PLATEAU MINING CORPORATION

Willow Creek Mining and Reclamation Plan
C/007/038

Refuse Pile Redesign and Post Mining Land Use Change for Price River Water Improvement District Industrial Use

December 2003

File in:
☐ Confidential
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In C/0070038 Incoming
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TABLE OF CONTENTS

Section — Page

3.4-1 General 3.4-1

3.4-2 Description of the Facility 3.4-2

3.4-3 Environmental Protection: Drainage Controls and Sanitary Facilities 3.4-5

3.4-3(1) Drainage Controls 3.4-5
3.4-3(2) Storm Runoff Calculations 3.4-6
3.4-3(3) Diversion Structures 3.4-7
3.4-3(4) Sedimentation Ponds 3.4-11

3.4-3(4)A Pond 011 . . . . . 3.4-12
3.4-3(4)B Pond 013 . . . . . 3.4-13

3.4-3(5) Pond Embankment Stability Analyses 3.4-14
3.4-3(6) Sanitary Facilities 3.4-15
3.4-3(7) Alternative Sediment Controls 3.4-15

3.4-4 Transportation Facilities 3.4-16

3.4-5 Stream Buffer Zones 3.4-17

3.4-6 Reclamation Plan 3.4-18

3.4-6(1) Postmining Land Use 3.4-18
3.4-6(~~1~~ 2) Reclamation Work . . . . . 3.4-?
3.4-6(~~2~~ 3) Reclamation Hydrology . . . . . 3.4-?
~~3.4-6(3) Reclamation Sedimentation Ponds~~ . . . . . ~~3.4-?~~
3.4-6(4) Reclamation Alternative Sediment Controls . . . . . 3.4-?

3.4-7 Reclamation Timetable . . . . . 3.4-?

3.4-8 Reclamation Costs . . . . . 3.4-?

3.4-~~8~~9 References . . . . . 3.4-?

LIST OF TABLES

Table | ~~Page~~

3.4-1 PREPARATION PLANT OPERATIONAL HYDROLOGY WATERSHED CHARACTERISTICS . . . . . ~~3.4-41~~

3.4-2 OPERATIONAL DIVERSION DITCH DESIGN SUMMARY . . . . . ~~3.4-43~~

3.4-3 OPERATIONAL DIVERSION CULVERT DESIGN SUMMARY . . . . . ~~3.4-45~~

3.4-4 PREPARATION PLANT AREA ROAD DESCRIPTIONS . . . . . ~~3.4-46~~

3.4-5 PREPARATION PLANT RECLAMATION MASS BALANCE SUMMARY . . . . . ~~3.4-48~~

3.4-6 PREPARATION PLANT RECLAMATION WATERSHED CHARACTERISTICS . ~~3.4-49~~

3.4-7 RECLAMATION DITCH DESIGN SUMMARY . . . . . ~~3.4-50~~

3.4-8 RECLAMATION CHANNEL RIPRAP AND FILTER BLANKET SUMMARY . . . . . ~~3.4-51~~

3.4-9 RECLAMATION CULVERT DESIGN SUMMARY . . . . . ~~3.4-52~~

LIST OF FIGURES

Figure

3.4-1 PRIMARY ROAD P-1 TYPICAL SECTION

3.4-2 PRIMARY ROAD P-2 TYPICAL SECTION

3.4-3 ~~PRIMARY ROAD P-3 TYPICAL SECTION~~ DELETED

3.4-4 PRIMARY ROAD P-4 TYPICAL SECTION

3.4-5 PRIMARY ROAD P-5 TYPICAL SECTION

LIST OF FIGURES (Continued)

Figure

3.4-6 PRIMARY ROAD P-6 TYPICAL SECTION

~~3.4-7 REFUSE PILE PROFILE FINAL RECLAMATION PHASE~~ DELETED

~~3.4-8 REFUSE PILE CROSS-SECTION FINAL RECLAMATION PHASE~~ DELETED

3.4-9 TYPICAL SILT FENCE

~~3.4-10 TYPICAL SILT FENCE LAYOUT~~ DELETED

3.4-11 REFUSE PILE MINING AREA AND COAL QUALITY EXPLORATION SITES

LIST OF APPENDICES

Appendix

3.4A 1978 GOLDER ASSOCIATES REPORT

3.4B EXCERPTS FROM 1977 GOLDER ASSOCIATES REPORT

3.4C 1983 HORROCKS AND CAROLLO REPORT

3.4D DESIGN OF OPERATIONAL DIVERSIONS

3.4E SEDIMENTATION POND DESIGN EVALUATION

3.4F EMBANKMENT STABILITY ANALYSIS FOR POND 011

3.4G OPERATIONAL PERIOD ALTERNATE SEDIMENT CONTROL CALCULATIONS

3.4H SLOPE STABILITY ANALYSIS

~~3.4I RECLAMATION SEDIMENTATION PONDS - CALCULATIONS~~ DELETED

3.4J DESIGN OF RECLAMATION DIVERSIONS

3.4K RECLAMATION PERIOD ALTERNATIVE SEDIMENT CONTROL CALCULATIONS

3.4L RECLAMATION CORRESPONDENCE, PUBLICATIONS, AND AGREEMENTS

LIST OF MAPS

Map

3.4-1 PRE-SMCRA DISTURBANCE AND SURFACE FACILITY MAP

3.4-2 RAW WATER POND AS CONSTRUCTED DRAWING

3.4-2A THICKENER OVERFLOW POND (AS-BUILT)

3.4-3 PREPARATION PLANT AREA WATERSHEDS

3.4-4A OPERATIONAL DIVERSION LOCATIONS - SHEET A

3.4-4B OPERATIONAL DIVERSION LOCATIONS - SHEET B

3.4-4C OPERATIONAL DIVERSION LOCATIONS - SHEET C

3.4-4D OPERATIONAL DIVERSION LOCATIONS - SHEET D

3.4-4E OPERATIONAL DIVERSION LOCATIONS - SHEET E

3.4-4F OPERATIONAL DIVERSION LOCATIONS - SHEET F

3.4-5 SCHOOL HOUSE CANYON REFUSE SITE FINAL OPERATIONAL DRAINAGE PATTERN AND DIVERSION DITCHES

3.4-6 SEDIMENTATION POND 011 AS BUILT

3.4-7 SEDIMENTATION POND 013 AS CONSTRUCTED

3.4-8 OPERATIONS CONTOUR MAP

3.4-9 ~~PHASE I~~ PREPARATION PLANT AREA AND REFUSE PILE RECLAMATION ~~FEATURES~~ TOPOGRAPHY MAP ~~AND TREATMENT MAP~~

3.4-10 ~~FINAL RECLAMATION TOPOGRAPHY MAP~~ PREPARATION PLANT AREA AND REFUSE PILE RECLAMATION CROSS-SECTIONS AND PROFILE MAP

3.4-11 ~~PHASE I RECLAMATION SEDIMENT CONTROL MEASURES - POND 012~~ PREPARATION PLANT AREA AND REFUSE PILE RECLAMATION WATERSHED MAP

3.4-12 ~~RECLAMATION WATERSHED BOUNDARY MAP~~ PREPARATION PLANT AREA AND REFUSE PILE RECLAMATION TOPOGRAPHY AND TREATMENT MAP

3.4-6 Reclamation Plan

3.4-6(1) Postmining Land Use

The preparation plant and refuse pile area have the potential of supporting wildlife habitat, grazing, and industrial. The reclamation plan supports both the designated pre- and postmining land uses of wildlife habitat and grazing, and the industrial use listed below.

The postmining land use for the preparation plant area is for industrial use by Price River Water Improvement District (PRWID). PRWID desires the land to address immediate and long term expansion of its water treatment and distribution system as expressed in the letter of intent and agreements presented in Appendix 3.4L. This is a higher and better use of the land.

Proof of publication and letters to and comments from the legal or equitable owner of record of the surface areas to be affected, concerning the proposed use are provided in Appendix 3.4L.

The lands not required for PRWID's intended use, as shown on Map 3.4-9, which includes the refuse pile will be reclaimed to its premining land use of wildlife habitat.

In order to facilitate the industrial postmining land use, primary roads P-1, P-2, P-4, P-5, and P-6 will be maintained in their entirety or portion there of as shown on Map 3.4-9. Map 3.4-9 also shows general locations of underground utilities such as: raw water, culinary water, and sewer. The underground utilities lie immediately below or adjacent to Primary roads P-1 and P-4.

It should also be noted that primary roads P-1 and P-4 are not only used by the Permittee, but also Utah Power and Light, Helper City, Price City, and PRWID to check and repair their underground utilities. Furthermore, this corridor is used as a secondary escape way should the railroad crossings be blocked during an emergency. Primary roads P-2 and P-5 are routinely used by Utah Power and Light to inspect and repair their power line the traverses up Barn Canyon.

3.4-6(2 ~~1~~) Reclamation Work

The preparation plant was ~~is~~ designed to remain in use until the minable reserve base is depleted or until mining permanently ceases. Reclamation of the School House Canyon refuse site will begin as soon as the canyon is filled to its design capacity or until no longer needed for the disposal of coal processing waste.

The post-mining reclamation topography plan for the preparation plant area is shown on Maps 3.4-9 (~~Phase I reclamation~~ Preparation Plant Area and Refuse Pile Reclamation Topography Map) and 3.4-10 (~~final reclamation~~ Preparation Plant Area and Refuse Pile Reclamation Cross-Sections and Profile Map). The reclamation work will consist of the following: demolition, backfilling and grading, pond removal, topsoil placement, and seeding and mulching.

~~Phase I -~~ ~~Demolition~~
~~Grading~~
~~Topsoil placement~~
~~Seeding and mulching~~

~~Phase II -~~ ~~Removal of retained sedimentation pond~~

~~Phase III -~~ ~~Water and vegetation monitoring~~

A description of these activities follows.

~~**Phase I Reclamation**~~

Demolition - All existing structures which lie within the disturbed area boundary and do not support the postmining land uses will be removed~~, including the beltline structures~~. However, utilities within the utility corridor, along with a buried telephone cable parallel with the utility corridor, will remain. Water supply intakes serving the preparation plant outside the disturbed area boundary will also remain~~, while the piping within the disturbed area boundary and outside the utility corridor will be removed~~. In addition, the diversion and culverts identified on Map 3.4-~~10~~ 9 will

remain~~. Removing these culverts and replacing them with permanent reclamation stream channels could possibly leave sections of the underground utilities in the utility corridor exposed. Since this is not desirable, these culverts will be retained following reclamation.~~

Portal Sealing - There are no portals to seal at the preparation plant.

Grading - The area will be graded to promote drainage and approximate the topography noted on Maps 3.4-9 ~~(Phase I reclamation topography~~) and 3.4-10 ~~(final reclamation topography)~~. This topography will be achieved by blending the soil material into the adjacent area and creating landforms which resemble the surrounding topography. The mass balance calculations associated with the grading are presented in Table 3.4-5. The grading plan as shown on Map 3.4-9 meets the criteria set forth in R645-301-553, Backfilling and Grading.

A comparison of Maps 3.4-1 and 3.4-10 indicates that all post-SMCRA and most pre-SMCRA cut slopes will be backfilled to the extent practical during reclamation. Those pre-SMCRA cut slopes which cannot practically be reclaimed are identified on Map 3.4-9. The cut slopes were analyzed for stability in their present configuration and for long-term retention following reclamation. This analysis is presented in Appendix 3.4H, with the cross sections used to analyze the slopes shown on Map 3.4-8.

As indicated in Section 4.0 of Appendix 3.4-H, the calculated factor of safety for the retained cut slopes exceeds the minimum static factor of safety of 1.3 stipulated by R645-301-553.130. Appendix 3.4-H further documents the existence of natural cliffs and ledges in the preparation plant area and concludes that the cut slopes to be retained are similar in structural composition and geometry to the naturally existing cliff/ledge formations and thus are compatible with the surrounding topography.

During ~~Phase I~~ the backfilling and grading, the following work will be performed:

- Elimination of berms and temporary diversions, except where ~~noted~~ necessary to support the postmining land use .

- Grading to remove cut slopes to the extent practical and establish overland flow drainage to support postmining land uses.
- Construction of permanent stream channels.
- Removal of existing culverts, except ~~as noted~~ where necessary to support the post mining land use.
- Removal of Ponds 011, 012A and 012B, and 013.
- ~~Enlargement of Pond 012B (renamed 012).~~ Maintain existing accesses and utility corridors
- ~~Installation of silt fences.~~
- Soil preparation, seeding, fertilizing and mulching.

~~During Phase I of reclamation, several berms and ditches which direct flow to the sediment ponds will be retained. However, many of the diversions that collect runoff from undisturbed areas will be eliminated. This necessitates enlargement of existing ponds to function as primary sediment control structures during Phase I of reclamation. Specifically, Sediment Pond 012B will be enlarged, while Ponds 011 and 013 will remain at their current size for Phase I of reclamation. The enlarged Pond 012B has been renamed Pond 012 for Phase I of reclamation. Pond 012A will be eliminated (see Map 3.4-9).~~

~~Map 3.4-11 contains more detailed plans to enlarge Pond 012B (thereafter to be known as Pond 012), along with pertinent design data. Appendix 3.4I contains the engineering calculations supporting the need to enlarge Pond 012. Ponds 011, 012, and 013 will be retained for two years or until adequate vegetation is established to control erosion.~~

The reclamation of the Willow Creek Preparation Plant area will take place over the area which was the old town site of Castle Gate. Hence, old utilities, foundations and debris may be uncovered during the grading operation. This may result in the alteration of the contours shown on Maps 3.4-9 and 3.4-10 by as many as two contour intervals in order to keep from uncovering the old town site. If foundation debris is cut during the reclamation process, it will be used as deep fill layers against cut slopes or as fill material within ponds.

~~Phase I of~~ Reclamation will also include the removal of all roads and culverts, except as noted on Map 3.4-9 which are necessary to support the postmining land use, and the establishment of permanent stream channels. ~~Asphalt removed from the road surfaces will be collected and properly disposed of beyond the boundaries of the permit area or buried on site under at least 4 feet of nonacid-forming, nontoxic, and noncombustible material.~~

The slurry injection wells discussed in Section 3.10 of this exhibit ~~will~~ have been sealed, and the area in the immediate vicinity of the wells reclaimed in accordance with the plan contained in Section 3.10 of this exhibit. The piezometers in the downstream embankment of Pond 013 will be ~~monitored~~ removed during ~~Phase I~~ reclamation ~~and then sealed at the beginning of Phase II reclamation~~. ~~No other unsealed monitoring or exploration wells exist on the property.~~

The reclamation topography plan for the Unit Train Loadout area is shown on Map~~s~~ 3.4-9 ~~and 3.4-10~~. A discussion of the reclamation plan is included in Section 3.8 of this exhibit.

