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State of Utah
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DIVISION OF OIL, GAS AND MINING

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June 20, 1996

Ben Grimes
Sr. Staff Project Engineer
Cyprus Plateau Mining Corporation
P. O. Drawer PMC
Price, Utah 84501

Re: Completion of Division Order DO94A (Crandall Canyon Reclamation Plan), AMAX Coal Company, Castle Gate Mine, ACT/007/004-DO94A, Folder #3, Carbon County, Utah

Dear Mr. Grimes:

The Division has received the information you submitted to address the outstanding stability issue at Crandall Canyon. Your plans are considered adequate to address the last remaining issue associated with Division Order 94A. Therefore your reclamation plans for Crandall Canyon are determined to be complete and adequate and the Division Order 94A is hereby terminated. Enclosed for your information and files is a copy of the Division's Technical Analysis which details the findings made for the Crandall Canyon Reclamation Plan. Thank you for your assistance in completing this project. Please call if you have any further questions.

Sincerely,

A handwritten signature in black ink that reads "Daron R. Haddock".

Daron R. Haddock
Permit Supervisor

Enclosure

cc: P. Baker
P. Grubaugh-Littig
TERMD094.AMA



**State of Utah
Division of Oil, Gas and Mining
Utah Coal Regulatory Program**



**AMAX Coal Company
ACT/007/004
Technical Analysis and Findings for Crandall Canyon
June 19, 1996**

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INTRODUCTION

This Technical Analysis (TA) is written as part of the permit review process. It documents the Findings that the Division has made to date regarding the application for a permit and is the basis for permitting decisions with regard to the application. The TA is broken down into logical section headings which comprise the necessary components of an application. Each section is analyzed and specific findings are then provided which indicate whether or not the application is in compliance with the requirements.

It may be that not every topic or regulatory requirement is discussed in this version of the TA. Generally only those sections are analyzed that pertain to a particular permitting action. TA's may have been completed previously and the revised information has not altered the original findings. Those sections that are not discussed in this document are generally considered to be in compliance.

TECHNICAL ANALYSIS AND FINDINGS

ENVIRONMENTAL RESOURCE INFORMATION

ENVIRONMENTAL DESCRIPTION

Regulatory Reference: R645-301-411

Analysis:

Paragraph 3.7-4(8) "Cultural, Historical, and Archaeological Sites", and Exhibit 3.7-2 describes current and past studies indicating no significant sites. This is consistent with Chapter 5 of the original plan. Paragraph 3.7-5(2)(1), "Premining Land Use", along with Exhibits 3.7-1 & -2 describe the premining land usage of wildlife habitat, grazing, and recreation as the same as the postmining land use.

RECLAMATION

Regulatory Reference: R645-301-760

Analysis:

Page 3.7-21, paragraph 3.7-5(2)(2), indicates, "Although the current reclamation plan requires that all of the permanent structures be removed, with the exceptions noted above, Cyprus Plateau reserves the right to re-evaluate retaining the main access road (P-1) at the time of final reclamation (Phase II)." The plan has been approved with removal of the main access road being part of the reclamation. In order to leave the road in the future, the Applicant would have to submit an application for Permit Change to consider such action.

February 20, 1996 revisions to page 3.7-31 have removed all references to retaining the main access road.

Findings:

The requirements of R645-301-760 have been met. This includes especially regulation R645-301-762, "Roads". A road not to be retained for use under an approved postmining land use will be reclaimed immediately after it is no longer needed for coal mining and reclamation uses.

SOILS RESOURCE INFORMATION

Regulatory Reference: 30 CFR Sec. 783.21, 817.200(c); R645-301-222, -223, -233.

Analysis:

Sodium-adsorption-ratio (SAR) values were originally calculated incorrectly, as submitted by the laboratory, using milliequivalent per kilogram of soil (meq/kg). The SAR is defined as $Na^+ / (Ca^{++} + Mg^{++}) / 2)^{1/2}$, where Na^+ , Ca^{++} and Mg^{++} refer to the concentrations of the designated soluble cations expressed in milliequivalent per liter (meq/L), not meq/kg. In addition to the erroneous SAR values, the analysis methods used by the laboratory to determine pH, electrical conductivity, soluble calcium, magnesium, and sodium were not those recommended by the Division's topsoil and overburden guidelines (Table 6, "Guidelines for Topsoil and Overburden Management"). These parameters were determined using an Environmental Protection Agency (EPA) accepted laboratory method that allows for the use of soil sample extracts as soil/water ratios of 1:5. The Division's guidelines recommend using American Society of Agronomy (ASA) methods that require the use of saturated soil paste extracts. Although the saturated soil paste extract method is recommended for soil analyses to determine soil salinity characteristics and provides for more accurate results, the EPA extract method using soil/water ratios of 1:5 is an alternate, accepted method. Since the Division's guidelines are "recommended" but not required, Cyprus has elected to retain the EPA 1:5 extract analytical results. Therefore, the analyses reported in the soil evaluation plan have been used to preliminarily determine the suitability and quantity of the soils in Crandall Canyon to be used as substitute topsoil.

Prior to reclamation construction activities Cyprus will thoroughly sample the soils in the middle and upper pads, to further determine the suitability of the soils as substitute topsoil. The samples will be analyzed for the parameters outlined in the Division's "Guidelines for Topsoil and Overburden Management" using the recommended ASA methods including the saturated soil extract procedure for pH, electrical conductivity, soluble calcium, magnesium, and sodium and SAR.

