0012

File

April 16, 1986

TO: Technical Memo

FROM: David W. Darby, Reclamation Geologist DWD

RE: Plateau's Graben Crossing Resubmittal Star Point Mine, ACT/007/006, Carbon County, Utah

Summary and Conclusion

Plateau's graben crossing response has been reviewed for technical consideration and has been found to be insufficient to adequately describe the ground water regime in and adjacent to the proposed graben crossing area.

Without sufficient detailed information concerning ground water gradient, movement and seasonal fluctuation long term adverse impacts could result from implacement of the graben crossing tunnel.

More information is needed to establish water levels within each fault block, to gain an understanding of annual ground water fluctuation for each fault block and movement of ground water between fault blocks.

Body

The applicant submitted a response (February 4, 1986) to our original review comments (December 13, 1985) for the proposed Graben Crossing. The proposed crossing will join Plateau's current mine workings to their permitted Federal Lease U-13097. The proposed twin tunnels will be driven in one of two proposed locations which cross the Bear Canyon Graben. The Bear Canyon graben consist of at least five (5) offset fault blocks.

The strata within the graben is more fractured than adjacent unfaulted areas. Faults and fractures act as conduits that can transmit large volumes of ground water. Several large springs discharge along these faults as well as ground water that was intercepted when mines have contacted faults that flanks the graben.

Plateau claims the tunnel will be driven above the regional water table and no adverse impacts will occur to the ground water regime. Some water will be produced when the tunnel encounters perched aquifers (also cavities where water is stored along faults) and as annual circulation from recharge enters the tunnel.

Plateau projected ground water levels and other aquifer characteristics from boreholes drilled in the area, a spring survey and contact with the graben during mining.

In reviewing the response, it was found that much of the information was generalized, conflicting, and inappropriately extrapolated to the tunnel site.

Sufficient detail has not been supplied to project water table gradients, annual fluctions of the water table, spring flow or the movement of groundwater between fault blocks.

Thus, Plateau still needs to submit more information as listed below.

1. Describe the seasonal flows of springs and thier hydrologic connection to ground water aquifers.
2. Determine the seasonal fluction of groundwater for all fault blocks within and adjacent to the graben.
3. Establish the gradient of ground water and how it relates to each fault block to be crossed by the tunnel.
4. Decide which tunnel plan will be implemented.
5. Establish and monitoring plan for springs in the area and measure water quality and quanitiy.

Recommendations:

1. Plateau should monitor and establish hydrographs of selected springs in and adjacent to the proposed tunnel area.

2. Plateau should gather and submit data from all boreholes located in the area.

3. Plateau should drill test wells south of the proposed tunnel crossing to establish the gradient and water levels for each fault block if no data exists for these areas.

Support:

Cross-section from drift of tunnel to well CVA-5A north of the tunnel site.

Review notes and comments.

Maps and response from February 4, 1986 submittal.

cc.
Sue Linner
John Whitehead

crh
0183R-6

0740F

Plateau
Star Point
ACT/007/006
Carbon Co Utah

Plateau Graben Crossing

Jointing

Two sets present
1) 2 shear joint sets (compressional),
shear joint form a conjugate shear couple
striking N 70°E & N 40°W
2) extentional set N 80°W

Plateau Mining Company - Graben Crossing
to Access ~~Land~~ Coal Lease M U-13097

One of two tunnel sets will be driven across the Bear Canyon fault. The applicant states that the southern most tunnel will probably be the set driven, but no commitment was made (p. 13).

The applicant will have to commit to which set of tunnels will be driven.

The tunnel will penetrate at least five major faults (5 fault blocks). ~~of which the permeabilities are not known~~ These faults and fault blocks are numbered for further discussion. The southern tunnel will be approximately 2600 feet long.

In evaluating the water table the applicant has presented data pertinent to the following wells

CUR-5A

W-17

83-14-5 ABD

83-14-2-C

CUR-1

83-14-13-C

83-14-1

W-12

that the Division does not think that grouting of the tunnel is not justifiable for controlling the groundwater inflow into this tunnel because, the extent and frequency of fracturing is not known and the amount of groundwater inflow is not predictable at this time.

Several contacts with the eastern boundary fault have produced large volumes of water. The applicant has encountered the fault twice.