The backfill and grading topography shown on Map 3.4-~~10~~ 9 is compatible with the postmining land use of industrial, wildlife habitat and grazing, and provides adequate drainage and long term stability as required by R645-301-553.522. The final configuration for the refuse pile is ~~also~~ suitable for the approved postmining land use of wildlife habit and grazing. ~~Terraces will be constructed on the outslope of the refuse pile which increase stability, control erosion, and conserve soil moisture. The grade on the outslope between the terrace benches will not be steeper than 2H:1V. The terraces will be approximately 40 feet wide, and slope at approximately 10%.~~ A profile and cross-sections of the ~~face of the~~ refuse pile are shown on Map 3.4-10 ~~presented as Figures 3.4-7 and 3.4-8, respectively~~.

Grading will be done in order to establish drainage and stabilize cutslopes. The scheduling of the grading work will minimize the disturbance to the hydrologic balance. Sediment ponds will remain in place as long as possible during the grading work. The planned sequence of removal of the sediment control structures follows:

- During the reshaping, resoiling, mulching, deep gouging, reseeding, final mulching, and channel construction on the refuse pile, Pond 013 will be maintained in full or partial capacity until when the channel must be constructed through the pond and pond embankment.

- Prior to the removal of Pond 013, most of the refuse pile upstream will have been treated using the deep gouging and mulching alternative sediment control measures.

- During the brief period when the refuse pile channel is not connected to the undisturbed culvert, any flow coming down the channel will flow into Ponds 012A and 012B. To minimize the potential for offsite contribution of sediment, and overloading the ponds' abilities to treat runoff, weather patterns will be monitored and work performed when conditions are less likely to cause significant flow from upstream watersheds.

- Ponds 011, 012A and 012B will be maintained until the majority of the land reporting to them is reshaped and gouged, and their backfilling is required.

- As required for temporary treatment, strawbales and/or silt fences will be installed following the removal of sediment ponds and maintained untill the reclamation alternative sediment control measures are in place.

Resoiling - Most of the 77.9 acres in ~~Castle Gate~~ the preparation plant area and refuse pile area which will be reclaimed were disturbed by mining activities prior to the enactment of SMCRA. Hence, no topsoil was salvaged from the site except in the area of post-SMCRA disturbance (e.g., the refuse pile and the clean-coal storage area). The existing soils at the site will be used as resoiling material except at the refuse pile and the clean-coal storage area, where the salvaged topsoil stored at the Gravel Canyon stockpile will be used.

Access onto and from Highway 6 will be conducted in accordance with the Utah Department of Transportation's requirements to protect the public's safety. All appropriate signs and traffic control personnel will be utilized.

The existing soils at the preparation plant site were sampled in May 1991 and analyzed for several chemical and physical parameters, including those recommended in the Division "Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining," dated April 1988. Results of these analyses are presented in Appendix 8-2, while sampling locations are depicted on Map 8-4. As indicated in Appendix 8-2, each of the parameters fell within the "good" to "fair" ranges as indicated in the abovementioned guideline. Hence, soil at the site is suitable for use in reclamation.

However, based on the much improved reclamation of the refuse pile, it appears that even with the addition of another foot of growth media, to three feet of cover, there will approximately 32,156 cubic yards of material remaining at Gravel Canyon for placement at the Preparation Plant area.

~~Given the time frame between the 1991 soil sampling and the probable onset of reclamation, the resoiling materials will be sampled again prior to reclamation. Appropriate horizons encountered within test pits installed for this effort will be sampled, with the samples being analyzed for appropriate parameters as recommended by the most recent Division guidelines which are in effect at the time. Appropriate soil amendments will be added according to results of these tests.~~

The refuse pile will be covered with ~~24"~~ 36" of soil from the Gravel Canyon soil storage site and Pond 13 embankment material during reclamation. Approximately ~~96,000~~ 96,800 cubic yards of material will be needed for this purpose. Approximately 80,654 cubic yards will be soil from Gravel Canyon and approximately 16,146 cubic yards from the Pond 13 embankment and adjacent area. Justification for use of less than 4' of cover on the refuse pile is the nontoxic nature of the refuse. ~~Approximately one year prior to placement of substitute topsoil from Gravel Canyon on the~~

~~refuse pile, the refuse will be evaluated in accordance with Division guidelines which are in effect at the time in order to prove non-toxicity and assess the necessity to add appropriate soil amendments. Results of the tests will be forwarded to DOGM for review.~~

Any acid forming or toxic materials exposed during the grading operation will be buried either on the Refuse Pile, adjacent to a cut slope, within a sedimentation pond, or in place. In any case, the acid and/or toxic material will be buried under at least four feet of nonacid- and nontoxic forming material as measured by the final reclamation grade.

The soil material placed on the refuse pile will be deep gouged, following the placement of 2.0 tons/acres of certified noxious weed free hay. The gouges provide a means by which to harvest precipitation and snow-melt, minimize erosion, provide a place for seeds to settle, and other enhancement aspects suitable for vegetation success. ~~Prior to placement of any borrowed material, the area will be scarified to a depth of approximately 4". After reclamation grading but prior to seeding, the soil on all slopes with grades less than 20% will be ripped to a depth of 18 to 24 inches parallel to the contours. This procedure will encourage moisture retention and reduce the surface compaction to allow for a more favorable germination environment for the vegetation. Soil ripping will not be performed on the Refuse Pile.~~

Seeding and Mulching - Two revegetation seed mixes will be used at the preparation plant site, as indicated in Chapter 9 of this exhibit, and Section 5.3, Volume I . The majority of the site will be seeded with the Upland Seed Mixture (Table 5.3-2)~~, as it is a pre-SMCRA site~~. The riparian areas shown on Map 3.4-9 will be seeded with species list #3. ~~In both cases, the seed will be mixed with a small amount of wood fiber mulch, used as a tracer, and water to form slurry. The slurry will be applied to the reclaimed surfaces using a hydroseeder. The balance of the mulch, mixed with a tackifier and the fertilizer also in a slurry, will then be sprayed over the same area. The total coverage of the mulch will be a the rate of 2,000 pounds per acre. In areas inaccessible to the hydroseeder, the seed will be broadcast by mechanical means. Areas inaccessible to the hydromulch equipment will be mulched with straw and tacked with nylon or other suitable netting. The rate of application for straw will be 2,000 pounds per acre.~~ Following the placement of the

growth media and prior to application of the reclamation seed mix, hay will be incorporated into the growth media at a rate of 2 tons per acre. This will be done to improve soil structure for aeration purposes, increase micropore space, and improve the water holding capacity of the soil. Incorporation of the mulch will occur through deep gouging. No fertilizer will be used during the reseeding activities.

Following seeding, an additional 1.0 to 1.5 tons per acre of certified noxious weed free straw mulch will be spread over the seeded growth media mostly be mechanical blowers with occasional hand spreading. The straw mulch will then be sprayed with a tackifier and mulch mixture at about 500 lbs per acre following spreading to retain it on the reseeded slopes. The tackifier and mulch technique provides a better means for retaining the straw mulch onto the reseeded areas than did the crimping technique.

~~Phase II Reclamation~~

~~Phase II reclamation will commence once the vegetation is adequately established based on the criteria presented in Chapter 9 of this exhibit. This phase of reclamation will consist of filling in the three sediment ponds (011, 012 and 013) and removing silt fences and accumulated soil in the vicinity of the fences. However, where removal of the silt fence fabric will substantially disrupt the established vegetation adjacent to the fence, the fabric may be cut at ground level and the buried fabric abandoned in place. All the temporary diversions and berms which were left to control runoff during Phase I reclamation will be removed. Grading will be performed to bring the site within tolerance of the postmining reclamation plan depicted in Map 3.4-10.~~

~~The areas disturbed during Phase II reclamation will be seeded and mulched according to the plan described above and in accordance with Chapter 9 of this exhibit.~~

~~All piezometer wells will be sealed in accordance with R645-301-731.400, R645-301-631, and R645-301-765.~~

~~Phase III~~ Reclamation Monitoring

~~Phase III~~ Reclamation monitoring will consist of water and vegetation monitoring until bond release.

3.4-6(3 ~~2~~) Reclamation Hydrology

Reclamation Channel Design - The reclamation channels for the Willow Creek Preparation Plant area were designed to approximate the geometry of the existing natural stream channels and to convey the design flow under stable conditions. The natural channel sections were measured in the field and approximated with a trapezoidal cross section. The reclamation channels were generally designed with a 2H:1V side slope to ensure channel stability. However, ~~three~~ existing stream channel~~s~~, Castle Gate ~~Reclamation~~ Ditches CGD-3, CGD-4, ~~CGRD-4~~, ~~CGRD-5~~, and ~~CGRD-10~~ were constructed with 1H:1V, 1~~.5~~H:1V, ~~and 1.2H:1V~~ side slopes~~, respectfully~~. These ~~three~~ two ditches were previously designed for the operational hydrology of the Castle Gate area and were determined to be adequately designed for reclamation hydrology. ~~While CGRD-4 and CGRD-5 are permanent reclamation channels, CGRD-10 will be removed when Pond 013 is removed at the end of Phase I of reclamation.~~ The hydraulic slope of each channel was measured from electronic versions of Map 3.4-10.

All calculations supporting the designs of the reclamation hydrology structures are presented in Appendix 3.4J. Curve numbers for the undisturbed drainage areas were based on professional judgement and typical tabulated values. The reclaimed areas ~~(CGRWS-R1, R2, R3, & R4)~~ were assumed to have a curve number of 75 ~~80~~. The reclamation channel drainage areas for the ~~Castle Gate~~ Preparation Plant Area are presented on Maps 3.4-11 ~~0~~ and in the calculations in Appendix 3.4J ~~3.4-12~~.

Peak discharge rates used to determine channel capacities and riprap sizing for the reclamation channels were calculated based on the 100-year 6-hour precipitation event of 2.10 inches for perennial channels, ~~and~~ intermittent channels, and any channel associated with the

refuse pile. All other channels were designed for the 10-year 6-hour storm event of 1.4 inches (Miller et.al, 1973). A summary of the runoff calculations is presented in Appendix 3.4J ~~Table 3.4-6~~. The reclamation channel geometries and minimum riprap sizes are presented in Table 3.4-7.

Appendix 3.4J contains calculations for riprap and filter blanket requirements ~~volumes~~ for permanent stream channels. The thickness, and thus the volume, of the riprap for each channel is related to the average proposed riprap stone diameter. For all channels ~~with maximum longitudinal slopes of less than 10%,~~ the method developed by the U.S. Department of Transportation (1967), was used to determine the average riprap particle size (D_{50}). The proposed thickness of the riprap in these channels is twice the D_{50} dimension, as recommended by Barfield et al. (1981). ~~Riprap for permanent channels with slopes exceeding 10% was sized based on the steep slope channel design methodology presented by Simons, Li & Associates (OSM/TR-82/2, 1982). In these cases, the riprap volume is based on a thickness of 1.25 times the calculated D_{50} (Simons, Li & Associates, 1982).~~ Filter blanket volumes are based on a thickness equal to one half the riprap thickness, but not less than six inches (Barfield et al., 1981).

The following general approach was used during design of the reclamation channels:

- The design capacity of the perennial and intermittent reclamation channels, as well as any channel associated with the refuse pile was based on the 100-year 6-hour storm and the minimum channel slope.
- The design capacity of the ephemeral reclamation channels was based on the 10-year 6-hour storm and the minimum channel slope.
- Riprap was sized based on the 100-year 6-hour storm and the maximum channel slope for perennial channel, ~~and~~ intermittent channels and all channels associated with the refuse pile.
- Riprap was sized based on the 10-year 6-hour storm and the maximum channel slope for ephemeral drainage channels.
- The roughness coefficient (Manning's "n") for riprapped channels was determined according to the equation (~~Barfield~~ Abt et al., 1981):

$$n = \cancel{0.0395 D_{50}^{1/6}}\ 0.0456(D_{50} * \text{slope})^{0.159}$$

where, n = Manning's roughness coefficient

D_{50} = median riprap diameter (ft)
Slope = channel slope (ft/ft)

- Designs are based on channel construction on soil. Where the reclamation channel construction occurs on rock, riprap quantities will be reduced or eliminated (depending on the competency of the rock).
- When transitioning downstream from a steep channel slope to a flat channel slope, the larger riprap from the steep section will be extended into the channel section with the flatter slope for at least 15 feet to minimize erosion (Simons, Li & Associates, 1982).
- The reclamation channels are designed to pass the peak discharge with a minimum freeboard of 0.5 ~~1~~ foot.
- ~~Where channel slopes exceed 20 percent, a small plunge pool will be constructed at the grade break to dissipate energy. This plunge pool will be lined with riprap to provide erosion protection.~~

A detailed riprap and filter blanket design is not presented in this text since adequate soil samples were not available. ~~Cyprus~~ The permittee is committed to preparing a detailed design for the riprap and filter blanket gradations. Samples will be taken once the reclamation grading has progressed sufficiently to expose the base of the reclamation channels. The riprap and filter blanket gradations for ~~the mild slope sections of the~~ all channels will be engineered based on methods presented in Barfield et al. (1981). The procedure presented by Simons, Li & Associates (1982) will be used to design the riprap gradation for steep slope channels. This design procedure assumes that the riprap is predominately angular in shape. The filter blanket will consist of a properly graded coarse grained soil; a synthetic fabric will not be used. ~~The detailed designs will be submitted to DOGM for approval prior to delivery of filter blanket and riprap materials to the site.~~

Table 3.4-8 summarizes the required riprap and filter blanket volumes for the reclamation channels. Total volumes ~~and tonnage~~ reported in Table 3.4-8 do not account for the riprap required at the base of the reclamation culverts.

Reclamation Culvert Design - Calculations regarding design of the Willow Creek preparation plant reclamation culverts are presented in Appendix 3.4J. Summaries of the reclamation culvert discharges and designs are presented in Table 3.4-9.

