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

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December 29, 1993

Mr. Richard H. Allison, Jr. P.E.
AMAX Coal West, Inc.
165 South Union Blvd., Suite 1000
Lakewood, Colorado 80228-0219

Re: Approval of Riprap Distribution Amendment, AMAX Coal Company, Castle Gate Mine, ACT/007/004-93A, Folder #3, Carbon County, Utah

Dear Mr. Allison:

The Division has completed a review of your permit change application, received on August 9, 1993, to more efficiently distribute riprap along the diversion SBRD-1. Your plans are considered complete and accurate and are hereby approved. Incorporation of this permit change will need to be accomplished along with the reorganizing of your entire plan, which is on schedule for the near future.

Although the Division is approving this amendment, there are some points of concern which we want to bring to your attention. Some of the methods used to arrive at the riprap size determination are considered marginal for these areas. Also, transition from areas requiring large riprap and areas requiring smaller riprap are not accounted for. We have enclosed the technical memo discussing these items for your use and information. You may want to consider additional engineering work to account for these concerns.

If you have any questions, please call me or Steven Johnson.

Sincerely,

Daron R. Haddock

Daron R. Haddock
Permit Supervisor

Enclosure
cc: P. Baker
S. Johnson
RIPRAP.AMA

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December 28, 1993

TO: File

THRU: Daron Haddock, Permit Supervisor

FROM: Steven M. Johnson, Reclamation Hydrologist SMJ

RE: Riprap Distribution Change, AMAX Coal Company, Castle Gate Mine, ACT/007/004-93A, Folder #2, Carbon County, Utah.

SUMMARY

Changes to the riprap designs were proposed for the reclaimed ditches of Sowbelly Canyon. The changes were made primarily to provide a more efficient distribution of riprap along the reclamation drainage diversion SBRD-1. These changes were reviewed by the Division on December 13, 1993.

ANALYSIS

The changes begin with new slope measurements in SBRD-1B and SBRD-1D. The grade for SBRD-1B was changed from 2-percent to 4-percent, and the slope for SBRD-1D was changed from 2-percent to a maximum slope of 5.5-percent. In both cases the required riprap D_{50} changed from 2.5-inches to 4-inches. Changes in the length of SBRD-1C and SBRD-1D were also made in this proposal. Length of SBRD-1C was decreased by 300-feet, from 850-feet to 550-feet. This length was added to SBRD-1D to increase its total length from 900-feet to 1200-feet.

Due to these changes the riprap thickness, riprap volume, and filter volume was recalculated for these three reaches of the channel. All calculations appear to have been made correctly and given the methods used reflect a correct design for riprap.

Riprap size was found by two different methods. The Office of Surface Mining (OSM), Simons et al., method was used for diversions of steep slopes, greater than 10-percent, and high discharges, greater than 30-cfs. The U. S. Department of Transportation, Searcy method was used for all other diversion. These methods resulted in a wide range of D_{50} sizes. The Searcy method returned values of less than 10-inches, while the OSM method returned values greater than 20-inches.

Reclamation of Sowbelly Canyon includes some very steep slopes and some relatively gradual slopes. These varying slopes should be considered in the reclamation plan. Two problems can arise at the transitions zones between steep and gradual slopes.

First, water flowing through the steep ditch segments could, and most likely will, be carrying high sediment loads because of their high energy. When water flow into the lower grade reaches, energy will be lost which will result in a lower sediment capacity and sedimentation. Eventually this would result in a loss of the diversion's discharge capacity, and possibly failure.

The second problem is rooted in the extreme size differences of the riprap on gradual slopes compared to steep slopes. Currently, the plan has no transitions between the large material on the steep slope and smaller material on the more gradual slopes. Potentially water may undercut and erode beneath the riprap because of the sudden changes in riprap size.

The methods used for riprap D_{50} size determination were complete and accurate. However, there is some uncertainty about the methods used and the applicability to each case. The Searcy method was used primarily for the low grade, low flow diversions; however, there are some instances were the design slope is greater than the Searcy method allows. For example, SBRD-3 has a maximum slope of 53-percent and a discharge of 2-cfs. Here, the slope would dictate that a steep slope method should be use, but the flow is too small to use the OSM charts. The option of using the Searcy method resulted in a riprap design of D_{50} equal to 3-inches. Intuitively, this is too small for any flow on a slope that is this steep. Ditches SBRD-4, SBRD-5, and SBRD-10 had similar problems.

RECOMMENDATION

The proposed changes to the plan are an improvement to the existing plan and are complete with respect to the regulations; therefore, its is recommended that they be approved. However, it should be noted that there are some questionable engineering methods used.

It is felt that the extreme changes in slope should be considered in reclaiming this channel. Measures, such as sediment pools, could be incorporated into the plan to decrease sedimentation in the gradually sloped sections of the channel. Furthermore, transition zones between reaches with large riprap and reaches with small riprap would increase the stability of the channel.

The method of riprap size determination is also questionable in some cases. First, the Searcy method is not intended for steep slope designs. Second, the use of even the steep slope method of riprap design is questionable when working with extremely steep slopes like that of SBRD-3. It is advisable to avoid these slopes as much possible, by grading them into more gradual slopes, or to use grade control structures on these slopes.

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