Both Section 3.7-5(5) and Appendix 3.7S were corrected for proper clarification of analytical methods dealing with soil saturation extracts, EPA 1:5 extracts, and the Division's recommended soil guidelines. References to analytical methods, used to determine specific parameters, have been modified to reflect actual analytical methods used. Corrected SAR values have been added to Appendix 3.7S and replace the erroneous values in Table 2. Laboratory data sheets, that include the information for determining Acid/Base potential, have been added to Appendix 3.7S in the analytical results appendix. Fertilizer recommendations have been modified in Section 3.7 to state that fertilizer requirements will again be evaluated after the pre-reclamation sampling is complete. The verb tense used

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within the text to describe reclamation activities with the access road has been changed to the proper tense. Table 3.7-10 was mistakenly referred to in the text as Table 3.1-10; the reference was changed. The reference to Simon, Li, and Associates have been added to the list of references. The discussion about partial ripping of P-1 was a misunderstanding by the Division and not an issue. The text reference was for access road A-1 not P-1. Discussion in the reclamation plan for access road P-1 indicates that P-1 will be entirely reclaimed with the facilities area.

Findings:

This portion of the application is considered complete and accurate.

TOPSOIL AND SUBSOIL OPERATION PLAN

Regulatory Reference: 30 CFR Sec. 817.22. UCA R645-301-200; R645-301-230

Analysis:

Substitute Topsoil Suitability

The 1984 Technical Analysis discusses soils salvaging in Crandall Canyon. According to this analysis, about 53,000 to 58,000 cubic yards of material was salvaged from 28 acres resulting in an average salvage depth of 15 inches. About 8,000 cubic yards of this was stored in Crandall Canyon, and the balance was presumably taken to Gravel Canyon. The plan, however, indicates about 40,000 cubic yards of soil was taken to Gravel Canyon. This leaves a discrepancy of 5,000-10,000 cubic yards of soil. The reason for this discrepancy is unknown.

Section 3.6 of the Mining and Reclamation Plan says a total of about 97,000 cubic yards of soil is in Gravel Canyon. This would include the soil from Crandall Canyon and also some substitute material available in Gravel Canyon.

The topsoil piles in Crandall Canyon were surveyed in 1995, and they contain a total of about 7890 cubic yards of soil. Of this, only 6680 cubic yards is currently considered usable because of noxious weeds on the lower stockpile.

The Permittee intends to use nearly all of the soil in Gravel Canyon for reclamation of the Schoolhouse Canyon refuse pile. According to the plan, the soil stored in Crandall Canyon could be used in Crandall Canyon in the area between Shafts 1 and 2.

Appendix 3.7S of the plan is a letter from EarthFax Engineering to AMAX Coal Company and describes 1995 soil sampling in Crandall Canyon. Seven soil pits were excavated to evaluate topsoil and alternate topsoil conditions in Crandall Canyon. Topsoil stockpiled near the mouth of the canyon was also sampled. The samples were taken at various depth increments and analyzed according to the Division's, "Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining". The plan also gives narrative descriptions of the profiles and maps showing sampling locations.

Test pits EF-1 through EF-3 were in the lower pad area between Shaft 1 and Pnd 14. Pits EF-4 through EF-6 were in the upper pad area between Pond 15 and the propane tanks. Pit EF-7 was south of Shaft No. 1 near the fans.

The letter from EarthFax Engineering to AMAX Coal Company identifies a few problems with using pad materials for topsoil substitutes. Coal fines were abundant from 30 to 48 inches in pit EF-1, and pit EF-2 had about 2% coal in the form of coarse fragments near the surface. Sample EF-1-3 had a hot water soluble selenium concentration of 0.11 mg/kg which is slightly above the Division's standard of 0.1 mg/kg.

Soils in the lower pad area had an average rock fragment content of 57%, and soil in the middle and upper pads averaged 32% rock fragment content. The Division's guidelines indicate more than 30% rock fragments is considered unacceptable, but the EarthFax letter says the Division will sometimes permit the use of soils with excessive rockiness in the event that all other parameters meet Division requirements. This statement is correct and would apply to soil materials in the middle and upper pad areas. Rocky soils can provide increased surface protection from erosion; however, soils with too many rock fragments will inhibit root growth.

Soil textures ranged from loam to loamy sand. The highest clay content value was 16.3%, but most samples had about 10% clay.

With the exception of some low values for plant nutrients and the one sample with a slightly elevated selenium content, soil chemical analyses indicate that the parameters fell within acceptable ranges. However, the procedures used were not according to Division guidelines. Since the methods in the guidelines are recommended and not required, the results were used to preliminarily determine the suitability and quantity of substitute topsoil in Crandall Canyon. Prior to reclamation, the Permittee will thoroughly resample the soils and analyze them using approved methods. The plan includes recommendations for soil amendments to correct nutrient deficiencies.

The plan gives some discussion of the amount of vegetation in the areas of the soil test pits. The lower pad area has relatively little vegetation. It was seeded for two

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consecutive years in 1992 and 1993 using a mixture of primarily introduced grasses. These grasses are vigorous and should have produced good growth if other conditions were right. Although the soils in this pad are compacted, they were loosened through discing before being seeded.

The upper pad areas have moderate vegetative cover, but it does not appear to be as great as that in adjacent undisturbed areas or in the associated reference area. The amount of cover is approximately 30-40%, while the reference area had 53% cover when it was measured in 1981. This indicates a potential problem with using this soil either in place or as substitute topsoil for the lower pad.

R645-301-233 says selected overburden materials may be substituted for, or used as a supplement to topsoil if the Operator demonstrates to the Division that the resulting soil medium is equal to, or more suitable for, sustaining vegetation on non-prime farmland areas than the existing topsoil and results in a soil medium that is the best available in the permit area to support revegetation. The question is whether the material in the upper shaft area will provide a soil medium at least equal to what existed before mining or if the Division should require the Permittee to use the topsoil stored in Gravel Canyon for Crandall Canyon reclamation rather than using it for the Schoolhouse Canyon refuse pile.

The Permittee has committed to conduct a vegetation field study in 1996 and qualitatively assess the vegetation in selected areas of the middle and upper pads. Based on this assessment, a vegetation sampling program will be implemented to compare the vegetation in these areas with appropriate reference areas. If the results indicate vegetative cover and production on the pads are truly less than in the reference areas, field trials may be conducted to establish the proper reclamation techniques to be used in those areas where substitute soil from the middle and upper pads is to be used for final reclamation.