Three culverts will remain for the preparation plant reclamation plan. As indicated in Appendix 3.4J, culvert CG~~R~~C-1 is an adequately designed existing ~~60~~ 18 inch ~~x 120 inch box~~ culvert which will remain after ~~for Phase I final~~ reclamation. ~~CGRC-1 will subsequently be removed when Phase I reclamation is completed. The average~~ No riprap ~~size~~ is required at the CGRC-1 outlet ~~is 1 inch~~.

CG~~R~~C-5 ~~2~~ is an adequately designed existing 60-inch diameter concrete culvert located under the road and the Utah Railway spur. CG~~R~~C-5 ~~2 (operations culvert CGC-5)~~ extends to the Price River and will be shortened ~~for Phase I~~ during reclamation as shown on Map 3.4-9. An average riprap size of ~~39~~ 40 inches will be required at the outlet.

CG~~R~~C-2 ~~3~~ consists of two 84-inch diameter CMP culverts which discharge into the channel of the Price River. These culverts are adequately designed to convey the peak flow resulting from the 100-year, 6-hour precipitation event. An average riprap size of 30 inches is required at the outlet.

~~**3.4-6(3) Reclamation Sedimentation Ponds**~~

~~During Phase I of reclamation, sedimentation ponds will be the primary means of capturing sediment erosion from the reclaimed areas designated on Map 3.4-9. Since several of the diversions channelling undisturbed area runoff around the disturbed area will be removed, some undisturbed area runoff will now contribute to the ponds. Ponds 011 and 013 will adequately handle the inflow contributed during the reclamation period. However, Pond 012B is currently undersized to accommodate approximately three years of sediment storage as well as the storm runoff from the 10-year 24-hour storm event under reclamation conditions. Hence, this pond will be expanded from its operational hydrology size, while Ponds 011 and 013 need not be modified. Since Pond 012A will be removed during Phase I of reclamation, Pond~~

~~012B is henceforth referred to as Pond 012 once it is enlarged. All pond sizing calculations are contained in Appendix 3.4I. Alternative sediment controls will be utilized to trap sediment where grading does not allow the runoff to flow to a sediment pond.~~

~~Curve numbers for the undisturbed drainage areas contributing to the ponds were estimated from vegetation data presented in Chapter 9 of this M&RP, and by field observations. Cover densities for each vegetative group were estimated from information presented in Chapter 9. Curve numbers varied from 75 to 78 for the undisturbed drainage areas which contribute to the sedimentation ponds. A summary of curve numbers for those areas is presented in Appendix 3.4J. A curve number of 80 for the reclaimed areas was chosen from professional judgement and tabulated values presented by the U.S. Soil Conservation Service (1972).~~

~~The 25-year 6-hour storm event was routed through reclamation Ponds 011 and 012 to determine the adequacy of the existing spillways under reclamation conditions. The computer software SEDIMOT II was used for the routing. SEDIMOT II assumes that the pond is full of water up to the spillway/overflow elevation at the beginning of the storm event. This results in a conservative estimation of the maximum stage since, in general, the pond can be assumed to be empty at the beginning of a storm. Overflow from Pond 011 discharges to reclamation ditch CGRD-6, while Pond 012 discharges to the railroad right-of-way and flows south toward Willow Creek.~~

~~A diversion/berm system was designed to convey the runoff and sediment from the reclaimed areas to the sedimentation ponds using the 10-year 6-hour storm event. Berms will be constructed in the locations indicated on Map 3.4-9. Adjacent to each berm will be a broad swale diversion which will convey the runoff. The height of the berm will be approximately 1.0 foot, with a 1.0 foot top width and side slopes of 2H:1V. The bottom width of the swales will be 8 feet alongside all the berms. Maximum flow velocities do not exceed 2.5 fps and, therefore, riprap protection will not be required. The last entry in Table 3.4-7 summarizes the geometry of a typical berm/swale. Calculations for the berm/swale system are provided in Appendix 3.4I.~~

~~Once Pond 012 is enlarged for Phase I reclamation and all grading and seeding have been completed, Ponds 011, 012 and 013 will serve to collect sediment for a minimum of two years. The ponds will not be removed until the removal is authorized by DOGM, vegetation over the reclaimed area has been properly established in accordance with R645-301-763.100, and the water quality bond release standards of R645-301-880.320 are complied with. Sediment will be removed from the reclamation sedimentation ponds when the sediment reaches the 60% cleanout level, as determined by reading the sediment marker in each pond. The sediment will first be evaluated to determine if it contains acid and/or toxic forming compounds, and the results forwarded to DOGM. The sediment will then be transported to a location designated within the Willow Creek Mine permit boundary.~~

~~The following summaries are provided for the proposed reclamation sedimentation pond structures.~~

~~**Reclamation Pond 011 -** The design of sedimentation pond 011 has been enlarged for the purposes of operational hydrology sediment control as indicated in Section 3.4-3(4)A of this exhibit. As indicated in Appendix 3.4E, the capacity of Pond 011 at the principle overflow is 1.74 acre feet.~~

~~Using reclamation parameters, an annual sediment volume of 1,653 cubic feet (0.04 acre-foot) was calculated for Pond 011 using the methods described in Chapter 7 (see Appendix 3.4I). The storm runoff volume from the 10-year 24-hour storm event is 53,600 cubic feet (1.23 acre-feet). The computation of the runoff volume assumed a reclaimed drainage area of 11.6 acres and a curve number of 80. A curve number of 75 was used for the undisturbed areas covering 33.4 acres. Thus, the expanded Pond 011, as currently constructed, is sufficient to contain the 10-year 24-hour storm and significant sediment during Phase I of reclamation.~~

~~From the stage/storage capacity curve for the pond structure contained in Appendix 3.4E, the allowable storage at the principle overflow elevation (6147.0 feet) is approximately 1.74 acre-feet. Therefore, the pond will contain the runoff from the 10-year 24-hour storm event (1.23 acre-feet) and 0.51 acre-feet of sediment storage after reclamation.~~

~~The 25-year 6-hour storm event (1.6 inches of precipitation (Miller, et. al., 1973)) was used to assess the capacity of the existing principle overflow for Phase I of reclamation. The methods used to calculate the capacity of the overflow pipe are described in Chapter 7. Computations assumed that the pond was full of water up to the overflow flowline prior to the start of the design runoff event.~~

~~From the analysis of the 25-year 6-hour storm event, the maximum combined inflow rate to the expanded pond structure under reclamation conditions is 4.86 cfs and the maximum outflow rate is 3.29 cfs. Since these inflow and outflow rates are smaller than those calculated for the same scenario under operations conditions (see Appendix 3.4E), the riprap on the emergency spillway will be adequate to prevent erosion during the reclamation period. Since riprap was not required at the principle spillway outlet barrel under operational conditions, it will also not be required under reclamation conditions.~~

~~The corresponding high water elevation during the design inflow event is 6147.4 feet, 2.6 feet below the minimum embankment elevation of 6150 feet. Thus, Pond 011 will adequately pass the 25-year 6-hour peak flow following reclamation, and the freeboard will be adequate. Since the emergency spillway is at elevation 6148.0 feet, it will not pass water during the 25-year 6-hour storm event. The calculations for sedimentation Pond 011 are contained in Appendix 3.4I.~~

~~The peak inflows into the north and south inlets were calculated to be 1.99 and 3.77 cfs, respectively, as shown in Appendix 3.4I. These inflow rates are lower than those calculated for the operational period (compare with Appendix 3.4E). Hence, riprap in these inlet channels will be adequate to safely control erosion during the reclamation period.~~

~~**Reclamation Pond 012** - Since the main access road traversing the Preparation Plant site will be removed during Phase I of reclamation, it cannot serve as a berm to transmit disturbed area runoff to Pond 012A. Thus, Pond 012A will be removed under Phase I reclamation, as mentioned above. Pond 012B was evaluated to determine its capacity to contain the 10-year 24-hour storm event and sufficient sediment erosion from the watersheds identified on Map 3.4-9.~~

~~Pond 012B was modified in 1991 and again in 1997 for the purposes of operational hydrology sediment control. The three year reclamation sediment storage volume for Pond 012B of 9573 cubic feet (0.22 acre-feet) was calculated using methods described in Chapter 7. The calculations are contained in Appendix 3.4I. The storm runoff volume from the 10-year 24-hour storm event is 60,025 cubic feet (1.38 acre-feet) during Phase I reclamation. These results are based on a curve number of 75 for the 9.91 acres of undisturbed area, and a curve number of 80 for the 28.94 acres of reclaimed area. The minimum necessary capacity of the pond at the elevation of the spillway must be 69,600 cubic feet (1.60 acre feet). Thus, the pond is undersized for its use during Phase I reclamation.~~

~~The design of Pond 012B was modified to increase its capacity without affecting the existing spillway structure. A plan view and two section views of the modified pond (referred to as Pond 012) are shown in Map 3.4-11. From the stage-capacity curve contained in Appendix 3.4I, the allowable storage at the spillway elevation (6097.5 feet) is 80,500 cubic feet. Therefore the pond will fully contain the 10-year 24-hour storm event and more than three years of sediment once it is enlarged.~~

~~The 25-year 6-hour storm event (1.6 inches of precipitation (Miller, et. al., 1973)) was used to assess the capacity of the existing Pond 012B spillway for use during Phase I of reclamation. The calculation methods used are described in Chapter 7, while the calculations are contained in Appendix 3.4I. Computations were conducted assuming that the pond was full of water up to the spillway elevation at the beginning of the storm event.~~

~~Using the above assumptions, SEDIMOT II calculated a maximum inflow rate of 5.94 cfs and a maximum outflow rate of 3.26 cfs for the modified Pond 012. The corresponding high water elevation is 6097.88 feet, 0.38 feet above the primary spillway flowline and 1.12 feet below the minimum embankment elevation of 6099.0 feet. Therefore, Pond 012 as modified under this design and the existing spillway are adequate to pass the 25-year 6-hour storm event during Phase I reclamation. The pond is considered adequate to meet the requirements of R645-301-742.220.~~

~~Appendix 3.4I includes the calculations for the inlet channel design. A trapezoidal inlet three feet wide and 1.4 feet deep with 3H:1V side slopes will be sufficient to transmit the maximum design flow of 5.94 cfs. This cross section will allow for one foot of freeboard. The peak flow velocity of 4.1 fps requires protection by riprap with and average diameter of 2 inches.~~

~~The spillway outlet channel of the modified Pond 012 was evaluated to determine its suitability to transmit the maximum design discharge (Appendix 3.4I). The existing open channel spillway on Pond 012B has a bottom width of 6 feet, side slopes of 2H:1V, and a channel slope of 50%. The design flow depth with the design discharge of 3.26 cfs is 0.1 feet. Since the existing channel is one foot deep, 0.9 feet of freeboard will be available during a 25 year 6 hour storm event during Phase I of reclamation. The maximum flow velocity of 5.9 fps requires an average riprap diameter of 4 inches. The existing outlet channel on Pond 012B has 9 inch riprap, and thus the outlet channel need not be modified for reclamation.~~

~~Pond 012 will be dewatered using the existing decant pipe system. The approximate flowline elevation of the dewatering device is 6093.5, which is above the maximum sediment storage elevation. Refer to Map 3.4-11 for a typical section of the existing decant system. Prior to dewatering, the impounded water will be sampled and tested to insure that it meets NPDES discharge requirements.~~

~~**Pond 013** - As indicated in the calculations contained in Appendix 3.4I, the storm runoff volume for the 10-year 24-hour event is 101,200 cubic feet. This assumes a curve number of 75 for the 59.6 acres of undisturbed area contributing Pond 013. A curve number of 80 was used for the 24.1 acres of reclaimed area. The stage-area and stage-capacity data for Pond 013 were previously determined from the pond topography contained in Map 3.4-7 (See Appendix 3.4E). From the stage-capacity curve, the allowable storage at the spillway elevation (6,205.0 ft) is approximately 392,000 cubic feet (9.00 acre-feet). Therefore, available sediment storage is more than adequate.~~

~~Appendix 3.4E includes an evaluation of the spillway and the inlet and outlet channels for the 100-year 6-hour storm event. These existing structures were deemed adequate for operational hydrology design flows. With a reduction of storm runoff design flows during reclamation, the existing structures are suitable for use during Phase I of reclamation without modifications.~~

~~According to R645-301-742.221.34 (DOGM, 1990), a non-clogging dewatering device must be installed in the pond. Because the pond does not require reconstruction, it will be dewatered using a pump system. The pond will be dewatered to the maximum sediment storage elevation. The pump system will include an oil skimmer to prevent floating matter from being discharged from the pond during dewatering. Prior to dewatering, the impounded water will be sampled and tested to insure that it meets NPDES discharge requirements.~~

3.4-6(4) ~~Reclamation~~ Alternative Sediment Controls Measures

Due to the desire to avoid redisturbance in a future phase of reclamation, the operational hydrology sedimentation ponds 011, 012A and 012B, and 013 will be removed during the reclamation grading operations. Therefore, alternative sediment control measures will be implemented during reclamation of the site to reduce the quantity of sediment yield from the area. These ASCMs will include the following practices in varying degrees: ~~Cyprus proposes to employ the following alternative methods in varying degrees to limit and control~~

~~sediment erosion in those reclaimed areas whose storm runoff does not flow to sedimentation Ponds 011, 012, or 013:~~

1. ~~Filter fabric (silt) fences~~ Placement of growth media,
2. ~~Surface ripping~~ Incorporation of hay mulch into the growth media,
3. ~~Mulch~~ Deep gouging of the growth media,
4. ~~Chemical (tackifier) added to mulch~~ Seeding the prepared soil,
5. ~~Straw bales~~ Addition of more mulch following seeding, and
6. ~~Seeding~~ Physically or chemically anchoring the final mulch layer.
7. ~~Reseeding areas that do not exhibit successful germination~~

Based on Simons, Li & Associates (1983), these methods constitute some of the best available control technology for the purpose of mining reclamation. These methods have been very successful at recently reclaimed sites and are expected to work well an this site.

