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

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January 10, 1996

John Pappas  
Sr. Environmental Engineer  
AMAX Coal Company  
P. O. Box PMC  
Price, Utah 84501

Re: Analysis and Approval of Crandall Canyon Reclamation Plan, AMAX Coal Company, Castle Gate Mine, ACT/007/004-95D, Folder #2, Carbon County, Utah

Dear Mr. Pappas:

The Division has completed a review and analysis of your latest revised plans (September 1995) for the reclamation of the Crandall Canyon Area. While your plans are not 100% complete, they are acceptable and adequate for incorporating into the Castle Gate Mine Plan and are hereby approved. At this time you will need to submit eight copies of the complete and finalized Crandall Canyon Reclamation plan in order for us to update our files and for distribution.

There are some deficiencies in your plans, and while they aren't of the magnitude that prevents us from approving your plans, they do need to be corrected. Enclosed is the Division's Analysis which discusses the items needing further attention. Please review it and respond to the deficiencies (summarized at the beginning of the document).

Because of some of the outstanding deficiencies, Division Order DO94A is still in effect. You will also note that a reclamation cost estimate for Crandall Canyon is needed at this time. Please provide the response to the outstanding deficiencies by February 9, 1996.

If you have any questions regarding this action or the requirements, please don't hesitate to call.

Sincerely,

A handwritten signature in cursive script that reads "Daron R. Haddock".

Daron R. Haddock  
Permit Supervisor

mt  
Enclosure  
cc: P. Grubaugh-Littig  
M. Sufflita  
P. Baker

H:cranappr.ama

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



**AMAX Coal Company  
ACT/007/004  
Draft Analysis and Findings for Crandall Canyon  
January 9, 1996**

## INTRODUCTION

This Draft 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.

Often the first technical review of an application finds that the application contains some deficiencies. The deficiencies are discussed in the body of the TA and are identified by a regulatory reference which describes the minimum requirements. In this Draft Technical Analysis we have summarized the deficiencies at the beginning of the document to aid you in responding to them. Once all of the deficiencies have been adequately addressed, the TA will be made final.

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.

## SUMMARY OF OUTSTANDING DEFICIENCIES

### R645-301-200

1. Errors in Appendix 3.7S must be corrected (described above). Information should be provided so that Acid/Base potentials can be calculated by the Division. Section 3.7 should include a Table of Volumes utilizing the information gained by the sampling reported in Appendix 3.7S. The Reclamation Plan should outline the soils which will be substitute topsoil and reflect the special handling of these soils. Ambiguities in section 3.7-4 and 3.7-5 (described above) should be clarified. Reclamation should include ripping of the entire road surface if the road is removed
2. The applicant needs to demonstrate that the proposed substitute topsoil materials are equal to or more suitable for sustaining vegetation than the premining topsoil and result in a soil medium that is the best available in the permit area to support revegetation. Although the recent soil sampling/testing has generally shown the chemical and physical characteristics are acceptable for revegetation, the amount of vegetation growing on these soils does not appear to be as great as would be expected for the area. Suggested methods are to show the existing vegetation meets revegetation standards or to establish field trials and try final revegetation techniques.
3. On page 3.7-47, the application implies that the cutoff for unacceptable levels of selenium is 0.11 mg/kg. This apparent typographical error should be corrected.
4. As required in the Division Order, the applicant needs to show adequate soil/spoil preparation plans including methods to reduce compaction to at least a depth of 18-24 inches prior to the application of borrow soils or hydroseeding.

### R645-301-340

1. Planting rates for ponderosa pine, Douglas fir, and juniper should be specified in the application.
2. The applicant needs to present information showing the proposed substitute soil material can be revegetated. The applicant could establish field trials or could obtain data showing that current vegetation cover in the upper pad areas approximates the cover in appropriate reference areas.

3. Section 3.5-5(1)(1) says no small depressions will be retained, but the applicant proposes in other parts of the application to retain a small depression in the area of pond 14. This apparent contradiction should be resolved.

**R645-301-500**

1. The Operator has not addressed how all the cutslopes will be reclaimed. There is no provision in the regulations to leave cutslopes because of lack of backfill material.
2. The Operator must state that all backfilled slopes will have a minimum safety factor of at least 1.3.
3. The Operator has not demonstrated that the reclaimed slopes will meet the minimum safety factor requirements.