Before mining there was a jeep road in Crandall Canyon. This road was widened and improved for the mining operations. There is no discussion in the plan about what happened to topsoil from the road area. It is assumed no topsoil was salvaged. The plan says access road development disturbed primarily the Curecanti and Uinta formation, except for one stretch of "made land" near Highway 6.

The Soil Conservation Service's, "*Soil Survey of Carbon Area, Utah*", lists many chemical and physical characteristics of the soils in the area. Although the information is not specific to Crandall Canyon, the only factors that appear to have a potential of limiting revegetation success are the slopes and the amount of rocks in the soils. However, considering the information in the soil survey and the amount of vegetation growing on the

road outsoles, the soils to be used to revegetate the road can be considered suitable for revegetation.

Analysis:

The vegetation issue regarding the soils of the upper and lower pad has been addressed on page 3.7-49 of the revised text. A vegetation field study will be conducted in the spring or summer of 1996 to assess the factors relating to poor establishment of vegetation in the middle and upper pads. Statistical comparisons of the vegetation in the middle and upper pads with a reference area will help delineate whether any further work will be done. If the comparison results demonstrate inadequate vegetation, field trials may be conducted to establish the proper reclamation techniques needed in those areas where soil from the middle and upper pads is used as substitute topsoil.

The text on page 3.7-48 has been modified to state that the maximum allowable concentration of selenium within the topsoil is 0.10.

Topsoil Protection

The plan says topsoil is stored in designated areas in stable piles. They were seeded with a mixture shown in the plan then mulched. Chapter 8 of the existing plan says all stockpiled resoiling materials will be protected from wind and water erosion by various means, including diverting runoff from storage areas, locating the piles in naturally-protected areas, and seeding, mulching, crimping, and using jute matting in extreme cases. A chain link fence will be installed at Gravel Canyon if unauthorized borrow becomes a problem.

Table 7-8 includes the two Crandall Canyon topsoil piles and the stockpile in Gravel Canyon among the areas where drainage would not report to a sediment pond. The sediment control for these areas is listed as "vegetation". Division personnel have not seen problems with topsoil loss at any of these piles.

The lower topsoil pile in Crandall Canyon has an infestation of whitetop, a noxious weed, and there is also a lot of field bindweed in the area near it. The Permittee has been trying since 1992 to control the whitetop, but has not yet been successful. Until the whitetop is controlled this topsoil should not be used. The Permittee must continue its efforts to control this weed and should also try to control the nearby bindweed since it is a potential problem.

Findings:

This portion of the plan is considered complete and accurate.

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TOPSOIL AND SUBSOIL RECLAMATION PLAN

Regulatory Reference: 30 CFR Sec. 817.22. UCA R645-301-240

Analysis:

The Permittee anticipates that only the facilities area will require application of additional topsoil during reclamation. It would require 14,520 cubic yards of topsoil to cover the area six inches deep, but only 6680 cubic yards is considered usable for reclamation. An additional 1210 cubic yards would become available if whitetop was controlled on the lowermost stockpile. The deficit could be made up if soils in the middle and upper pads were shown to be suitable and were used in the lower pad area. Part of the deficit might also be made up if suitable soils were found in the lower pad area.

The Permittee proposes to grade the lower pad area then take at least three samples based on vegetative cover and apparent coarseness of the soils. These would be analyzed for various parameters as shown in the plan. Soils found to be unacceptable for use as substitute topsoil would be used as backfill against cutslopes. If none of the soils in the lower pad area are considered acceptable, the Permittee would cover the area with soil from Stockpile No.2. It appears that the area could be covered about 12 inches deep.

Soils present west of Shaft No. 1 and east of the LP tanks (middle and upper pads) appear to sustain moderate vegetation growth and the results of the soil study indicate they could be considered as substitute topsoil. The plan contains a commitment to sample soils in the middle and upper pads on 100-foot centers and to analyze these samples according to a group of parameters listed in the plan. It says suitable topsoil identified in the upper and lower pad areas will be used to supplement the existing 6680 cubic yards of soil.

During reclamation construction, soil samples would be taken at a rate of one for every two and one-half acres and analyzed for pH, electrical conductivity, texture, total nitrogen, available phosphorous, and potassium. Soil amendments would be added based on the results of these analyses. This sampling would include soils placed on the access road.

Soil tests performed in 1995, together with brief descriptions of the vegetation, already give a good idea of what conditions will be encountered in grading and for reclamation. As discussed under "Topsoil and Subsoil Operation Plan", soils in the upper pad area are probably suitable for reclamation. However, since vegetation does not appear to be as great as would be needed for reclamation, the plan needs to contain a demonstration that the soils are adequate to achieve revegetation success.

The lower pad area may contain some areas with suitable substitute soil material, but it appears a large part of the area has too many rock fragments. The proposed testing regime should serve to identify those areas with less reclamation potential where topsoil or substitute topsoil should be applied. The substitute topsoil from the upper pad area should only be used to cover the lower pad if field trials or other data indicate this substitute soil can be successfully revegetated. Areas of soil with suitable characteristics in the lower pad should be similar to the soils in the upper pad area. This would be shown in testing at the time of reclamation.

Section 3.7-5(4)(6) discusses alternative sediment control measures that include seedbed preparation. Possible measures to be used include surface ripping, contour furrowing, mulching, and surface roughening with mulch incorporation. Soil preparation will include loosening the soils to 18-24 inches.

Mulch will be applied at the rate of two tons per acre prior to roughening the surface. The area will be roughened by gouging the soil to a depth of 12 to 18 inches using the bucket of a track-mounted backhoe. Chapter 9 says wildlife habitat will be created by development of microtopographic features, such as swales and rises. Following seeding and fertilization the site will be mulched again at a rate of two tons per acre.

Analysis:

This portion of the plan is complete and accurate.