The ~~proposed~~ alternative sediment control measures can be classified into three categories: filtering structures, mechanical treatment, and surface protection measures. Filtering structures inhibit runoff and sediment transport capacity by reducing flow velocity. They also physically trap sediment in the filter openings while allowing water to pass through. Mechanical treatment increases surface roughness thereby reducing overland flow velocity, which minimizes the sediment transport capacity. Detaining some of the would-be runoff also improves soil moisture for plant germination. Surface protection measures include mulching, mulch binders, netting, and seeding. These measures are the most effective controls since they minimize the amount of soil detached by raindrop impact, and thus limit soil loss at the source. Surface protection measures also increase the surface roughness and increase water infiltration into the ground.

~~Simons, Li & Associates (1983) indicates that synthetic filter fabric is more efficient than straw bales at trapping silt and, therefore, synthetic fabric fences and not straw bales will be utilized wherever possible. The sections of the reclamation stream channels protected by silt fences are indicated on Map 3.4-9. The fences will be installed parallel to the contours with the ends of the fences turned up perpendicular to the contours to contain the sediment. Silt fences will be installed in accordance with Figures 3.4-9 and 3.4-10. The filter fabric will be composed~~

~~of a UV-resistant, perforated synthetic fabric with an integral supportive netting. A separate supportive backing could be used in lieu of the integral netting. To prevent sediment runoff from passing under the fence, the fabric will be secured by burying the bottom edge of it in a small trench along the length of the fence.~~

~~Calculations have been performed that verify that a single tier system of 36" high silt fences will be adequate to capture sediment during a 10-year 6-hour storm event without failing, assuming they are properly maintained. Length, spacing, and angle of the fence segments are contingent on the slope of the channel, the slope of the reclaimed surface immediately adjacent to the channel, and the relative expected sediment load along each specific reach of the canyon. For example, fence segments along the east side of CGRD-5 along the upper reach should be 50 feet in length and spaced approximately 55 feet on center, angled at about 45° from a line perpendicular to the channel. This general configuration will allow the fence segments to be parallel to the contours adjacent to the channel, and to provide a 10 foot projected overlap. See Figures 3.4-9 and 3.4-10 for a typical silt fence installation, and Appendix 3.4K for supporting calculations.~~

Mechanical treatment of slopes ~~of less than 20%~~ will be performed by ripping and/or deep gouging the soil to a depth of 18" to 24". Ripper shanks, if used, should be spaced about seven feet apart, or as allowed by the piece of equipment, and create parallel slots four to ten inches wide. Ripping and or deep gouging will loosen the soil and allow root penetration, increase surface roughness, and increase moisture storage. This will allow for quicker vegetation establishment, which will reduce erosion. The depressions from roughening trap sediment dislodged by raindrop impact and overland flow. They also shorten the exposed reaches over which runoff will flow, thereby reducing the sediment carrying capacity of the runoff.

In regard to surface protection measures, the incorporation of the mulch into the surface roughening will ensure that the major portion of mulch is anchored on site. ~~a chemical additive will be used in combination with wood fiber mulch to help prevent the removal of the mulch by~~

~~wind.~~ The mulch itself can significantly reduce the amount of sediment yield from an area (Simons, Li & Associates, 1983) The mulch also helps retain moisture to allow for seed germination. Based on a rainfall intensity factor of 0.61 inches per hour, the minimum mulch application rate is 0.9 tons per acre to prevent mulch removal by rainfall (Simon et al., 1983). The referenced figure assumes that no chemical binder will be used. The intensity factor corresponds to a 10-year 6-hour storm event. Mulch, with a tackifier, will be applied at the rate of 2,000 pounds per acre.

Permanent plant growth is the best method of controlling erosion from slopes, according to Simons, Li & Associates (1983). Upon completion of the grading in accordance with the plan depicted in Map 3.4-~~10~~ 9, and ~~ripping~~ mechanical treatment of the soil, the reclaimed area will be seeded with grasses, shrubs and forbs ~~legumes~~. The species seed mix is addressed in Chapter 9, and Section 5.3, Volume I. Seeding will be performed at the appropriate time of the year in consideration of available moisture for germination. Areas in which the seed does not germinate will be reseeded. Following seeding the area will be mulched again at a rate of 1.0 to 1.5 tons per acre

Appendix 3.4K presents calculations that quantify the sediment yield that could be expected annually under pre-mining conditions, immediately after reclamation, and after vegetation establishment, as 20.78 tons/acre/yr, 0.12 tons/acre/yr, and 18.82 tons/acre/yr, respectively ~~and during a 10-year 6-hour storm event with and without various sediment control measures in place~~. These calculations were performed to compare the sediment yield during each of the time periods to demonstrate that the reclaimed surface will produce less sediment than the same area under undisturbed conditions ~~improvement of the sediment control measures listed above against background levels~~. The cumulative implementation of each sediment control measure substantially reduces the amount of sediment eroded from the reclaimed areas, to the point that the mulch and roughening theoretically inhibits soil loss more effectively than the undisturbed ground cover. Since the undisturbed areas contributing sediment to the stream channels ~~through silt fences~~ are often larger than the reclaimed areas, most of the sediment erosion will occur from the undisturbed areas. As long as the depressions

from surface roughening are in place, the sediment yield from upgradient areas will be prevented from reaching any stream channels. ~~More than 90% of the sediment loss trapped by the silt fence along CGRD-5 was calculated to be from the undisturbed areas. Thus, the background sediment loss overshadows the sediment loss from the reclaimed areas once the wood fiber mulch is in place. In addition, the combination of the surface sediment controls on the reclaimed areas and the silt fences along the channels reduces the silt load from the reclaimed areas to the streams by approximately 80% from what it would be if the same reclaimed areas were undisturbed and in their natural state.~~

Whenever possible, a minimum of one method of sediment control will be in place during reclamation construction. Filter fabric (silt) fences and/or straw bales will be installed to collect sediment runoff from areas which will not report to sedimentation ponds as soon as it is feasible to do so. Upon completion of the grading and soil ripping, the reclaimed area will be seeded and mulched ~~using either hydromulching or straw tacked by a suitable netting~~.

The possibility exists that a 10-year 6-hour storm (or larger) will occur during the grading and removal of the sedimentation ponds. Although every reasonable effort will be made to have at least one sediment control measure in place, there may be a period of time when that is not feasible. However, the probability that a 10-year event will occur during the construction period of approximately six months is only 5.1% (Linsley and Frazini, 1979). This probability is relatively small, and thus no special measures will be taken to address the possibility.

The alternative sediment controls constructed during ~~Phase I~~ reclamation will be inspected quarterly or after every major storm event. Observations made during these inspections, as well as corrective actions taken, will be recorded. Corrections to any weaknesses in the implementation of the sediment control plan will be remedied immediately to prevent future silt runoff into the Price River. Corrective action will be taken when ~~trapped sediment builds up along a silt fence to half its height, when the sediment fence is listing more than 20 degrees from the vertical, when the straw bales become 50% saturated with silt, when~~ a gully greater than ~~six~~ nine inches in depth is created due to lack of vegetation establishment,

or when the mulch and seed have been transported by wind or overland flow. Corrective action will consist of ~~repairing/replacing or adding filter fabric fences as necessary, replacing straw bales,~~ regrading of the ground surface only as necessary to fill in six inch gullies caused by erosion, and reseeding and mulching, as warranted, to reestablish vegetation. ~~Soil material trapped by sediment control structures that is not used in repairing erosion damage on the site will be removed and disposed of within the boundaries of the Willow Creek Mine permit area.~~

~~All alternative sediment control structures will remain in place for a minimum of two years after the last seeding, until the removal is authorized by DOGM, until vegetation over the reclaimed area is properly established in accordance with R645-301-763.100, and the water quality bond release standards of R645-301-880.320 are complied with.~~

3.4-7 Reclamation Timetable

The following time frames can be used to estimate the length of time for reclamation.

1. Demolition	Week ~~1 - 36~~ Completed with the exception of the Load out facility
2. Grading	Week ~~36 - 60~~ 1-28
~~3. Installation of Alternative Control Measures (ASCM's)~~	~~Week 36 - 40~~
3 ~~4~~. Resoiling	Week ~~60 - 72~~ 4-30
4 ~~5~~. Seed bed preparation	Week ~~73~~ 5-32
5 ~~6~~. Seeding & mulching	Week ~~74~~ 6-34 ~~After Oct. 1~~
~~7. Pond and ASCM maintenance~~	~~0 - 2 years after seeding~~
~~8. Removal of Ponds 011, 012, 013, and removal of ASC structures~~	~~All alternative sediment control structures will remain in place for a minimum of two years after the last seeding, until the removal is authorized by DOGM, until vegetation over the reclaimed area is~~

	~~properly established in accordance with R645-301-763.100, and the water quality bond release standards of R645-301-880.320 are complied with.~~
6 ~~9~~. Vegetation and water monitoring	~~2 -~~ For 10 years after seeding
7 ~~10~~. Reclamation Monitoring	Until Bond Release

3.4-8 Reclamation Costs

The reclamation bond amount calculated for the Postmining land use change for the Preparation Plant Area and Refuse Pile is presented in Exhibit 17. Actual and accepted contractor bid costs for the refuse pile area are used in this bonding cost.

TABLE 3.4-5
RECLAMATION MASS BALANCE SUMMARY

WILLOW CREEK MINE PREPARATION PLANT REFUSE PILE

AREA	CUT (CY)		FILL (CY)		NET (CY)	
	Subsoil	Topsoil	Subsoil	Topsoil	Subsoil	Topsoil
Refuse Pile (refuse only)	172,318		169,421	0	2,897 (C)	0
Topsoil from Gravel Canyon Stockpile	0	80,654	0	0	0	80,654 (C)
Channel from Pond 13 to the road (CGRD-1)	20,508 [(a)]	0	4,362	0	16,146 (C)	0
Topsoil need to cover refuse with 3' of soil	0	0	0	96,800	0	96,800 (F)
SUBTOTAL	192,826	80,654	173,783	96,800	19,043 (C)	16,146 (F)
TOTAL	273,480		270,583		2,897 (C)	

WILLOW CREEK MINE PREPARATION PLANT AREA

AREA	CUT (CY)		FILL (CY)		NET (CY)	
	Subsoil	Topsoil	Subsoil	Topsoil	Subsoil	Topsoil
Concrete and surface coal waste to be buried	3,000	0	0	0	3,000 (C)	0
Train Loadout	756	0	556	0	200 (C)	0
Clean Coal Stockpile Area	5,187	0	15,014	10,639	9,827 (F)	10,639 (F)
Prep Plant and Raw Coal Stockpile Area	10,703	0	33,155	0	22,452 (F)	0
Access Road to Refuse Pile	10,233	0	10,559	0	326 (F)	0
Belt Transfer Tower Area	41	0	1,528	0	1,487 (F)	0
Topsoil from Gravel Canyon to cover Clean Coal Stockpile Slope	0	10,639	0	0	0	10,639 (C)
Excess topsoil from Gravel Canyon	0	32,156	0	0	0	32,156 (C)
SUBTOTAL	29,920	42,795	60,812	10,639	30,892 (F)	32,156 (C)
TOTAL	72,715		71,451		1,264 (C)	

(a) Most of this cut is from the Pond 013 embankment and will be used as growth media to cover the coal refuse with 3' of soil.

(b) Volume calculation by GRID method with a node spacing of 10 feet or less and a swell factor of 1.0. (Softdesk, Inc., formerly DCA Software, Inc.)

(c) Excess cut material and fill shortages will be compensated for in the field with minor excavation and backfill modifications during reclamation construction activities. Changes will be based on survey information generated during reclamation.

TABLE 3.4-7

RECLAMATION DITCH DESIGN SUMMARY

Diversion Ditch (CGRD-)	Design Flow (cfs)	Minimum Conditions				Calculation Results		Min. Design Requirements	
		Bottom Width (ft)[a]	Side Slopes (ft)	Max. Bottom Slope (%)	Min. Bottom Slope (%)	Max. Velocity (ft/s)	Max. Flow Depth (ft)	Channel Depth (ft)	Riprap D_{50} (in)
1	36.92	8	2:1	29.0	4.7	8.24	0.72	1.5	12
2	4.36	3	2:1	27.0	2.0	5.38	0.39	1.0	6
3 (MS)[b]	1.80	3	2:1	10.0	2.0	3.57	0.24	1.0	None
3 (SS)[b]	1.80	3	2:1	23.5	10.0	3.82	0.17	1.0	6
4 (MS)[b]	1.82	3	2:1	10.0	2.0	3.58	0.25	1.0	none
4 (SS)[b]	1.82	3	2:1	32.3	10.0	4.12	0.17	1.0	6
5 (MS)[b]	3.08	3	2:1	4.7	2.0	3.36	0.33	1.0	None
5 (SS)[b]	3.08	3	2:1	32.3	4.7	4.96	0.27	1.0	6
6	0.12	3	2:1	26.7	2.7	1.91	0.04	1.0	None
7	3.60	3	2:1	35.7	1	5.32	0.41	1.0	6
8	2.50	3	2:1	27.8	1	4.43	0.33	1.0	6
9	3.08	0	3:1	7.8	1.1	4.97	0.66	1.25	None
10	2.24	0	1.5:1	6.7	0.5	4.83	0.9	1.5	None
11	0.96	0	3:1	4.9	0.71	3.12	0.46	1.25	None

(a) Minimum bottom width measured at munimum depth from top of channel.
(b) MS = mild slope (no riprap), SS = steep slope (riprapped section).
(c) Riprap D_{50} calculated by using the Searcy method developed for the U.S. D.O.T.
(d) Channel dimensions represent the operational configuration. The watershed area changed and this calculation was done to verify that the operational channel was still adequate.

Revised: December 2003

TABLE 3.4-8

RECLAMATION CHANNEL RIPRAP AND FILTER BLANKET SUMMARY

Channel (CGRD-)[e]	Riprap D_{50} (in)	Length (ft)	Riprap Thickness (in)	Riprap Volume (ft^3)	Filter Thickness (in)	Filter Volume (ft^3)
1	12	2,680	24	96,480	12	64,320
2	6	110	12	990	6	660
3	6	90	12	810	6	540
4	6	130	12	1,170	6	780
5	6	210	12	1,890	6	1,260
7	6	75	12	675	6	450
8	6	75	12	675	6	450
TOTALS				102,690		68,460

Channels CGRD-6, CGRD-9, CGRD-10, and CGRD-8 require no riprap or filter (see Table 3.4-7)

Revised: December 2003

TABLE 3.4-9

RECLAMATION CULVERT DESIGN SUMMARY

Culvert (CGC-)	Size and Type	Slope (%)	Peak Flow (cfs)	Outflow Velocity (ft/s)	Actual Outlet D_{50} [(a)] (in)
1	18" CMP	17	0.12	3.48	None Req'd
2	2-84" CMP	5	222.90	14.29	30
5	60" Concrete	10	36.92	21.16	40

(a) Actual riprap size exceeds minimum requirements under reclamation

Note: The above culverts are existing operational culverts that will be left in place to convey runoff from reclamation channels under the road and railroad tracks to the Price River. Greater detail about these culverts can be found on Table 3.4-3.