"The 2nd Left encounter initially experience little water inflow (~ 6 gpm) from roof strata on the face offset. Within three weeks, liquified gouge in the faces of entries #2 and #3 flowed approximately 10 to 15 feet into the entries. Underground drilling in the #1 entry penetrated 40 to 60 feet of gouge and fractured rock before tapping into a significant ground water conduit. Inflow peaked at about 150 gpm from drill holes before dropping to less than 10 gpm after 10 weeks (the flow dropped to 50 gpm in 2 weeks).

"A second encounter with the east side of the graben (in the 2nd West Mains) experienced an initial inflow rate of about 20 gpm from the roof strata. This flow was reduced to less than 10 gpm after 4 weeks of exposure. Very little water has been found at the actual face offset."

Inflow from the drill hole which penetrated the fault at the 2nd Left encounter has since dropped to zero.

The applicant also drilled some 400 feet into the graben at the proposed tunnel site and encountered a flow of 150 gpm that reduced to 10 gpm in 10 weeks.

The applicant claims that this information indicates that they are above the water table

Permeabilities

The applicant quotes the following permeabilities from Lines (1984) report for the Trail Mountain area of the Wasatch Plateau (p. 7).

A combined transmissivity for the Starpoint SS, Blackhawk, Price River and North Horn Formations is (except where fractured) less than 75 gallons per day per ft squared.

* Shale in the Blackhawk - impermiable at pressure of 5000 lbs/in² ↑2↓

Conductivities of siltstone from 7.8×10^{-10} to 6.4×10^{-12} cm/sec

As the applicant states (P.8), "Secondary permeability within the graben expected to be greater than permeabilities outside the graben.

The applicant also states (P. 8) "Joint densities within the Bear Canyon graben are approximately 50 percent greater than joint densities on either side of the graben.

Comment: This information was collected 1¼ miles to the north of proposed tunnel.

Increased joint densities on the interior of the graben indicate a greater groundwater transport capacity within the graben (p. 8).

Boundry faults as well as interior faults form physical hydrologic boundries to the movement of groundwater across these faults (p. 9) due to the vertical displacement of formations.

Gouge zones of clay (.1 to 2 feet thick), which form impermiable barriers to groundwater, form along the fault plane as seen in fig. 1

As identified in figure 1, the fault plane consists of a gouge zone of clay and highly fractured breccia zones (.5 to 5 feet thick) on one but usually both sides of the gouge (p. 9).

Comment

The brecciated zones should act as conduits to transmit groundwater down gradient, whereas the impervious gouge zones should restrict or reduce groundwater movement between fault blocks creating seperate and distinct local aquifers having different water table levels. This would depend on the velocities of groundwater movement within the particular fault block and the gradient of the water table of each fault block.

Comment:

On page 9 the applicant has observed that the gouge and breccia zones increase in width proportional to the net slip along the fault plane. Yet, there is no data showing the amount of displacement along the the faults or the thickness of gouge and breccia associated with each fault in the vicinity of the tunnel area.

As illustrated on Plate 1, most springs identified as having flows in excess of 5 gpm lie directly along a fault, in close proximity to a fault, or appear to fall in line with the projection of an identified fault. All higher yielding spring are associated with the north-south extensional fault system not along the east-west compression fault system (P. 11).

Comment

As indicated on Plate 1 Spring 15-7-14-3 has a flow greater than 5 gpm and discharges near a fault above the proposed tunnel. Springs 15-7-14-6, S23-2, 15-7-24-3 and 15-7-14-6 discharge near faults below the proposed tunnel. Several other springs occur along the faults whose discharge are less than 5 gpm.

The date that these spring flows were measured is not stated. This is important because spring flows

are not necessarily constant throughout the year. That is, the discharge (hydrograph) is reflected by the season.
The control on all the springs should be established whether they are fault controlled or perched.

The general direction of groundwater movement along the north-south fault system is south towards Huntington Creek (p. 12).

Comment: The applicant does not establish the gradient of groundwater flow.

Graben Crossing

The applicant proposes that the tunnel will be above the regional water table (P. 13).

The establishes the relationship of the regional water table to the proposed tunnel by the following data characteristic of hole CVR-5A which lies 2200 feet north of the proposed northern tunnel and 2600 feet north of the proposed southern tunnel (measurements made by David Daly from plate 1).