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VEGETATION INFORMATION

Regulatory Reference: R645-301-321

Analysis:

Baseline vegetation information is in Chapter 9, Appendix 9-1, of the existing Mining and Reclamation Plan. Vegetation types in the Crandall Canyon disturbed area were mixed brush, conifer, grass-sage, riparian bottom, and previously disturbed. Three reference areas were established in Crandall Canyon. They are conifer, pinyon-juniper, and riparian bottom. The pinyon-juniper reference area would only be used for judging revegetation success in an area of Barn Canyon formerly proposed for disturbance. Additional reference areas that would be used for judging revegetation success in Crandall Canyon are the Castle Gate mixed brush and the Barn Canyon grass-sage reference areas.

The Crandall riparian reference area had vegetation cover of 47%. Dominant species included narrowleaf cottonwood, bluegrass, an aster, and some weedy plants. Some of the other woody plants were bigtooth maple, Gambel oak, snowberry, juniper, Douglas fir, and ponderosa pine. Thirty-six species were found in this reference area.

Vegetative cover in the Crandall conifer reference area was 74%, mostly from Douglas fir and ponderosa pine. Other frequently-occurring plants included snowberry and perennial grasses. Twenty-three species were encountered in this reference area.

The Crandall pinyon-juniper reference area had 53% total vegetative cover comprised primarily of intermediate wheatgrass, western wheatgrass, pinyon, juniper, and curlleaf mountain mahogany.

The two other reference areas proposed as standards for revegetation success are outside Crandall Canyon. The Castle Gate mixed brush and Barn Canyon grass-sage reference areas had 41 and 53% vegetative cover, respectively. Dominant species are typical for these vegetation communities, including *Agropyron* sp. (probably salina wild rye rather than a wheatgrass), sagebrush, Utah serviceberry, and fourwing saltbush.

Appendix 9-1 also includes raw data sheets which give complete lists of all species encountered in sampling. With this information it is possible to determine the extent of cover of each species.

The Division normally requires sampling of areas proposed for disturbance before they are disturbed. This information was apparently not gathered, and it would be

impossible to obtain it now. Although this is considered a deficiency in the plan, it cannot be corrected.

Revegetation feasibility is discussed under "Revegetation".

Findings:

This section of the Mining and Reclamation Plan is complete and accurate except that it does not contain baseline vegetation information for disturbed areas. However, since this information was apparently not gathered and since the area has already been disturbed, it is impossible to obtain it.

REVEGETATION

Regulatory Reference: R645-301-340

Analysis:

Revegetation Methods

Revegetation plans are contained in both Chapter 9 and the proposed amendment.

Section 3.7-5(4)(6) discusses alternative sediment control measures that include seedbed preparation. Possible measures to be used include surface ripping, contour furrowing, mulching, and surface roughening with mulch incorporation.

Mulch will be applied at the rate of two tons per acre prior to roughening the surface. The area will be roughened by gouging the soil to a depth of 12 to 18 inches using the bucket of a track-mounted backhoe. Chapter 9 says wildlife habitat will be created by development of microtopographic features, such as swales and rises. Following seeding and fertilization, the site will be mulched again at a rate of two tons per acre.

The methods proposed are considered the best available seedbed preparation techniques for revegetation in this area of Utah. Gouging provides microtopographic features that trap water and increase seedling germination and establishment.

Seeding will commence immediately after seedbed preparation to minimize the potential for erosion. Chapter 9 says planting will typically occur after October 15 and before the ground freezes. When necessary, spring planting may occur between March 15

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and May 15. Drainages will be planted in April when possible. Unusually favorable weather conditions or compliance requirements may necessitate planting at other times.

The planting times discussed in Chapter 9 are standard for Utah. Spring seeding is not recommended but is sometimes necessary. Where it is necessary, it should be done as early as possible; May is usually too late (except in 1995).

Species list two, as shown in Chapter 9, will be used to seed most areas, including cut slopes along the roads. Species list five will be used to seed areas within 20 feet of the edge of reclamation channels CCRD-23A, CCRD-23B, and CCRD-23C. The seed mixes will be mechanically or hand broadcast according to the accessibility of the area. The area will then be mulched and fertilized. Chapter 9 says native hay or straw mulch will be used except in areas that are hydroseeded where a wood fiber hydromulch will be applied at the rate of one ton per acre. The Applicant does not propose to hydroseed Crandall Canyon.

North-facing slopes will be seeded with species list three, but willows and cottonwoods will be replaced by ponderosa pine, juniper, and Douglas fir planted at the rate of three hundred per acre. Planting locations will be determined by the Division and the Applicant.

Species list three was intended for a riparian area, but, with a few exceptions, it is appropriate for the north-facing slopes in Crandall Canyon. The exceptions are dogwood and the two species the Applicant plans to exclude, cottonwoods and willows.

The planting rate for ponderosa pine, Douglas fir, and juniper will not produce a closed stand. Rather, there should be more open areas conducive to wildlife use.

Species lists two, three, and five meet regulatory requirements and include those species expected to be necessary to reestablish vegetative cover in Crandall Canyon. Cottonwoods and willows are listed as optional in species list five. The riparian area in Crandall Canyon has cottonwoods and willows, so they should be planted.

Chapter 9 discusses irrigation and pest and disease control. No irrigation is planned, but transplants will be watered on a case-by-case basis to minimize drought kill. No pest or disease control measures are anticipated to be necessary, but a plan will be developed in coordination with Carbon County Weed and Pest if needed. This plan would also be approved by the Division.

Revegetation Success Standards

Four reference areas will be used to determine revegetation success. Two of these, the Crandall riparian bottom and Crandall conifer, are in Crandall Canyon. The other two, the mixed brush and grass-sage, are outside Crandall Canyon. Section 3.7 does not specify which grass-sage and mixed brush reference areas would be used, but Table 3.3 in Appendix 9-1 indicates the Permittee intends to use the Barn Canyon grass-sage and Castle Gate mixed brush reference areas. Appendix 3.7T is a map showing which reference areas would be compared to which revegetated areas. Judging from the data in Appendix 9-1, these reference areas are appropriate for comparing to reclaimed areas. Since the riparian species mix will be used within 20 feet of the edge of the channel, the Crandall riparian bottom reference area will be used for comparison in this same area.