CGC-5 will be replaced by channel CGRD-1 up to the road where the inlet is assumed to be projecting for the inlet capacity estimate.

Revised: December 2003

Design of Reclamation Diversions
Willow Creek Preparation Plant

Methodology

- Curve number techniques of the U.S. SCS (1972)
- Triangular unit hydrograph of the U.S. SCS (1972) as programed by Hawkins + Marshall (1979)
- Precipitation depths

10-yr, 6-hr → 1.4 in
100-yr, 6-hr → 2.1 in
} NOAA Atlas 2: Volume III - Utah

- Drainage Areas, slopes and hydraulic lengths determined using contour maps in AutoCad.
- All Calculations for the Refuse Pile are made assuming the 100-yr, 6-hr storm event. All other calculations assume a 10-yr, 6-hr storm event.
- The same CN for each vegetation type will be used as listed in Appendix 3.4D of Exhibit 19. Namely:

Conifer	CN = 65
Grassland / Sagebrush	CN = 70
Mixed Brush	CN = 75
Pinyon / Juniper	CN = 75
Disturbed	CN = 90
Reclaimed	CN = 75
Paved	CN = 98

see Exhibit 13, Appendix H-1, Page 2

- Hydrology calculations for the Pond 12a + 12b area can be found as part of the Willow Creek Mine Permit in Exhibit 13 Appendix H-1

REGISTERED PROFESSIONAL ENGINEER
12-17-03
No. 189797
LAYNE D. JENSEN
STATE OF UTAH

Willow Creek Prep Plant Reclamation Weighted Curve Numbers

Watershed	Undisturbed		Reclaimed		Disturbed.		Weighted
Area (a)	Area (ac.)	CN *	Area (ac.)	CN	Area (ac.)	CN #	CN (b)
CGRWS-1	130.5	71	25.5	75	0	85	72
CGRWS-2	11.7	75	0.1	75	0	85	75
CGRWS-3	4.6	75	0.1	75	0	85	75
CGRWS-4	4.6	75	0.1	75	0	85	75
CGRWS-5	7.85	75	0.2	75	0	85	75
CGRWS-6	3.9	70	0.88	75	0	90	71
CGRWS-7	0	75	0.89	75	4.59	90	88
CGRWS-8	0	75	0	75	5.41	91	91
CGRWS-9	5.24	75	9.97	75	4.21	91	78
CGRWS-10	0.35	75	1.34	75	1.89	91	83

Notes

a See Exhibit 3.4-11 for watershed locations

b Weighted CN = (CN1)(A1)+(CN2)(A2)+(CN3)(A3)+(CN4)(A4) / (A1+A2+A3+A4)

* Represents an area weighted average of vegetation types in undisturbed areas.

\# Represents an area weighted average of paved and disturbed areas or areas that were previously disturbed but revegetated with time.

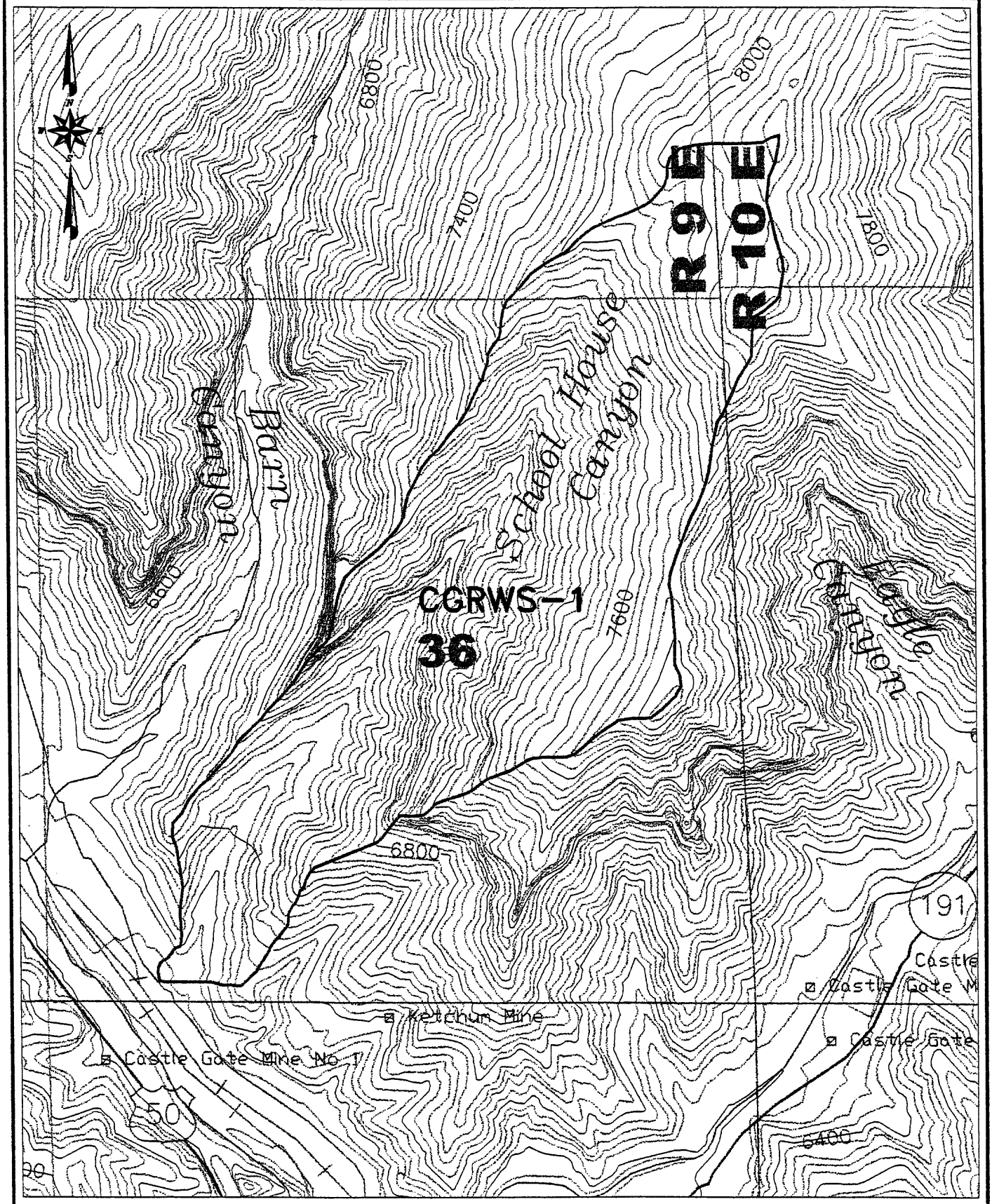
CASTLE GATE PREPARATION PLANT
REFUSE PILE RUNOFF SUMMARY

Watershed Area a	Drainage Area (ac)	Curve Number	S (in)	Y (%)	I (ft)	L (hr)	Time of Conc. (hr)	Peak Flow (cfs)
CGRWS-1	261.1	72	3.889	64	8175	0.270	0.450	36.92
CGRWS-2	11.8	75	3.333	90	1725	0.060	0.100	4.36
CGRWS-3	4.7	75	3.333	83.6	1265	0.049	0.081	1.80
CGRWS-4	4.7	75	3.333	96.6	1201	0.043	0.073	1.83
CGRWS-5	8.05	75	3.333	67.8	1080	0.048	0.080	3.08
CGRWS-6	4.78	71	4.085	62	1294	0.064	0.108	0.12
CGRWS-7	5.48	88	1.364	12.1	1330	0.087	0.146	2.5
CGRWS-8	5.41	91	0.989	14.6	2802	0.128	0.213	3.08
CGRWS-9	19	78	2.821	36.8	1963	0.096	0.160	2.24
CGRWS-10	3.24	83	2.048	36.9	980	0.047	0.078	0.95

Notes

Watershed locations can be found on Exhibit 3.4-10 and attached map
S = 1000/CN - 10
Y = average watershed slope = (length of contour lines)(contour interval)/(watershed area)
I = hydraulic length
L = watershed lag =(I^0.8(S+1)^0.7) / (1900(Y)^0.5)
Time of Concentration = 1.67L
Peak Flow is based on a 100-yr 6-hr storm event for CGWS – 1 through 5 and a 10 – yr 6 – hr storm
For the remaining watersheds.

G:\UC709\17\FINAL-WORK\WATERSHED.DWG



0' 1000'

FIGURE 1. SCHOOL HOUSE CANYON MAIN CHANNEL WATERSHED

EarthFax

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-1

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 261.10 acres
Depth = 2.10 inches	CN = 72.00
Duration = 6.0 hrs	Time conc.= 0.45 hrs

OUTPUT SUMMARY

Runoff depth: 0.335 inches
Initial abstr: 0.778 inches
Peak flow: 36.92 cfs (0.140 iph)
at time: 2.820 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-2

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 11.80 acres
Depth = 2.10 inches	CN = 75.00
Duration = 6.0 hrs	Time conc.= 0.10 hrs

OUTPUT SUMMARY

Runoff depth: 0.431 inches
Initial abstr: 0.667 inches
Peak flow: 4.36 cfs (0.366 iph)
at time: 2.520 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-3

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 4.70 acres
Depth = 2.10 inches	CN = 75.00
Duration = 6.0 hrs	Time conc.= 0.08 hrs

OUTPUT SUMMARY

Runoff depth: 0.431 inches
Initial abstr: 0.667 inches
Peak flow: 1.80 cfs (0.380 iph)
at time: 2.517 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-4

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 4.70 acres
Depth = 2.10 inches	CN = 75.00
Duration = 6.0 hrs	Time conc.= 0.07 hrs

OUTPUT SUMMARY

Runoff depth: 0.431 inches
Initial abstr: 0.667 inches
Peak flow: 1.83 cfs (0.386 iph)
at time: 2.511 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-5

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 8.05 acres
Depth = 2.10 inches	CN = 75.00
Duration = 6.0 hrs	Time conc.= 0.08 hrs

OUTPUT SUMMARY

Runoff depth: 0.431 inches
Initial abstr: 0.667 inches
Peak flow: 3.08 cfs (0.380 iph)
at time: 2.517 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-6

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 4.78 acres
Depth = 1.40 inches	CN = 71.00
Duration = 6.0 hrs	Time conc.= 0.11 hrs

OUTPUT SUMMARY

Runoff depth: 0.073 inches
Initial abstr: 0.817 inches
Peak flow: 0.12 cfs (0.026 iph)
at time: 3.520 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-7

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 5.48 acres
Depth = 1.40 inches	CN = 88.00
Duration = 6.0 hrs	Time conc.= 0.15 hrs

OUTPUT SUMMARY

Runoff depth: 0.510 inches
Initial abstr: 0.273 inches
Peak flow: 2.50 cfs (0.452 iph)
at time: 2.540 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-8

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 5.41 acres
Depth = 1.40 inches	CN = 91.00
Duration = 6.0 hrs	Time conc.= 0.21 hrs

OUTPUT SUMMARY

Runoff depth: 0.660 inches
Initial abstr: 0.198 inches
Peak flow: 3.08 cfs (0.565 iph)
at time: 2.548 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-9

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 19.00 acres
Depth = 1.40 inches	CN = 78.00
Duration = 6.0 hrs	Time conc.= 0.16 hrs

OUTPUT SUMMARY

Runoff depth: 0.191 inches
Initial abstr: 0.564 inches
Peak flow: 2.24 cfs (0.117 iph)
at time: 2.581 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-10

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 3.24 acres
Depth = 1.40 inches	CN = 83.00
Duration = 6.0 hrs	Time conc.= 0.08 hrs

OUTPUT SUMMARY

Runoff depth: 0.323 inches
Initial abstr: 0.410 inches
Peak flow: 0.95 cfs (0.292 iph)
at time: 2.517 hrs

Reclamation Channel Design

- All Channels related to the Refuse Pile are designed to handle a 100-yr, 6-hr storm event.
- All channels not associated with the refuse pile are designed to handle the 10-yr, 6-hr storm event.
- The Manning n for riprap channels will be determined based on the following equation.

$$n = 0.0456\,(D_{50} \times Slope)^{0.159}$$ Abt, et. al (1987)

where D_{50} = riprap size (in)
Slope = channel slope (ft/ft)

- A $n = 0.035$ will be used for rocky earthen channels.
- Riprap is not necessary for flows less than 5 fps.

Channels designed based on

- maximum slope to determine erosional stability
- minimum slope to determine cross-sectional requirements.

The maximum allowable velocity for a riprap channel is based on the method presented by Searcy (1967) See nomograph on pg of this calculation

The minimum freeboard and hence the channel depth is determined by adding 20% of the flow depth or 0.5' whichever is greater (Barfield et. al. 1994)

Flowmaster Calculation sheets	pages 18-45
Design Summary	page 17
Channel Cross-sections	pages 46-48

WILLOW CREEK MINE PREPARATION PLANT AND REFUSE PILE DIVERSION DITCH DESIGN FLOWS

Diversion Ditch	Contributing Watersheds	Design Flow (cfs)
CGRD-1	CGRWS-1	36.92
CGRD-2	CGRWS-2	4.36
CGRD-3	CGRWS-3	1.80
CGRD-4	CGRWS-4	1.83
CGRD-5	CGRWS-5	3.08
CGRD-6	CGRWS-6	0.12
CGRD-7	Flow from operational Ditch CGD-14, See Table 3.4-2	3.60
CGRD-8	CGRWS-7	2.50
CGRD-9	CGRWS-8	3.08
CGRD-10	CGRWS-9	2.24
CGRD-11	CGRWS-10	0.95

Note: When only part of a watershed contributes runoff to a ditch or culvert the runoff will be determined by multiplying the total flow by the percentage of the watershed area flowing to the ditch or culvert. In some cases the total watershed runoff may be used.