Total depth of CUR-5A   1744 ft. (elevation 8202 ft.)
Depth to Watter seam   1554 ft (elevation 8403 ft.)
Elevation of proposed tunnel 8492 ft (see figure 2)

water level

Comment:

The use of drill hole CVR to establish the regional water table in relationship to the proposed tunnel does not necessarily depict the true nature of the water table near the tunnel(s) location. First the regional that the applicant refers to may not exist as the applicant portrays it. First the data presented from one drill hole (CVR-5A) 2600 ft away can not be to the site of the tunnel without adjustments. The gradient of the water table has not been established or considered. Does it maintain a constant level or does it slope? If the fault systems do block the the transfer of ground water between fault blocks as pointed out on page 9 and Figure 1, then each fault block could maintain its seperate local aquifer. Thus, the graben would exhibit several local aquifers at various levels.

The data extrapolated from CUR-5A to the tunnel area does not consider the ground water levels on the eastern end of the tunnel. Without knowing the levels or gradient on the aquifers the eastern end of the tunnel could be five feet below the aquifer, according to the following data supplied by the applicant.

Elevation of the top of the Wattis seam on the east is 8492 ft..
Water elevation in drill hole CUR-5A is 8445 ft..
Elevation of Wattis seam to the west is 8440 ft..
(according to Fig 2 top of Wattis is 8450 ± 10 ft)

If, without knowing ground water levels or gradients, of the regional or local water tables the water level at CUR-5A would then be extrapolated across to the west end of the tunnel, it would place the top of the coal seam 5 ft below the regional water table (see Preparation 1).

It should be justifiable at this time to state and they are only dewatering a perched aquifer system associated with fractures.

Comment: This statement could probably be true. We are however, interested in the areas deficient in data past that 400 ft drill hole, which is only 15% of the tunnels distance.

another thing to consider is that the fractures could be self sealing. But, could they do that in a 10 week period?

84-23-1

Exploratory hole on Sentry Ridge identified perched aquifer at elevation 9638 ft.. Spudded in at 9836 ft. (p. 12).

Q What was the total depth of the drill hole?

Comment: Perched aquifer lies 198 ft below surface.

83-26-1

Elevation of drill hole is about 9780 ft. Water inflow was suspected at 8130 ft elevation. (p.12).

Q How deep is the drill hole?

84-26-3

Elevation of drill hole is approximately 9750 ft. A fluid level was obtained during logging was recorded at 8557 ft elevation (p.12).

Q How deep is the drill hole?

Comment The difference in water levels between this hole and 83-26-1, 1700 ft to the north, is about 427 ft. It lead one to wonder if they are connected.

drill holes

W-12

Approximate elevation is 9730 feet. Intercepted interior fault encountered open fracture at 1200 feet (8530 feet). Water could be heard inside the hole depth of water is unknown. (p. 8)

Q. How deep is the hole? Was the stem or cutting wet? Was water flowing from a perched aquifer to bottom of hole?

83-14-1

Calcite crystal was found with terminations was retrieved from this hole, inferring an open fracture (p. 8)

Q. What depth was the crystal found? How deep was the hole?

CUR-5A

Drilled in the interior of the graben (fault block 8) Depth is 1744 ft (8202' elevation). Depth of Waters seen in hole was 1554 ft (8403' elevation). Fluid level intercepted at 1512 ft. (8445' elevation) (p. 8). The applicant presumed the water level to still be falling.

Q. What leads the applicant to presume the water level was still falling? Why wasn't more measurement taken to find the static water level?

The surface elevation of drill hole CUR-5A is

83-14-3-C, 83-14-2-C, 83-14-5-ABD & CUR-1

These drill holes are shown on plate 1 and figure 2. They drilled along the axis of the northern proposed tunnel approximately 800 ft to 1600 ft north of the southern proposed tunnel in fault block C.

Fluid levels indicated on figure 2.

No more information or discussion of the drill holes are mentioned in the proposal.

Q Why hasn't more information been supplied about this drill holes? That is, depths, elevations at drill site and discussion of water contacts.

Are the water level marked on figure 2. the water table?

W-14, W-15, W-16, W-17, W-18, W-20, W-21, W-22 CUR-6, CUR-7 & CUR-8

These drill holes are all drilled in the vicinity of the proposed tunnel (Nov 23, 1984 submittal) that may give some information on the groundwater movement and location. Yet, none of these drill holes, geologic or hydrologic information obtained from them was discussed.

Cross-section from Drill Hole CVR-5A to Proposed Tunnel Location - Showing Constant Water Table Gradient