With the exception of erosion control, Chapter 9 includes methods for judging the diversity, seasonality, and other characteristics of reestablished vegetation as required by R645-301-353 and R645-301-356. Absolute cover will be used to compute the Motyka Index. This index will then be used to compare reclaimed and undisturbed areas. Cover, production, and stocking, as applicable, will need to meet the requirements of R645-301-356.100 and R645-301-356.200.

In the proposed Section 3.7, the Applicant proposes to judge erosion control success by comparing runoff from reclaimed areas with runoff from an undisturbed adjacent area. Erosion will be controlled such that sediment contributions from the reclaimed area will be equal to, or less than, the contributions from the undisturbed area. Should the reclaimed area show signs of excessive erosion, steps will be taken to remedy the situation through contour furrowing, ripping, surface roughening, or other techniques. The standard is acceptable, but it will require the Operator to obtain upstream and downstream water quality samples. Any rills or gullies that either disrupt the postmining land use or vegetation reestablishment will need to be repaired.

According to Section 3.7 of the current Mining and Reclamation Plan, the postmining land use for the Crandall Canyon area is undeveloped land. This is different from a wildlife or rangeland grazing postmining land use mainly in the degree of management it receives. Because the postmining land use is not wildlife, no specific woody plant density standard for success is being established. However, the Permittee will still need to meet diversity requirements which will necessarily include establishment of trees and shrubs.

Field Trials

The middle and upper pads appear to have soil that will be adequate for final reclamation; however, they do not appear to sustain as much vegetation as expected. Several

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reasons may account for this, including compacted or rocky soils, wildlife use, or adverse climatic conditions. The Permittee intends to use these soils as substitute vegetative growth medium during reclamation. The Division has concerns about whether cover and productivity for the vegetation existing in this area are similar enough to reference area values and if vegetation that is at least equal in extent of cover to the natural vegetation of the area be reestablished using the substitute soils.

The Permittee has committed to conduct a vegetation field study in 1996 and qualitatively assess the vegetation in selected areas of the middle and upper pads. Based on this assessment, a vegetation sampling program will be implemented to compare the vegetation in these areas with appropriate reference areas. If the results indicate vegetative cover and production on the pads are truly less than in the reference areas, field trials may be conducted to establish the proper reclamation techniques to be used in those areas where substitute soil from the middle and upper pads is to be used for final reclamation.

Fish and Wildlife Habitat

Chapter 9 says microtopographic features, such as swales and rises, will be created during regrading. Where rocks become available, the Permittee will construct rock piles. Snags and roosts will be constructed whenever materials become available. Wetland areas will be created where topography and hydrology lend themselves to their creation.

The Permittee had proposed to leave a depression in the area of Pond 14 to catch water from a seep that is suspected to be in the area. However, because of perceived regulatory requirements, the Permittee decided not to pursue this option.

A warm season water source in Crandall Canyon would be very desirable for wildlife habitat enhancement. Current Division personnel have never seen Pond 14 without water, and the vegetation near this pond is indicative of a continual water source. Chapter 9 of the approved plan has provision for creating small depressions where conditions warrant.

OSM directive TSR 14, "Construction of Wetlands as a Postmining Land Use", discusses the criteria for creating small depressions. It says:

" . . . wetlands may be created and retained on reclaimed lands without regard to the permanent impoundment requirements. The depressions must be 'small.' The surface area or depth of water which would qualify as 'small' are not defined in the Federal rules. Depressions may be of any size compatible with the postmining land use and must not pose a safety risk associated with potential failure of an impoundment."

“Small depressions must be a dugout or basin as opposed to an embankment-type construction.”

The wording in this directive indicates the normal requirements for permanent impoundments do not apply to small depressions as long as they are constructed according to certain criteria. Thus, the Division would be able to allow construction of a small depression meeting the criteria of the directive without requiring a great deal of design and post-construction inspection work.

Since the plan already contains provisions for making small depressions, the plan for Crandall Canyon can be approved. However, the Permittee is encouraged to reinstate the specific plan to put a small depression in Crandall Canyon.

In Sections 3.7-5(3)(1) and 3.7-5(3)(5), the application says power poles being used for raptor habitat will not be removed in final reclamation. The Applicant will need to determine whether the power poles are being used by raptors, and they may also need to modify them. Use would be evidenced by whitewash on the poles or regurgitated bones or portions of animal carcasses at the base. Any poles not being used are probably not needed for raptor habitat and should be removed. The Division of Wildlife Resources should be able to provide additional information about what modifications may be needed and which poles are in good locations.

Findings:

This portion of the application and Chapter 9 of the current plan are complete and accurate. The Permittee is encouraged to reinstate the plans to put a small depression in the area near Pond 14 for wildlife habitat. OSM directive TSR14 would allow the Permittee to build a depression with minimal design and construction requirements.

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HYDROLOGIC RESOURCE INFORMATION**ENVIRONMENTAL DESCRIPTION FOR HYDROLOGY**

Regulatory Reference: R645-301-720.

Analysis:

Generally the cross-sections and maps describe the required parameters. However, there are some confusing discrepancies. Page 3.7-15 indicates, "The *ground* water monitoring station for Crandall Canyon, designated as B-22 (was B-43), was monitored quarterly and was included in the monitoring plan submitted to all regulatory authorities during 1978. Surface water monitoring has occurred within the same time frames. The Crandall stations are B-25 and B-26 (see Exhibit 7-3)." On Exhibit 7-3, B-22 is designated as "B-22 *SPRING* MONITORING STATION".

Page 7-8, under "Regional Aquifer System", indicates "The low permeability of the Blackhawk Formation has been verified by testing three *wells* within the mine plan area (MC-205, MC-206, and MC-207, see Exhibit 7-2 for location)". Exhibit 7-2 shows MC-207 also designated as B-43.

