SANDSTONE: Carbonaceous.	
170			
		175 - 203.1': SHALE: Sandy.	
180			
190			
200			

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-4 Boring/Well Location: 4,393,760 N 495,860 E
Project Number: UC-244	Reference Elevation: 7800' Reference Point: GROUND SURFACE
Date Drilled: 1 JAN 1980 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 430' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"



LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
175 - 203.1': SHALE: Sandy.	BLACKHAWK FORMATION
203.1 - 205.3': COAL: No gamma response on geophysical log.	Upper O'Conner
205.3 - 215.3': SANDSTONE: Shaley. IM RF = 5.5' massive	Upper O'Conner
215.3 - 227': COAL: Old works--top 6.0 - 6.5' mined out ? rubble (old National Mine workings).	Upper O'Conner
227 - 232': SANDSTONE: Carbonaceous, silty. IM floor = 5'	
232 - 233+': SANDSTONE: Massive.	Upper Spring Canyon Sandstone
LITHOLOGY (CORE) DESCRIPTION ENDS AT 233.0'.	
274 - 293': SILTSTONE: Shaley.	
293 - 324.5': SANDSTONE: Massive	Lower Spring Canyon Sandstone

EARTHFAX ENGINEERING, INC. DRILLING LOG

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-4 Boring/Well Location: 4,393,760 N 495,860 E
Project Number: UC-244	Reference Elevation: 7800' Reference Point: GROUND SURFACE
Date Drilled: 1 JAN 1980 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 430' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
300			
310			
320			
		324.5 - 367.9': SHALE: Silty.	
330			
340			
350			
360			
		367.9 - 368': COAL	Lower O'Conner
370		368 - 420': SANDSTONE: Silty. Massive.	Storrs Sandstone
380			
390			
400			

EARTHFAX ENGINEERING, INC. DRILLING LOG

Project Name: BLUE BLAZE COAL Owner/Client: ROGER SKAGGS	Boring/Well Number: LMC-4 Boring/Well Location: 4,393,760 N 495,860 E
Project Number: UC-244	Reference Elevation: 7800' Reference Point: GROUND SURFACE
Date Drilled: 1 JAN 1980 Logged By: --	Drilling Contractor: HOLLANDER Drilling Method: -- Rig Type: --
First occurrence of G.W.: -- Static W.L.: -- Dates Measured: -- --	Boring Depth (Ft): 430' Well Depth (Ft): -- Boring Diameter (in): 4 3/4"

DEPTH (FT)	GRAPHICAL LOG	LITHOLOGIC DESCRIPTION AND OBSERVATIONS	FORMATION/REGIONAL GROUP
400		400 - 430': SANDSTONE: Silty. Massive.	Storrs Sandstone
410			
420			
430			
440			
450			
460			
470			
480			
490			
500			