**R645-301-720**

1. The Permittee must revise the exhibits and text to provide consistent labeling of the sampling points for B-22 and B-43.

**R645-301-760**

1. The Permittee must remove all provisions alluding to making a decision regarding road retention at the time of final reclamation. The plan calls for removal of the road. Submittal of a Permit Change is necessary to retain the road and such a request will be entertained if and when submitted.

**R645-301-731.600**

1. The Permittee must provide to the Division the referenced information sufficient to make a finding regarding Stream Buffer Zones of less than 100 ft.

**R645-301-542.620**

1. The Permittee must revise the exhibits and text to reflect removal of all culverts. This includes, but is not limited to, pg 3.7-39 & 41 and Exhibits 3.7-7A, B, & C.

## SOILS RESOURCE INFORMATION

Regulatory Reference: 30 CFR Sec. 783.21

### Analysis:

3.7-3A, B, and C Crandall Canyon Surface Facilities Maps  
3.7-5A, B, and C Crandall Canyon Operations Topography Maps  
3.7-7A, B, and C Crandall Canyon Reclamation Topography Maps  
3.7-7D Crandall Canyon Reclamation Topography Cross-Sections and Profile  
Sections 3.7-3 through 3.7-5  
Appendix 3.7S Crandall Canyon Soil Sampling Results  
Appendix 3.7C Test Hole MC 207 analysis

Excavated shaft materials present in the fill may be acidic (test hole MC207, Appendix 3.7C) and may contain elevated levels of selenium (soil sampling site EF-1-3). Most commonly, the fill consists of large rock fragments and boulders.

EarthFax has recommended in Appendix 3.7S that soils in the location of EF1 are buried in the fill due to slightly elevated selenium values. (This area has elevated SAR values as well.)

The remainder of the soils are suitable except for the excessive amounts of rock fragments which would not be suitable as a topsoil substitute (spread 6 inches thick). The following soils might be utilized as topsoil substitutes:

EF-2 proximity 0 - 48 inches  
EF-3 proximity 0 - 6 inches  
EF-4 proximity 0 - 48 inches  
EF-5 proximity 0 - 72 inches  
EF-6 proximity 30 - 96 inches  
EF-7 proximity 0 - 24 inches.

This should provide an adequate amount of substitute topsoil material. The remainder of the soils tested, have too many boulders and large rock fragments to be included in topsoil.

Some issues should be clarified within Section 3.7 of the submittal.

**Section 3.7-4**

1. There appears to be a misprint on page 3.7-14 where reference is made to Appendix 3.7C for soil salvage information with regard to the access road development.
2. If the road P-1 has already been constructed, then the wrong verb tense has been used and this is confusing when discussing available topsoil material.

**Section 3.7-5**

1. The plan indicates that road P-1 "where compaction is evident" will be ripped with backhoe teeth. Standard practices require that the entire road surface be ripped prior to topsoil application.
2. Table 3.1-10 is referred to but not found in this submittal. Earthwork volumes are crucial to the discussion of substitute topsoil requirements. It is recommended that Table 3.1-10 be reprinted in this Section.
3. A reference attributed to Simons, Li and Associates (1983) was not found with the list of references cited.

Some issues should be clarified within Appendix 3.7S of the submittal:

1. All reported SAR values have been miscalculated and appear to be off by a factor of five. Table 2 and the narrative (page 10) should be revised accordingly. SAR is calculated by dividing the exchangeable sodium value by the square root of the sum of the calcium and magnesium values divided by 2.
2. The laboratory should provide information necessary for the Division to check the calculations of Acid/Base Potential. Sulfur and calcium carbonate percentages should be reported.
3. Laboratory methods used were not those recommended by the Guidelines. Table 2 should be revised accordingly.
4. Appendix 3.7S has included specific recommendations for fertilization at the time of reclamation, based upon the quality of the topsoil at its present state. These recommendations differ from the norm in that high application of potassium and phosphorus is suggested. These fertilization recommendations assume that "the lab followed the procedures used at USU laboratory. These recommendations

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## DRAFT ANALYSIS AND FINDINGS

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should be incorporated into the plan after ascertaining whether the procedures used were the same. If not the same, then modification of the recommendations may be necessary. (Resampling may be practical considering the length of time which will pass before reclamation occurs.)