Adding to the confusion is a discrepancy in locations of sites B-22 and B-43. Exhibit 7-2 shows MC-207 (B-43) near the center of the SE quarter of Section 28, which is in the disturbed area. Figure 7-3 shows B-22 near the North quarter corner of Section 27, which is near the mouth of Crandall Canyon. The two locations are separated by about one mile.

Field inspection on 12/04/95 showed a sign reading "Water Monitoring Point B-22" is physically located near the mouth of Crandall Canyon and designates a spring in the bottom of Crandall Creek.

February 20, 1996 revisions to page 3.7-15 make it sufficiently clear as to the location and correct reference for Spring Monitoring Station B-22.

Findings:

The requirements of R645-301-722.300, to provide the, "Elevations and locations of monitoring stations used to gather baseline data on water quality and quantity...", have been met.

BASELINE INFORMATION

Regulatory Reference: R645-301-724

Analysis:

Section 7.1, Groundwater Hydrology, describes existing wells and springs, and provides a detailed description of the geology and groundwater aquifers. The discussion provides a description of the regional aquifer, mine area aquifer, and alluvial aquifers. The groundwater quality and effects of mine operation on groundwater are also presented. Tables 7-1 through 7-3 detail the regional aquifer conductivity, seepage rates into the mine, and groundwater recharge. Section 7.2, Surface Water Hydrology, describes surface water regime including flows, runoff calculations, sedimentation pond design, diversion ditch design, and culvert design.

Tables 7-4 through 7-10 detail the watersheds, design rainfall events, exhibits for sediment calculations, and rip-rap designs for the mine area.

Findings:

The above-described information has been previously reviewed as part of past Technical Analysis and appears to be adequate to meet regulatory requirements for this review of Crandall Canyon reclamation.

RECLAMATION PLAN

Discharges Into an Underground Mine

Regulatory Reference: R645-301-731.510

There are no discharges into an underground mine in Crandall Canyon.

Gravity Discharges from Underground Mines

Regulatory Reference: R645-301-731.520

Page 7-19 of the original plan submittal and page 3.7-37 of the reclamation submittal both explain the prospect of water flow in the shafts due to intersecting aquifers. The amount is expected to be about 13 gpm with an upper figure of 50 gpm. This water will

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enter the mine and eventually reach an equilibrium, with possible outflow from the mine. This would be similar to the Aberdeen and Adit No. 1 Mines and appears to be typical.

Water Quality Standards and Effluent Limitations

Regulatory Reference: R645-301-751

Page 3.7-52 describes continuous monitoring of the spring at B-22 and lists the 16 parameters which will be monitored for compliance to R645-300-145 and R645-301-731. Further, three surface water monitoring points, one above the disturbed area site and two below it, are also described. Four additional parameters will be monitored at these sites. In all cases DOGM would be notified and corrective action taken in the event analysis showed non-compliance with permit conditions. This is appropriate, except that the requirement is for compliance with U.S. Environmental Protection Agency standards as set forth in 40 CFR Part 434. As long as permit conditions meet that standard, this is acceptable.

Diversions, General

Regulatory Reference: R645-301-732.300 & -742-300

Page 3.7-34 and Exhibits 3.7-7A, B, C, & D describe reclaiming the canyon to its approximate original contour and to reflect the general shape and condition of the original canyon. Included is reclamation of all diversion ditches used during operations. An enhancement is the pond left at the site of sediment Pond 014 which will benefit wildlife with a water source.

Diversions of Perennial and Intermittent Streams

Regulatory Reference: R645-301-742.320

Diversions of Miscellaneous Flows

Regulatory Reference: R645-301-742.330

Page 3.7-39 details the design of reclamation channels and associated riprap. The appropriate 100-yr, 6-hr precipitation event was used for permanent diversions on the permanent and intermittent Streams and the 10-yr, 6-hr event was used for permanent diversions on the ephemeral Streams. Page 3.7-41 describes "Reclamation Culvert Design". These are appropriate designs for the site.

Stream Buffer Zones

Regulatory Reference: R645-301-731.600

From Exhibit 3.7-7A, B, and C and "Backfilling and Grading", described on page 3.7-32, it is evident that reclamation activities will definitely take place within 100 feet of Crandall Creek. This is inevitable due to the narrow canyon and the disturbed area configuration. However, it is still necessary that the Division authorize such activities only upon finding as described in R645-301-731.600. The Permittee needs to provide the necessary information to render such a finding. The required stream buffer zones could not be found in the narrative, on the drawings, or in the field.

A February 20, 1996 letter to DOGM correctly indicates that Stream Buffer Zone issues were resolved in a January 24, 1996 meeting between AMAX Coal Co, and DOGM. They had been previously addressed in the original Technical Analysis, however, they were inadvertently raised again. Further, the Permittee has committed to erect Buffer Zone signs in Crandall Canyon as soon as the ground is no longer frozen.

Findings:

The requirements of R645-301-731.600 have been met. Especially paragraph 620 which stipulates that, "the area not to be disturbed will be designated as a buffer zone, and the Operator will mark it as specified in R645-301-521.260".

Sediment Control Measures

Regulatory Reference: R645-301-732 & -742

Siltation Structures

Regulatory Reference: R645-301-732.100 & -742.200

Appendix 3.7J shows the design and inspection of the siltation ponds by a Registered Professional Engineer. Page 3.7-32 describes working from the upper end of the canyon down to the mouth during reclamation. This is appropriate for the site. The upper sedimentation pond, Pond 015, will be removed during reclamation as described on page 3.7-43. It is apparent from the narrowness of the canyon and location of the pond that it would be impractical to retain it until two years after the last augmented seeding as required in R645-301-763.100. The alternate sediment control measures described on page 3.7-43 are appropriate to use on the reclaimed pond site. They are close to the Roughen, Mulch, &

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Vegetate method recommended by the Division. Therefore, the removal of the pond with reclamation is deemed appropriate.