TAB[illegible]3.4-7

RECLAMATION DITCH DESIGN SUMMARY

Diversion Ditch (CGRD-)	Design Flow (cfs)	Minimum Conditions				Calculation Results		Min. Design Requirements	
		Bottom Width (ft)[a]	Side Slopes (ft)	Max. Bottom Slope (%)	Min. Bottom Slope (%)	Max. Velocity (ft/s)	Max. Flow Depth (ft)	Channel Depth (ft)	Riprap D_{50} (in)
1	36.92	8	2:1	29.0	4.7	8.24	0.72	1.5	12
2	4.36	3	2:1	27.0	2.0	5.38	0.39	1.0	6
3 (MS)[b]	1.80	3	2:1	10.0	2.0	3.57	0.24	1.0	None
3 (SS)[b]	1.80	3	2:1	23.5	10.0	3.82	0.17	1.0	6
4 (MS)[b]	1.82	3	2:1	10.0	2.0	3.58	0.25	1.0	none
4 (SS)[b]	1.82	3	2:1	32.3	10.0	4.12	0.17	1.0	6
5 (MS)[b]	3.08	3	2:1	4.7	2.0	3.36	0.33	1.0	None
5 (SS)[b]	3.08	3	2:1	32.3	4.7	4.96	0.27	1.0	6
6	0.12	3	2:1	26.7	2.7	1.91	0.04	1.0	None
7	3.60	3	2:1	35.7	1	5.32	0.41	1.0	6
8	2.50	3	2:1	27.8	1	4.43	0.33	1.0	6
9	3.08	0	3:1	7.8	1.1	4.97	0.66	1.25	None
10	2.24	0	1.5:1	6.7	0.5	4.83	0.9	1.5	None
11	0.96	0	3:1	4.9	0.71	3.12	0.46	1.25	None

(a) Minimum bottom width measured at munimum depth from top of channel.
(b) MS = mild slope (no riprap), SS = steep slope (riprapped section).
(c) Riprap D_{50} calculated by using the Searcy method developed for the U.S. D.O.T.
(d) Channel dimensions represent the operational configuration. The watershed area changed and this calculation was done to verify that the operational channel was still adequate.

CGRD-1 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.042	$D_{50} = 12''$
Slope	0.047000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	8.00 ft	
Discharge	36.92 cfs	

$n = 0.0456(D_{50} \times Slope)^{0.159}$
(Abt et. al.)

Results		
Depth	0.72 ft	< 1.5' ∴ ok
Flow Area	6.7 ft²	
Wetted Perimeter	11.20 ft	
Top Width	10.86 ft	
Critical Depth	0.81 ft	
Critical Slope	0.030353 ft/ft	
Velocity	5.47 ft/s	
Velocity Head	0.47 ft	
Specific Energy	1.18 ft	
Froude Number	1.22	
Flow Type	Supercritical	

CGRD-1 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.056	D_{50} = 12"
Slope	0.290000	ft/ft
Left Side Slope	2.00	H : V
Right Side Slope	2.00	H : V
Bottom Width	8.00	ft
Discharge	36.92	cfs

Results		
Depth	0.50	ft
Flow Area	4.5	ft²
Wetted Perimeter	10.23	ft
Top Width	9.99	ft
Critical Depth	0.81	ft
Critical Slope	0.053960	ft/ft
Velocity	8.24	ft/s < 10.75 fps ∴ ok
Velocity Head	1.06	ft
Specific Energy	1.55	ft
Froude Number	2.17	
Flow Type	Supercritical	

CGRD-2 MIN SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	PLATEAU MINING
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.032	$D_{50} = 6''$
Slope	0.020000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	4.36 cfs	100-yr 6-hr

$n = 0.0456 (D_{50} \times Slope)^{0.159}$

(Abt et. al)

Results		
Depth	0.39 ft	< 1.0' ok
Flow Area	1.5 ft²	
Wetted Perimeter	4.74 ft	
Top Width	4.55 ft	
Critical Depth	0.37 ft	
Critical Slope	0.023669 ft/ft	
Velocity	2.98 ft/s	
Velocity Head	0.14 ft	
Specific Energy	0.53 ft	
Froude Number	0.92	
Flow Type	Subcritical	

CGRD-2 MAX SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	PLATEAU MINING
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.049	$D_{50} = 6''$
Slope	0.270000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	4.36 cfs	100-yr 6-hr

Results		
Depth	0.23 ft	
Flow Area	0.8 ft²	
Wetted Perimeter	4.04 ft	
Top Width	3.93 ft	
Critical Depth	0.37 ft	
Critical Slope	0.054693 ft/ft	
Velocity	5.38 ft/s	< 7.5 fps
Velocity Head	0.45 ft	
Specific Energy	0.68 ft	
Froude Number	2.09	
Flow Type	Supercritical	

CGRD-3 MIN SLOPE No Riprap
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	PLATEAU MINING
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	rocky soil
Slope	0.020000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	1.80 cfs	

Results		
Depth	0.24 ft	< 1.0' ok
Flow Area	0.9 ft²	
Wetted Perimeter	4.09 ft	
Top Width	3.98 ft	
Critical Depth	0.21 ft	
Critical Slope	0.032172 ft/ft	
Velocity	2.11 ft/s	< 5.0 fps ok
Velocity Head	0.07 ft	
Specific Energy	0.31 ft	
Froude Number	0.80	
Flow Type	Subcritical	

CGRD-3 NO RIPRAP MAX SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Plateau Mining
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	Rocky soil
Slope	0.100000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	1.80 cfs	

Results		
Depth	0.15 ft	
Flow Area	0.5 ft²	
Wetted Perimeter	3.68 ft	
Top Width	3.61 ft	
Critical Depth	0.21 ft	
Critical Slope	0.032172 ft/ft	
Velocity	3.57 ft/s	< 5.0 fps ok
Velocity Head	0.20 ft	
Specific Energy	0.35 ft	
Froude Number	1.68	
Flow Type	Supercritical	

CGRD-3 RIPRAP MIN SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Plateau Mining
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.042	D_{50} = 6"
Slope	0.100000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	1.80 cfs	

Results		
Depth	0.17 ft	< 1.0' ok
Flow Area	0.6 ft²	
Wetted Perimeter	3.76 ft	
Top Width	3.68 ft	
Critical Depth	0.21 ft	
Critical Slope	0.046329 ft/ft	
Velocity	3.17 ft/s	
Velocity Head	0.16 ft	
Specific Energy	0.33 ft	
Froude Number	1.42	
Flow Type	Supercritical	

CGRD-3 RIPRAP MAX SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Plateau Mining
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.048	D_{50} = 6"
Slope	0.235000	ft/ft
Left Side Slope	2.00	H : V
Right Side Slope	2.00	H : V
Bottom Width	3.00	ft
Discharge	1.80	cfs

Results		
Depth	0.14	ft
Flow Area	0.5	ft²
Wetted Perimeter	3.64	ft
Top Width	3.57	ft
Critical Depth	0.21	ft
Critical Slope	0.061015	ft/ft
Velocity	3.82	ft/s < 7.5 fps ok
Velocity Head	0.23	ft
Specific Energy	0.37	ft
Froude Number	1.86	
Flow Type	Supercritical	

CGRD-4 NO RIPRAP MIN SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Plateau Mining
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	rocky soil
Slope	0.020000	ft/ft
Left Side Slope	2.00	H : V
Right Side Slope	2.00	H : V
Bottom Width	3.00	ft
Discharge	1.82	cfs

Results		
Depth	0.25 ft	< 1.0' ok
Flow Area	0.9 ft²	
Wetted Perimeter	4.10 ft	
Top Width	3.98 ft	
Critical Depth	0.21 ft	
Critical Slope	0.032110 ft/ft	
Velocity	2.12 ft/s	
Velocity Head	0.07 ft	
Specific Energy	0.32 ft	
Froude Number	0.80	
Flow Type	Subcritical	

CGRD-4 NO RIPRAP MAX SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Plateau Mining
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	rocky soil
Slope	0.100000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	1.82 cfs	

Results		
Depth	0.15 ft	
Flow Area	0.5 ft²	
Wetted Perimeter	3.69 ft	
Top Width	3.61 ft	
Critical Depth	0.21 ft	
Critical Slope	0.032110 ft/ft	
Velocity	3.58 ft/s	< 5.0 fps OK
Velocity Head	0.20 ft	
Specific Energy	0.35 ft	
Froude Number	1.68	
Flow Type	Supercritical	

CGRD-4 RIPRAP MIN SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Plateau Mining
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.042	$D_{50} = 6''$
Slope	0.100000	ft/ft
Left Side Slope	2.00	H : V
Right Side Slope	2.00	H : V
Bottom Width	3.00	ft
Discharge	1.82	cfs

Results		
Depth	0.17	ft < 1.0' OK
Flow Area	0.6	ft²
Wetted Perimeter	3.76	ft
Top Width	3.68	ft
Critical Depth	0.21	ft
Critical Slope	0.046240	ft/ft
Velocity	3.18	ft/s
Velocity Head	0.16	ft
Specific Energy	0.33	ft
Froude Number	1.43	
Flow Type	Supercritical	

CGRD-4 RIPRAP MAX SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Plateau Mining
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.051	D_{50} = 6"
Slope	0.323000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	1.82 cfs	

Results		
Depth	0.14 ft	
Flow Area	0.4 ft²	
Wetted Perimeter	3.60 ft	
Top Width	3.54 ft	
Critical Depth	0.21 ft	
Critical Slope	0.067114 ft/ft	
Velocity	4.12 ft/s	< 7.5 fps ok
Velocity Head	0.26 ft	
Specific Energy	0.40 ft	
Froude Number	2.06	
Flow Type	Supercritical	

CGRD-5 NO RIPRAP MIN SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Plateau Mining
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	rocky soil
Slope	0.020000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	3.08 cfs	

Results		
Depth	0.33 ft	< 1.0' ok
Flow Area	1.2 ft²	
Wetted Perimeter	4.49 ft	
Top Width	4.33 ft	
Critical Depth	0.30 ft	
Critical Slope	0.029381 ft/ft	
Velocity	2.52 ft/s	
Velocity Head	0.10 ft	
Specific Energy	0.43 ft	
Froude Number	0.84	
Flow Type	Subcritical	

CGRD-5 NO RIPRAP MAX SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Plateau Mining
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	rocky soil
Slope	0.047000	ft/ft
Left Side Slope	2.00	H : V
Right Side Slope	2.00	H : V
Bottom Width	3.00	ft
Discharge	3.08	cfs

Results		
Depth	0.26	ft
Flow Area	0.9	ft²
Wetted Perimeter	4.17	ft
Top Width	4.04	ft
Critical Depth	0.30	ft
Critical Slope	0.029382	ft/ft
Velocity	3.36	ft/s < 5.0 fps ok
Velocity Head	0.18	ft
Specific Energy	0.44	ft
Froude Number	1.24	
Flow Type	Supercritical	

CGRD-5 RIPRAP MIN SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Plateau Mining
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.037 $D_{50} = 6''$
Slope	0.047000 ft/ft
Left Side Slope	2.00 H : V
Right Side Slope	2.00 H : V
Bottom Width	3.00 ft
Discharge	3.08 cfs

Results	
Depth	0.27 ft < 1.0' ok
Flow Area	1.0 ft²
Wetted Perimeter	4.21 ft
Top Width	4.08 ft
Critical Depth	0.30 ft
Critical Slope	0.033369 ft/ft
Velocity	3.22 ft/s
Velocity Head	0.16 ft
Specific Energy	0.43 ft
Froude Number	1.17
Flow Type	Supercritical

CGRD-5 RIPRAP MAX SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Plateau Mining
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.051	$D_{50} = 6''$
Slope	0.323000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	3.08 cfs	

Results		
Depth	0.18 ft	
Flow Area	0.6 ft²	
Wetted Perimeter	3.82 ft	
Top Width	3.74 ft	
Critical Depth	0.30 ft	
Critical Slope	0.061651 ft/ft	
Velocity	4.96 ft/s	< 7.5 fps ok.
Velocity Head	0.38 ft	
Specific Energy	0.57 ft	
Froude Number	2.14	
Flow Type	Supercritical	

CGRD-6 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	bare earth
Slope	0.027000	ft/ft
Left Side Slope	2.00	H : V
Right Side Slope	2.00	H : V
Bottom Width	3.00	ft
Discharge	0.12	cfs

Results		
Depth	0.04	ft < 1.0' ok
Flow Area	0.1	ft²
Wetted Perimeter	3.18	ft
Top Width	3.16	ft
Critical Depth	0.04	ft
Critical Slope	0.040148	ft/ft
Velocity	0.95	ft/s
Velocity Head	0.01	ft
Specific Energy	0.06	ft
Froude Number	0.84	
Flow Type	Subcritical	

CGRD-6 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	bare earth
Slope	0.267000	ft/ft
Left Side Slope	2.00	H : V
Right Side Slope	2.00	H : V
Bottom Width	3.00	ft
Discharge	0.12	cfs

Results		
Depth	0.02	ft
Flow Area	0.1	ft²
Wetted Perimeter	3.09	ft
Top Width	3.08	ft
Critical Depth	0.04	ft
Critical Slope	0.040147	ft/ft
Velocity	1.91	ft/s < 5.0 fps ok
Velocity Head	0.06	ft
Specific Energy	0.08	ft
Froude Number	2.35	
Flow Type	Supercritical	

CGRD-7 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	$D_{50} = 6''$
Slope	0.010000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	3.60 cfs	from CGD-14 peak flow

Results		
Depth	0.41 ft	< 1.0' ok
Flow Area	1.5 ft²	
Wetted Perimeter	4.82 ft	
Top Width	4.62 ft	
Critical Depth	0.33 ft	
Critical Slope	0.021048 ft/ft	
Velocity	2.32 ft/s	
Velocity Head	0.08 ft	
Specific Energy	0.49 ft	
Froude Number	0.71	
Flow Type	Subcritical	

CGRD-7 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.052	$D_{50} = 6''$
Slope	0.357000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	3.60 cfs	From flow in CGD-14.