### Findings:

The reclamation plan can not be considered technically adequate.

Although the plan submitted has provided a full characterization of the existing soils in Crandall Canyon, there are errors and omissions which should be corrected. Special handling of soils as recommended in Appendix 3.7S should be incorporated into the reclamation plans described in Section 3.7.

The permittee must provide the following, prior to approval, in accordance with the requirements of:

**R645-301-232.200 and R645-301-240**

Errors in Appendix 3.7S must be corrected (described above). Information should be provided so that Acid/Base potentials can be calculated by the Division. Section 3.7 should include a Table of Volumes utilizing the information gained by the sampling reported in Appendix 3.7S. The Reclamation Plan should outline the soils which will be substitute topsoil and reflect the special handling of these soils. Ambiguities in section 3.7-4 and 3.7-5 (described above) should be clarified. Reclamation should include ripping of the entire road surface if the road is removed.

## ENVIRONMENTAL RESOURCE INFORMATION

Reg. Ref: R645-301-411, Environmental Description

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.

**R645-301-720. Environmental Description.**

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.

**Findings:**

**R645-301-720.** The Permittee must revise the exhibits and text to provide consistent labeling of the sampling points for B-22 and B-43.

**R645-301-760, Reclamation**

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.

**Findings:**

**R645-301-760**, The Permittee must remove all provisions alluding to making a decision regarding road retention at the time of final reclamation. The plan calls for removal of the road. Submittal of a Permit Change is necessary to retain the road and such a request will be entertained if and when submitted.

## HYDROLOGIC RESOURCE INFORMATION

**Reg. Ref: R645-301-724, Baseline Information**

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 for Crandall Canyon Reclamation.

## 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 application, however, indicates about 40,000 cubic yards of soil was taken to Gravel Canyon. Section 3.6 of the mining and reclamation plan says a total of about 97,000 cubic yards of soil is in Gravel Canyon. The application says 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 application, 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 current application 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 application 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 pond 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.

On page 3.7-47, the application implies that the State considers selenium levels above 0.11 mg/kg to be unacceptable. This appears to be a typographical error; the correct value is 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. 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 characteristics fell within acceptable ranges for all parameters. To correct the nutrient problems, the application includes recommendations for soil amendments.

The application 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 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 they were 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 nonprime 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 applicant to use the topsoil stored in Gravel Canyon for Crandall Canyon reclamation.

As discussed above, it does not appear the chemical and physical characteristics of the substitute soils in the upper pad should limit vegetative growth. For this reason and because of the Division's observations that vegetation is less than what would be expected in the area, the operator should provide further data to demonstrate the proposed substitute topsoil meets the requirements of R645-301-233.100. Options for doing this include:

1. Gathering vegetative cover and production information from existing vegetation and comparing it to the revegetation success standard and to the potential production of premining soils.
2. Establishing field trials that would use the proposed reclamation techniques. Decreased amounts of vegetation could be caused by compaction or by initial low nutrient levels that could both be corrected. This should be shown in the field

trials.

It is anticipated that field trials would show that adequate vegetation can be established.

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 application 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 *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 outcrops, the soils to be used to revegetate the road can be considered suitable for revegetation.

#### **Topsoil Protection**

The application 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 application is considered complete and accurate with the following exceptions:

1. The applicant needs to demonstrate that the proposed substitute topsoil materials are equal to or more suitable for sustaining vegetation than the premining topsoil and result in a soil medium that is the best available in the permit area to support revegetation. Although the recent soil sampling/testing has generally shown the chemical and physical characteristics are acceptable for revegetation, the amount of vegetation growing on these soils does not appear to be as great as would be expected for the area. Suggested methods are to show the existing vegetation meets revegetation standards or to establish field trials and try final revegetation techniques.
2. On page 3.7-47, the application implies that the cutoff for unacceptable levels of selenium is 0.11 mg/kg. This apparent typographical error should be corrected.

## TOPSOIL AND SUBSOIL RECLAMATION PLAN

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

### Analysis:

The applicant 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 is controlled on the lowermost stockpile.

The applicant 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 application. 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 applicant would cover the area with soil from stockpile No.2. It appears that the area could be covered about 12 inches deep.