During reclamation sedimentation Pond 014, the lower pond, is to be modified as shown on Exhibit 3.7-7B and left as a permanent impoundment. Because this provides a water source for wildlife, this is considered to be a beneficial enhancement. As such, the sediment pond is approved by the Division for retention as a permanent impoundment as provided for in R645-301-763.200.

Other Treatment Facilities

Regulatory Reference: R645-300-742.230

There are no other treatment facilities in Crandall Canyon.

Exemptions

Regulatory Reference: R645-301-742.240

No exemptions are requested.

Discharge Structures

Regulatory Ref: R645-301-744

Both sediment ponds have provision for preventing stream erosion. Pond 015, primary spillway, empties through a culvert into Crandall Creek, with the outlet being next to the Hilfiker wall a few feet upstream of CCC-7. The emergency spillway is rip-rap lined and empties into Crandall Creek. (See Exhibit 3.7-9B) Pond 014 has an 18" culvert for a primary spillway and it empties through the Hilfiker into the creek. The emergency spillway is a 24" culvert that feeds a 36" culvert which, in turn, empties into the creek. (See Exhibit 3.7-9A)

Page 3.7-12 and 13 along with Appendix 3.7H describes the design of the three diversion culverts carrying the main flow in Crandall Creek. The 100-yr, 24-hr storm event was used which is appropriate for temporary and permanent diversions. Rip-rap is appropriately designed also. It has been observed in the field that erosion is not a problem with these culverts after several years of operation.

Page 3.7-17 and 18 along with Appendices 3.7-E & F describe the design of the culverts and diversion ditches throughout the remainder of the project. The 10-yr, 24-hr

storm event was used which is appropriate for temporary and permanent diversions. Rip-rap is appropriately designed also. It has been observed that erosion is not a problem with these culverts after several years of operation.

Impoundments

Regulatory Reference: R645-301-733 & 743

See comments above under "Discharge Structures".

Reclamation

Regulatory Reference: R645-301-760

Diversion

Regulatory Reference: R645-301-742.313

Page 3.7-30, under Phase I, indicates, "Reclamation activities will include removal of all.....culverts... .", and under Phase II, indicates, "This will include the removal of all culverts". Similarly, on page 3.7-12, under "Backfilling and Grading" it states, "All culverts and associated inlets works will be removed." These are consistent with the comments from DOGM in the first Technical Analysis (TA).

However, on page 3.7-39 it indicates, "Culverts used during mine operation to route undisturbed area runoff under the facilities pad area will be sealed and abandoned, or removed." Similarly, on page 3.7-41, under Reclamation Culvert Design, it indicates that, "The existing culverts will be removed where possible or sealed and abandoned in-place during reclamation activities." These last two statements conflict with the previous two statements and with the previous TA.

Exhibit 3.7-7C shows the former CCC-24 as remaining in place and carrying full stream flow after reclamation. It is not clear why these are included as the plan was approved with the road being gone and all culverts removed.

February 20, 1996 revisions to pages 3.7-39 and -42 explicitly remove all culverts during reclamation.

TECHNICAL ANALYSIS AND FINDINGS

Findings:

The plan is now in conformance with the requirements of R645-301-760. Specifically, "761. General Requirements.... the Operator will ensure that all temporary structures are removed and reclaimed...". Further, the requirements of -742.313 are met where it is required that "Temporary diversions will be removed when no longer needed to achieve the purpose for which they were authorized."

Operation Plan, General Requirements

Regulatory Reference: R645-301-731

Alternative Water Source Information

Regulatory Reference: R645-301-727

Water Rights and Replacement

Regulatory Reference: R645-301-731.800

Page 3.7-37 indicates, "Finally, AMAX Coal Company has 1.7 cfs (763 gpm) of water right on the Price River to mitigate the minor reduction in yield of the drainage basin". This is also mentioned on page 7-24 of the original plan submission.

Findings:

R645-301-731.800: The Permittee has committed to provide 1.7 cfs from their water right should it be determined that mining impacts water flows.

ENGINEERING

BACKFILLING AND GRADING

Analysis:

As part of Phase I reclamation activities, all surface structures will be removed. Additionally, all sections of the Hilfiker retaining wall, not covered by a minimum of 4 feet of soil, will be removed from approximately station 1+00 to station 10+00. Also, the retaining wall down gradient of Pond 15, at approximate station 19+00 will be removed as

needed. Access road (A-1) will be reclaimed as well as a portion of the main access road (P-1).

As part of the Phase II reclamation activities, the remainder of the main access road (P-1) from Highway 6 & 50 to the Phase I/Phase II reclamation boundary will be reclaimed. If the road is surfaced with asphalt, the asphalt will be removed, placed against the cutslopes as fill material, and covered with a minimum of 4 feet of soil. During backfilling of the road, the best available soils within the outslope or base of the road will be used as final topsoil cover.

There are no highwalls in Crandall Canyon, since the only access to the underground workings is through the shafts. There are no spoil piles, refuse piles, or small depressions that will be retained in the reclamation plan.

Cut slopes will be completely backfilled and graded when technically possible. There are four cut slope segments that can only be partially backfilled. Completely backfilling the cut slopes would result in either covering up the stream channels or creating unsteep slopes. If the four cut slope segments are completely backfilled they would either cover the stream channels or be steeper than 2 to 1.

Topsoil placed on slopes steeper than 2 horizontal to 1 verticle will erode before vegetation can be established. When possible slopes no steeper than 3 to 1 should be left to insure reclamation success.

The unreclaimed cut slopes are in bedrock and will have a safety factor of at least 1.3. The existing cut slopes show no signs of instability with the exception of usual surface weathering. Should slope failure occur is will most likely be from surface sluffing rather than catastrophic deep set rotational failure.

Cut material necessary to cover the facilities area will come from two on-site sources. Initially, topsoil was removed from the disturbed area and stored in stockpiles No. 1 and 2. However, Stockpile No. 1 has apparently been invaded by noxious weeds and is suspect as a topsoil source. Therefore, topsoil will be taken from Stockpile No. 2, located along access road P-1, and from soils located within the facilities area.

Findings:

The Operator has met the minimum regulatory requirements.