Results		
Depth	0.20 ft	
Flow Area	0.7 ft²	
Wetted Perimeter	3.89 ft	
Top Width	3.80 ft	
Critical Depth	0.33 ft	
Critical Slope	0.063236 ft/ft	
Velocity	5.32 ft/s	< 7.5 fps
Velocity Head	0.44 ft	
Specific Energy	0.64 ft	
Froude Number	2.22	
Flow Type	Supercritical	

CGRD-8 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	D_{50} = 6"
Slope	0.010000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	2.50 cfs	

Results		
Depth	0.33 ft	< 1.0' ok
Flow Area	1.2 ft²	
Wetted Perimeter	4.48 ft	
Top Width	4.32 ft	
Critical Depth	0.26 ft	
Critical Slope	0.022346 ft/ft	
Velocity	2.07 ft/s	
Velocity Head	0.07 ft	
Specific Energy	0.40 ft	
Froude Number	0.69	
Flow Type	Subcritical	

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CGRD-8 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.050	D_{50} = 6"
Slope	0.278000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	3.00 ft	
Discharge	2.50 cfs	

Results		
Depth	0.17 ft	
Flow Area	0.6 ft²	
Wetted Perimeter	3.76 ft	
Top Width	3.68 ft	
Critical Depth	0.26 ft	
Critical Slope	0.062071 ft/ft	
Velocity	4.43 ft/s	< 7.5 fps ok
Velocity Head	0.30 ft	
Specific Energy	0.47 ft	
Froude Number	1.99	
Flow Type	Supercritical	

CGRD-9 MINIMUM SLOPE
Worksheet for Triangular Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	bare earth
Slope	0.011000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Discharge	3.08	cfs

Results		
Depth	0.66 ft	< 1.25' ok
Flow Area	1.3 ft²	
Wetted Perimeter	4.15 ft	
Top Width	3.94 ft	
Critical Depth	0.58 ft	
Critical Slope	0.021258 ft/ft	
Velocity	2.39 ft/s	
Velocity Head	0.09 ft	
Specific Energy	0.74 ft	
Froude Number	0.73	
Flow Type	Subcritical	

CGRD-9 MAXIMUM SLOPE
Worksheet for Triangular Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	bare earth
Slope	0.078000 ft/ft	
Left Side Slope	3.00 H : V	
Right Side Slope	3.00 H : V	
Discharge	3.08 cfs	

Results		
Depth	0.45 ft	
Flow Area	0.6 ft²	
Wetted Perimeter	2.87 ft	
Top Width	2.73 ft	
Critical Depth	0.58 ft	
Critical Slope	0.021258 ft/ft	
Velocity	4.97 ft/s	< 5.0 fps. close but ok
Velocity Head	0.38 ft	
Specific Energy	0.84 ft	
Froude Number	1.84	
Flow Type	Supercritical	

Also the steepest slope is at the beginning of the channel where the discharge is much less and therefore the velocity will be lower.

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CGRD-10 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	Bare earth
Slope	0.005000	ft/ft
Left Side Slope	1.50	H : V
Right Side Slope	1.50	H : V
Bottom Width	0.00	ft
Discharge	2.24	cfs

Results		
Depth	0.90	ft < 1.5' ok
Flow Area	1.2	ft²
Wetted Perimeter	3.26	ft
Top Width	2.71	ft
Critical Depth	0.67	ft
Critical Slope	0.024087	ft/ft
Velocity	1.83	ft/s
Velocity Head	0.05	ft
Specific Energy	0.96	ft
Froude Number	0.48	
Flow Type	Subcritical	

CGRD-10 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	bare earth
Slope	0.067000 ft/ft	
Left Side Slope	1.50 H : V	represents configuration of the operational ditch. This calculation verifies that the current ditch is adequate.
Right Side Slope	1.50 H : V	
Bottom Width	0.00 ft	
Discharge	2.24 cfs	

Results		
Depth	0.56 ft	
Flow Area	0.5 ft²	
Wetted Perimeter	2.00 ft	
Top Width	1.67 ft	
Critical Depth	0.67 ft	
Critical Slope	0.024087 ft/ft	
Velocity	4.83 ft/s	< 5.0 fps ∴ OK
Velocity Head	0.36 ft	
Specific Energy	0.92 ft	
Froude Number	1.62	
Flow Type	Supercritical	

CGRD-11 MINIMUM SLOPE
Worksheet for Triangular Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	bare earth
Slope	0.007100	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Discharge	0.96	cfs

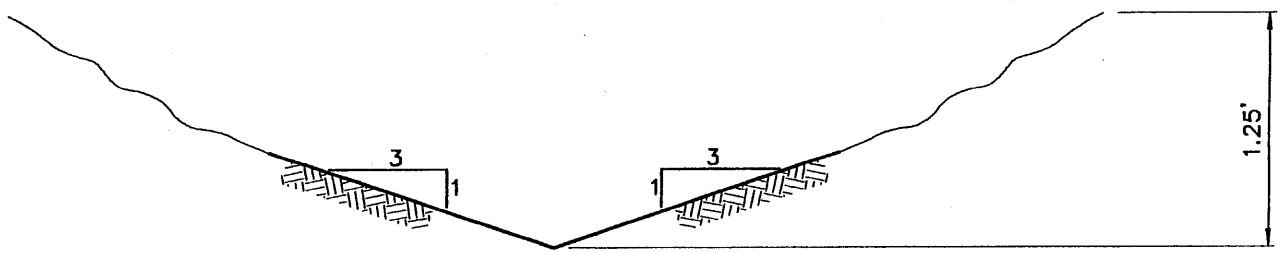
Results		
Depth	0.46 ft	< 1.25' ∴ ok
Flow Area	0.6 ft²	
Wetted Perimeter	2.91 ft	
Top Width	2.76 ft	
Critical Depth	0.36 ft	
Critical Slope	0.024832 ft/ft	
Velocity	1.51 ft/s	
Velocity Head	0.04 ft	
Specific Energy	0.50 ft	
Froude Number	0.56	
Flow Type	Subcritical	

CGRD-11 MAXIMUM SLOPE
Worksheet for Triangular Channel

Project Description	
Worksheet	Preparation Plant Hydrology
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	bare earth
Slope	0.049000 ft/ft	
Left Side Slope	3.00 H : V	
Right Side Slope	3.00 H : V	
Discharge	0.96 cfs	

Results		
Depth	0.32 ft	
Flow Area	0.3 ft²	
Wetted Perimeter	2.03 ft	
Top Width	1.92 ft	
Critical Depth	0.36 ft	
Critical Slope	0.024833 ft/ft	
Velocity	3.12 ft/s	< 5.0 for ∴ ok
Velocity Head	0.15 ft	
Specific Energy	0.47 ft	
Froude Number	1.38	
Flow Type	Supercritical	



NO SCALE

FIGURE 2. CGRD-9 AND CGRD-11

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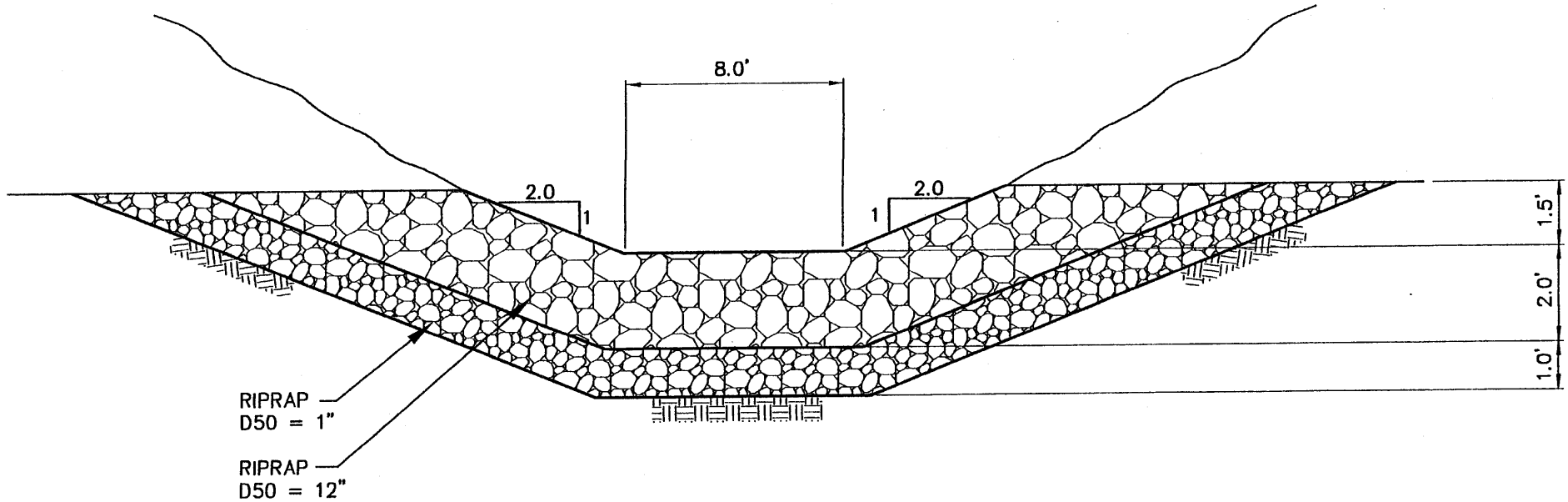
45a



NO SCALE

FIGURE 3. MAIN CHANNEL CROSS-SECTION

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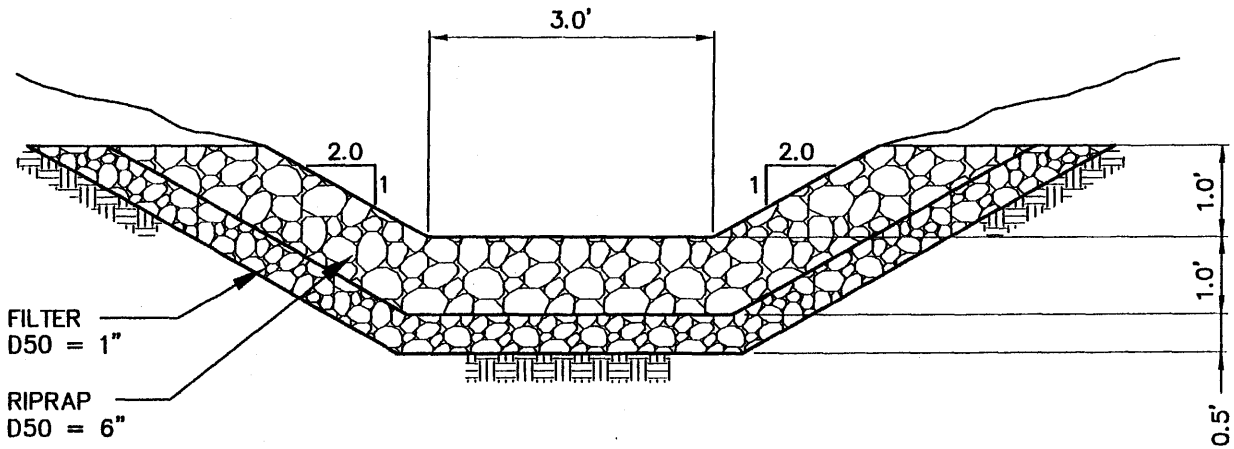

NO SCALE

FIGURE 4. CGRD–7, CGRD–8 AND RIPRAPPED PORTIONS OF CGRD–2, 4, AND 5

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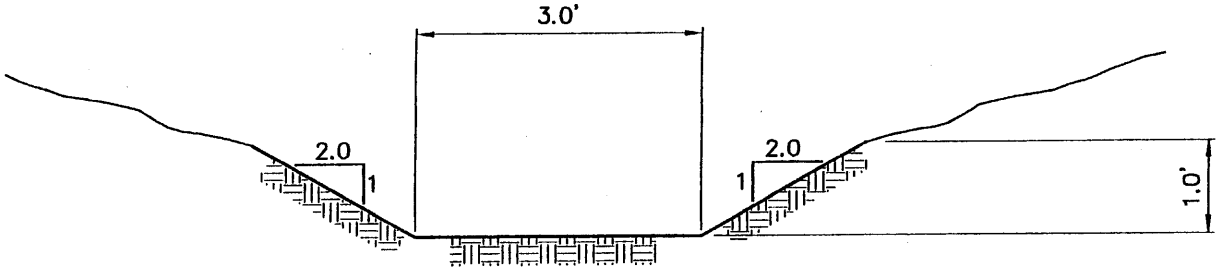

FIGURE 5. CGRD-6, CGRD-9, CGRD-11 AND NON-RIPRAPPED PORTIONS OF CGRD-2, 4 AND 5

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48

- Culverts -

Three operational culverts will be used to convey runoff from the reclaimed area under the road and railroad tracks to the Price River.

CGC-1 is connected to CGRD-6 and must handle a design flow of 0.12 cfs (CGRWS-6). Table 3.4-3 states that this 18" CMP has a capacity of 11 cfs. Therefore this culvert is adequate for use during reclamation

Culvert Slope = 17 %
Outlet velocity = 3.48 (Pg 50)
Required Riprap size = None

CGC-2 is connected to CGD-3. The drainage area for this ditch and channel have not changed other than the required capacity being reduced due to the runoff from Schoolhouse Canyon no longer being diverted to Barn Canyon. These culverts had the required capacity prior to removing the Schoolhouse Canyon runoff and therefore, has even more excess capacity.

CGC-2 consists of (2) 84" CMPs with a combined capacity of 900 cfs as seen on Table 3.4-3. Prior to removing the Schoolhouse Canyon Runoff the peak flow was estimated to be 222.9 cfs Thus, these culverts are adequate.

Culvert Slope = 5 %
Assumed Peak flow = 222.9 cfs
Outlet Velocity = 14.29 (Pg 51)
Required Riprap size = 20"

CGC-5 is connected to CGRD-1 and must handle 36.92 cfs (CGRWS-1). According to Table 3.4-3 the 60" Concrete culvert has a capacity of 185 cfs. Therefore, this culvert is adequate.