The application says soils present west of Shaft No.2 and 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 reference to Shaft No. 2 appears to be a mistake; the middle and upper pads are west of Shaft No. 1 according to Exhibit 3.7-3B. The application 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 application. 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 application needs to contain a demonstration that the soils are adequate to achieve revegetation success. With this demonstration, the samples taken on 100-foot centers would not be needed.

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.

The Division Order requires the permittee to provide plans to show adequate soil/spoil preparation plans (i.e. deep ripping to 18-24 inches) prior to the application of borrow soils or hydroseeding. The application says all regraded areas will be scarified by deep ripping prior to spreading topsoil. A ripping depth of 18-24 inches is felt to be necessary to provide adequate uncompacted soil. The applicant should commit to rip or otherwise reduce compaction to at least this depth on all slopes where it is feasible.

**Finding:**

This portion of the application is complete and accurate with the following exception:

1. As required in the Division Order, the applicant needs to show adequate soil/spoil preparation plans including methods to reduce compaction to at least a depth of 18-24 inches prior to the application of borrow soils or hydroseeding.

## 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.

The Division Order specifically requires seedbed preparation plans. 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 amendment contains a specific commitment to roughen the area 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 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. The rate and 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.

Planting rates for ponderosa pine, Douglas fir, and juniper should be specified in the application. A closed stand of mature conifers would probably have about 500 trees per acre, but, since the applicant is also planting shrubs and since the area would produce more wildlife forage with fewer trees, a total rate of about three hundred trees per acre is recommended.

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 applicant 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, AMAX will still need to meet diversity requirements which will necessarily include establishment of trees and shrubs.

### Field Trials

The soils section of this review discusses the need to demonstrate that proposed substitute soil materials will be adequate for revegetating the area. The applicant needs to propose methods of testing whether soils in the upper pad area will be suitable. Suggested methods are to establish field trials or to take measurements of existing vegetation growing on the substitute soil and compare these with measurements of vegetation in appropriate reference areas.

### Fish and Wildlife Habitat

Chapter 9 says microtopographic features, such as swales and rises, will be created during regrading. Where rocks become available, AMAX 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 applicant proposes 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, in Section 3.5-5(1)(1) (page 3.7-33 of the current application), the application says no small depressions will be retained. This appears to be contradictory.

A warm season water source in Crandall Canyon is 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. The plan to leave a depression in the area of pond 14 should be very beneficial.

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 with the following exceptions:

1. Planting rates for ponderosa pine, Douglas fir, and juniper should be specified in the application.
2. The applicant needs to present information showing the proposed substitute soil material can be revegetated. The applicant could establish field trials or could obtain data showing that current vegetation cover in the upper pad areas approximates the cover in appropriate reference areas.
3. Section 3.5-5(1)(1) says no small depressions will be retained, but the applicant proposes in other parts of the application to retain a small depression in the

area of pond 14. This apparent contradiction should be resolved.

## 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 No. 015, 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.

Cutslopes above the access roads (A-1 and P-1) will be reclaimed as per current UDOGM regulations. As allowed under existing UDOGM approximate original contour regulations, limited portions of cutslopes will remain where they mimic or blend with existing topography or where insufficient backfill material is available to completely cover the cutslopes. The backfill slopes will be constructed in such a manner as to not exceed 36 degrees, the maximum safe angle of repose determined for the soils in Crandall Canyon.

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.

The Operator states that, "...some limited portions of cutslopes will remain where insufficient backfill material is available to completely cover the cutslopes as per DOGM

regulations". R645-301-553.500, Previously Mined Areas, pertains to backfilling highwalls on previously mined areas. Highwalls in previously mined areas do not have to be completely backfilled if the Division determines that there is insufficient material. A highwall is defined, for an underground coal mine, as a face or exposed overburden of coal for entry to an underground coal mine. Cut slope cannot be left because there is insufficient fill material.

The Operator states that backfill slopes will be constructed in such a manner as to not exceed 36 degrees. While 36° may be the angle of repose, slopes with that angle will not meet the safety factor requirement of 1.3. In addition, the slope must be gentler than 2 horizontal to 1 vertical to prevent topsoil erosion.