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APPROXIMATE ORIGINAL CONTOUR RESTORATION

Analysis:

To achieve AOC, the current reclamation plan specifies returning the channel to near the center of the canyon floor and the construction of concave fill slopes extending from the undisturbed boundary to the reclaimed channel. This was done to allow the fill slopes to be less than the angle of repose for the granular backfill, and flatter than a 2:1 slope. In the area of Shaft No. 1 a topographically high area will be constructed in such a manner as to blend in with existing topographic features.

A topographically low area will be left in the area of Pond 14. This low area is intended to capture some of the flow from a nearby seep. Construction in this low area is intended to benefit wildlife after reclamation is complete.

The reclamation plan meets the engineering requirements for approximate original contour requirements of R645-301-553.600. The issue of stream placement from a hydraulic standpoint has not been addressed in this section. If the placement of the stream channel fails to meet the hydrological requirements then the reclamation plans are defective and must be modified.

Findings:

The Operator has met all the engineering requirements for meeting the AOC regulations.

MINE OPENINGS

Analysis:

The shaft sealing plan consisted of placing 6 inch thick concrete slabs over the top of the openings to shafts No. 1 and 2. A 2 inch PVC vent pipe was installed through the seal of both shafts. The seals were intended to be temporary in the event that mining operations resumed. However, the seals appear to be in compliance with MSHA guidelines 30 CFR 75.1711-1.

The Division approves the concept of using a concrete slab to seal the shafts. There are concerns about the long term stability of the slabs. Although the steel used in the slabs will be corrosion protected there is a possibility that over time the protection will fail.

The shaft cap design in the MRP meets the current MSHA requirements and is similar to shaft closure devices used by other states. The life of the shaft cap is expected to be 30 years. Replacing the shaft seal every 30 years may be part of the on-going maintenance at the site.

If the shafts were to be sealed at this time the Division would accept the proposed shaft closure method. Prior to sealing the shafts the Division will reevaluate shaft sealing technology. If better shaft sealing techniques exist, then the Division will require the Operator use the newer methods.

Findings:

The Division approves the shaft sealing method, but reserves the right to reevaluate the shaft sealing techniques during the reclamation period. If superior shaft sealing technology has been developed then the Division will require the Operator to implement the improved methods.

RECLAIMED SLOPE STABILITY

Analysis:

The angle of repose of loose sand generally varies between 30 and 35 degrees. According to Tomlinson, the angle of repose for loose, dry sand can vary from 28.5 degrees for round uniform sand grains to 34 degrees for angular well graded sand grains. Increasing the density of the sand can increase the angle of repose to 33 to 46 degrees, respectively.

Though slopes up to 36 degrees would have a critical safety factor of 1.4 under static conditions, some sloughing of surface soils may occur, especially as the soils dry if the soils are placed in a loose condition. As stated in Section 3.7-5(3)(1), since soil may be erosionally unstable at inclinations greater than 2:1, reclamation slopes will be generally constructed at, or less, than 2:1. This reduction in slope will further increase the long-term static safety factor above the value of 1.4 calculated for a 1.4:1 slope (Appendix 3.7R).

The Operator has demonstrated that the slopes will have a safety of at least 1.3. The Operator has met the minimum requirements of R645-301-553.130.

Findings:

The Operator has met the minimum requirements of R645-301-553.130.

TECHNICAL ANALYSIS AND FINDINGS

ELECTRICAL POWER LINES**Analysis:**

During Phase I of reclamation, all electrical equipment will be dismantled and salvaged to the extent possible. All secondary power poles and distribution lines will be removed. The primary power distribution wires and poles will be removed. However, any poles that are being used as raptor habitat at the time of reclamation will be left in place.

Findings:

The Operator has met the minimum regulatory requirements.

LEACH FIELD PIPING AND OTHER UNDERGROUND UTILITIES**Analysis:**

The Operator proposes to leave the underground utility piping that does not interfere with reclamation grading. Ends, of the pipes to be abandoned, will be capped in place.

Findings:

The Operator has met the minimum regulatory requirements.

ROAD SYSTEMS**Analysis:**

The leach field access road (A-1), from the LP tanks to and through the leach field, has been partially reclaimed. During final reclamation activities, a low ground pressure tracked excavator will be used to remove the culverts from this section of the road. In areas where topsoil is currently stored adjacent to the road in berms, the berms will be knocked down and the topsoil spread across the road. Where soil compaction and rutting is evident in the road, the compacted and rutted soils will be loosed with the teeth of the backhoe bucket and the exposed soils roughened and revegetated following the procedures specified in Section 3.7-5(4)(6) and 3.7-5(6).

As part of the Phase II reclamation activities, the remainder of the main access road (P-1) from Highway 6 & 50 to the Phase I/Phase II reclamation boundary will be reclaimed. If the road is surfaced with asphalt, the asphalt will be removed, placed against the cutslopes as fill material, and covered with a minimum of 4 feet of soil. Material used for reclamation of the road will be obtained from the current outslopes of the road. This will require the disturbance of vegetation that currently covers much of the outslopes. During backfilling of the road, the best available soils with the outslope or base of the road will be used as final topsoil cover. The surface of the soils placed in the road and the disturbed portions of the outslopes will be reclaimed following the procedures detailed in Section 3.7-5(4)(6).

Findings:

The Operator has met the minimum regulatory requirements.

BONDING AND INSURANCE REQUIREMENTS

Analysis:

The Division has reviewed the bond and determined it adequate at this time. The Crandall Canyon area will be covered under two separate bonds, the Castle Gate and Willow Creek. Because of the double bonding the Division feels that the deficiencies in the bond are insignificant. If the Permittee wants to remove Crandall Canyon from one of the permitted areas then the bond calculations will have to be modified. The modification includes determining earthwork costs by using productivity calculation based on the Caterpillar Handbook and cost from the Bluebook cost.

Findings:

The Permittee has adequate bond for this area because it is bonded under both the Castle Gate and Willow Creek permit.