**Findings:**

The Operator's proposal to leave cutslopes due to insufficient backfill material is not allowed under Division regulations. The Operator must state that all backfill slopes will have a minimum safety factor of at least 1.3.

**Deficiencies:**

1. The Operator has not addressed how all the cutslopes will be reclaimed. There is no provision in the regulations to leave cutslopes because of lack of backfill material.
2. The Operator must state that all backfilled slopes will have a minimum safety factor of at least 1.3.

## 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 #014. 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 stand point 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:

According to R645-301-553.130 reclaimed slopes shall not exceed the angle of repose and shall have a minimum long-term safety factor of greater than 1.3. Using only the angle of repose as a design criteria the Operator recommends that the reclaimed slopes should not exceed 36°. While 36° meets the angle of repose requirement does not meet the minimum safety factor requirements. In general slopes consisting of unconsolidated material cannot exceed a 2 horizontal to 1 vertical slope (26°) and still meet the minimum safety factor requirements.

### Findings:

The Operator has not demonstrated that the design criteria of limiting the slope angle to 36° will meet the safety factor requirement for slope design. Until the Operator demonstrates that the reclaimed slopes will meet the minimum safety factor requirements the Division cannot approve the slope designs.

### Deficiencies:

1. The Operator has not demonstrated that the reclaimed slopes will meet the minimum safety factor requirements.

## 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.

## **HYDROLOGIC INFORMATION**

**Reg. Ref: R645-301-731.510, Discharges Into an Underground Mine**

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

**Reg. Ref: R645-301-731.520, Gravity Discharges from Underground Mines**

Page 7-19 of the original plan submittal and pg. 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 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.

**Reg. Ref: R645-301-751 Water Quality Standards and Effluent Limitations.**

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.

**Reg. Ref: R645-301-732.300 & -742-300, Diversions, General.**

Pg 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 & 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.

**Reg. Ref: R645-301-742.320, Diversions of Perennial and Intermittent Streams**

**Reg. Ref: R645-301-742.330, Diversions of Miscellaneous Flows**

Pg. 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 & intermittent streams and the 10-yr, 6-hr event was used for permanent diversions on the ephemeral streams. Pg 3.7-41 describes Reclamation Culvert Design. These are appropriate designs for the site.

Reg. Ref: R645-301-731.600, Stream Buffer Zones

From Exhibit 3.7-7A, B, & C and Backfilling and Grading described on pg. 3.7-32, it is evident that reclamation activities will definitely take place within 100 ft. 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.

**Findings:**

**R645-301-731.600,** The Permittee must provide to the Division the referenced information sufficient to make a finding regarding Stream Buffer Zones of less than 100 ft.

Reg. Ref: R645-301-732 & -742, Sediment Control Measures  
Reg. Ref: R645-301-732.100 & -742.200, Siltation Structures

Appendix 3.7J shows the design and inspection of the siltation ponds by a Registered Professional Engineer. Pg 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 pg. 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 pg. 3.7-43 are appropriate to use on the reclaimed pond site. They are close to the Roughen, Mulch, & Vegetate method recommended by the Division. Therefor, 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.

Reg. Ref: R645-300-742.230, Other Treatment Facilities

There are no other treatment facilities in Crandall Canyon.

Reg. Ref: R645-301-742.240, Exemptions

No exemptions are requested.

**Reg. Ref: R645-301-744 Discharge Structures**

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.

Pg. 3.7-12 & 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.

Pg. 3.7-17 & 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.

**Reg. Ref: R645-301-733 & 743, Impoundments**

See comments above under Discharge Structures

**Reg. Ref: R645-301-760, Reclamation & -742.313, Diversion**

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 analysis.

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.

**Findings:**

**R645-301-542.620**, The permittee must revise the exhibits and text to reflect removal of all culverts. This includes, but is not limited to, pg 3.7-39 & 41 and Exhibits 3.7-7A, B, & C.

**R645-301-731, Operation Plan, General Requirements, and R645-301-727, Alternative Water Source Information, and R645-301-731.800 Water Rights and Replacement.**

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.

## **BONDING AND INSURANCE REQUIREMENTS**

**Analysis:**

The Operator is waiting for the Division to tentatively approve the reclamation plan before submitting bond information.

**Findings:**

The Operator must submit a reclamation bond estimate.