Culvert Slope = 10 %
Outlet Velocity = 21.16 (Pg 52)
Required Riprap Size = 40"

CGC-1 OUTLET VELOCITY
Worksheet for Circular Channel

Project Description	
Worksheet	Prep Plant Hydrology
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Slope	0.170000	ft/ft
Diameter	18	in
Discharge	0.12	cfs

Results		
Depth	0.08	ft
Flow Area	3.5e-2	ft²
Wetted Perimeter	0.69	ft
Top Width	0.66	ft
Critical Depth	0.13	ft
Percent Full	5.2	%
Critical Slope	0.020638	ft/ft
Velocity	3.48	ft/s < 5 fps no riprap needed
Velocity Head	0.19	ft
Specific Energy	0.27	ft
Froude Number	2.69	
Maximum Discharge	25.23	cfs
Discharge Full	23.46	cfs
Slope Full	0.000004	ft/ft
Flow Type	Supercritical	

CGC-2 OUTLET VELOCITY
Worksheet for Circular Channel

Project Description	
Worksheet	Prep Plant Hydrology
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Slope	0.050000 ft/ft	
Diameter	84 in	
Discharge	111.45 cfs	Assumes half of peak flow in each culvert.

Results		
Depth	1.80 ft	
Flow Area	7.8 ft²	
Wetted Perimeter	7.43 ft	
Top Width	6.11 ft	
Critical Depth	2.72 ft	
Percent Full	25.6 %	
Critical Slope	0.010196 ft/ft	
Velocity	14.29 ft/s	Requires $D_{50} = 20''$
Velocity Head	3.17 ft	
Specific Energy	4.97 ft	
Froude Number	2.23	
Maximum Discharge	832.29 cfs	
Discharge Full	773.71 cfs	
Slope Full	0.001037 ft/ft	
Flow Type	Supercritical	

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CGC-5 OUTLET VELOCITY
Worksheet for Circular Channel

Project Description	
Worksheet	Prep Plant Hydrology
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Slope	0.100000	ft/ft
Diameter	60	in
Discharge	36.92	cfs

Results		
Depth	0.72	ft
Flow Area	1.7	ft²
Wetted Perimeter	3.90	ft
Top Width	3.51	ft
Critical Depth	1.69	ft
Percent Full	14.4	%
Critical Slope	0.003296	ft/ft
Velocity	21.16	ft/s
Velocity Head	6.96	ft
Specific Energy	7.68	ft
Froude Number	5.29	
Maximum Discharge	885.89	cfs
Discharge Full	823.55	cfs
Slope Full	0.000201	ft/ft
Flow Type	Supercritical	

$D_{50} = 40''$

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Comparison of Pre-Mining and Post-Reclamation Sediment Yields for the Willow Creek Preparation Plant and Refuse Pile

Sediment control after reclamation of the Preparation Plant and Refuse Pile will be by Alternate Sediment Control Measures ("ASCM"). The same reclamation methods will be used for the reclamation of this site as was used for the reclamation of Hardscrabble Canyon, Crandall Canyon, Adit No. 1, and Star Point Mines. Sediment control at these sites have been successful and the same methods are expected to be successful at this site as well. The sediment control methods to be applied at this site are as follows:

1. Deep gouging;
2. Mixing hay into the soil;
3. Mulching the gouged surface;
4. Securing the mulch with a tackifier; and
5. Revegetation.

The purpose of this calculation is to evaluate the sediment yield characteristics of the disturbed area under pre-mining and post-mining conditions. The three conditions to be evaluated will be as follows:

1. Pre-mining, This site was a town prior to the building of the Preparation Plant. The site has been disturbed for over 100 years. Hence pre-disturbance information is not available and the pre-mining condition is a disturbed condition. Although the pre-mining condition is a disturbed condition where possible an undisturbed condition will be assumed for these calculations.

2. Immediate Post-Reclamation, after deep gouging, mulching and seeding but before vegetation establishment.

3. Long Term Post-Reclamation, after vegetation is well established and depressions from deep gouging are mostly gone.

Mixing hay into the soil consists of 2 tons/acre of hay being mixed into the soil during deep gouging. Another 1 to 1.5 tons/acre of straw mulch will be broadcast on the surface. The straw mulch will be secured with a tackifier when the site is hydroseeded. A small amount of wood fiber mulch will also be applied with the tackifier during hydroseeding.

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Methodology

Sediment yield calculations will be made using the Modified Universal Soil Loss Equation ("MUSLE") as presented by Israelsen et. al. (1984) and Barfield et. al. (1994)

$$A = R*K*LS*VM$$

where:

A = Sediment Yield (tons/acre/year)
R = Rainfall Factor
K = Soil Erodibility Factor
LS = Length and Steepness of slope factor
VM = Erosion Control Factor

Each of the above factors will be evaluated for each of the three conditions.

Rainfall Factor (R)

R=11 From Map R7 Israelsen et. al. (1984)

The same factor will apply for all three conditions.

Soil Erodibility Factor (K)

As mentioned above the site has been disturbed for a long time and pre-disturbance data are not available. The Soil Survey of Carbon Area, Utah catagorizes soils in the vicinity of the site that were not disturbed at the time of the survey. The bottom of the canyon with relatively flat slopes are identified as map unit 107 Shupert-Winette Complex. The erodibility factor identified in Table 12 on page 280 is 0.24 for the surface sample. The steep slopes around the disturbed areas are identified as Map unit 121 Travisilla-rock outcrop-Gerst Complex. The near surface has some cementation and has a very low erodibility of 0.05 while soils 2 inches down have a much higher erodibility factor of 0.37. Since the bulk of the site is the flatter areas and the erodibility factor of 0.24 is between the two extremes of the steep slopes factor I will assume a soil erodibility factor of 0.24 for the undisturbed condition.

Most of the soil being used during the reclamation of the Preparation Plant and Refuse Pile area is being hauled over from the Gravel Canyon Topsoil Stockpile. This stockpile is mostly composed of topsoil hauled from Crandall Canyon during the construction of that facility. The area where the soils were hauled from are identified as map unit 125 Uinta-Toze Families Complex. This soil has a surface soil erodibility factor of 0.24 with the lower soil layers having a factor of 0.15 and 0.1. These soils had high organic content and lower clay content than the soils in the Preparation Plant Area and should be excellent growth media. Since most of the soils stripped from Crandall Canyon have an Erodibility Factor of 0.15 of 0.10 I will assume a factor of 0.20 for both reclamation time periods

Length-Steepness Factor (LS)

$$LS = \left(\frac{65.41\,s^2}{s^2+10{,}000} + \frac{4.56\,s}{\sqrt{s^2+10{,}000}} + 0.065\right)\left(\frac{l}{72.6}\right)^m$$

Where:

LS = Length Steepness Factor
S = Slope Gradient (%)
l = Slope Length (ft)
m = empirical exponent (function of slope)

Pre-mining

Since the site was disturbed before or near 1900 no pre-disturbance topography is available. However, using adjacent undisturbed topography the site had slopes between 1 and 100%. Most of the site is located in a broad relatively flat area of Price Canyon. The slopes of the undisturbed areas on the canyon sides are mostly between 60% and 80%. In an undisturbed conditions the slopes extend unbroken from the ridge lines down to the channels in the canyons. These distances may be up to 1100'. However most slope lengths are 400' to 500' in length. The steepest slopes will generate the greatest erosion so I will focus on the steep areas when comparing sediment yield. For the undisturbed conditions I will assume a slope of 60% and a slope length of 400'.

LS = 46.3 (Table C-1 Israelsen et. al. (1984))

Immediate Post Reclamation

The reclaimed areas will be deep gouged prior to seeding. Deep gouging creates 1 to 3' deep holes that prevent runoff from concentrating and achieving an erosive velocity. In the early stages of reclamation the gouges prevent any water from running off the reclaimed areas. The gouges also stop any runoff from upgradient undisturbed areas. Therefore, the slope length is very short. I will assume a slope length of 10' although the distance is actually less. The maximum slope of reclamation is a 2:1 slope or 50%. I will assume the maximum slope of 50% and a slope length of 10'.

LS = 5.64 (Table C-1 Israelsen et. al. (1984))

Long-term Post Reclamation

In the long term the depressions from gouging will disappear leaving an unbroken slope with a maximum slope of 50%. I will assume a 50% slope and the same slope length as for the pre-mining condition (400').

LS = 35.65 (Table C-1 Israelsen et. al. (1984))

Erosion Control Factor (VM)

Pre-Mining

No pre-mining vegetation data is available. However, Exhibit 9-1 identifies adjacent undisturbed areas to be mostly mixed brush. I will use the Castle Gate Mixed Brush reference area to estimate the Erosion Control Factor.

Total vegetation cover = 40.9%
Litter/rock cover = 35.2%
Bare soil = 23.9%

Grass density = 51% ==> 21%
Sage brush = 26% ==> 10.6%
Other brush = 23% ==> 9.4%
Total brush 20%

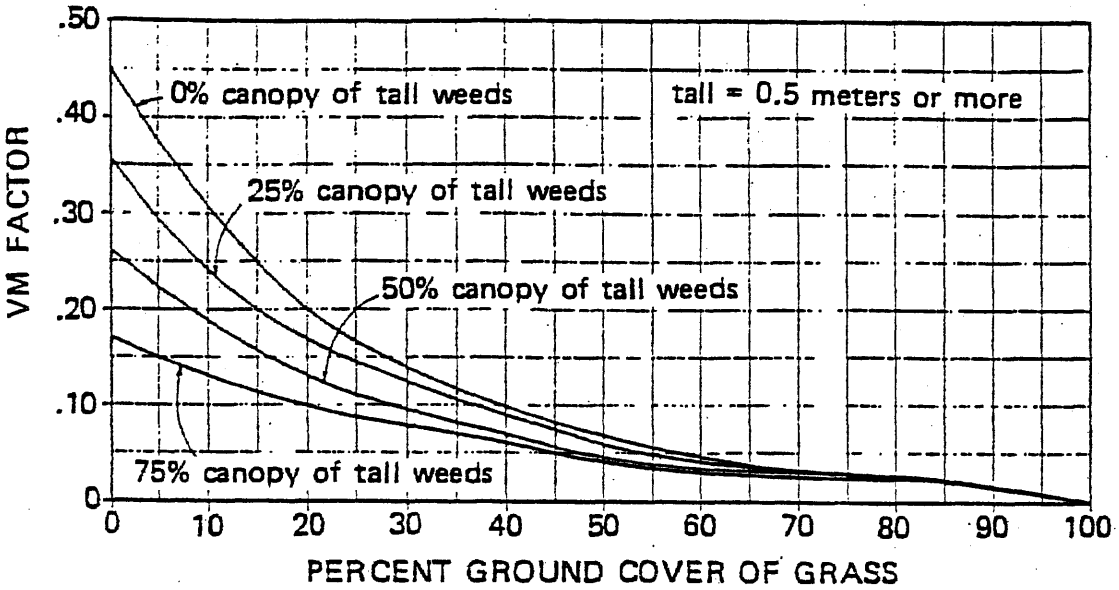

Figure 7. Relationship between grass density and VM factor.

Israelsen et. al. (1984)

VM = 0.17

Immediate Post Reclamation

R * K * LS = 11*0.24*5.64 = 14.89

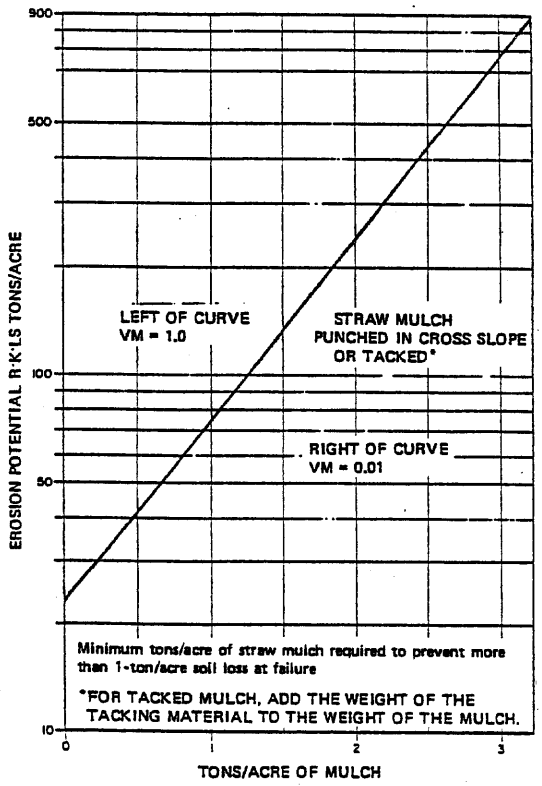

Figure 4. Straw mulch anchored vs. R·K·LS.

At least 1 ton/acre of mulch will be added with a tackifier to the reclaimed surface. Therefore, the point plots on the right side of the line.

VM = 0.01

Long-term Post Reclamation

Section 3.2.2.4 of the Willow Creek Permit describes the vegetation in an area near the site that has been reclaimed (The old Royal Refuse Pile). I will use that data to estimate the Erosion Control Factor although the Preparation Plant area will be better vegetated.

Total plant cover = 30%
Brush density = 50% ==> 15.5%
Grasses density = 40% ==> 12.4%

VM = 0.24 (see figure 7 on page 4)

Calculation Summary

Time Period	R	K	LS	VM	A (tons/acre/yr)
Pre-Mining	11	0.24	46.3	0.17	20.78
Immediate Post Reclamation	11	0.20	5.64	0.01	0.12
Long-term Post Reclamation	11	0.20	35.65	0.24	18.82

Thus the reclaimed surface will generate far less sediment immediately after reclamation and will generate slightly less sediment for the long-term post reclamation period.

APPENDIX 3.4L

RECLAMATION CORRESPONDENCE, PUBLICATIONS, AGREEMENTS

PRICE RIVER WATER
IMPROVEMENT DISTRICT
P.O. Box 903
265 South Fairgrounds Road
Price, Utah 84501
Telephone (435) 637-6350
FAX (435) 637-6374

December 15, 2003

Dennis Ware, Controller
P.O. Box 30
Helper, Utah 84526

RE: Proposed Land Purchase by Price River Water Improvement District

Dear Sir,

Please accept this letter as a formal proposal by the Price River Water Improvement District to purchase up to 130 acres of land currently owned by Cyprus Plateau Corporation in the Price Canyon area of Carbon County, Utah. We submit an offer of $ 32,500.00 for this parcel so long as the following conditions can be agreed upon:

- The District owns and operates the sewer system through this property, and this system must remain in place and all abandoned connections must be vacated according to District policy.
- The District would request that the power sub-station and all power poles and underground utilities remain as is and undisturbed.
- The District would request that minimal topsoil cover be applied for re-growth areas and that no contouring reclamation be done that we would need to undo at a later date.
- The District will be utilizing the existing buildings (i.e., warehouse, lab, pump houses, etc) and would request that these structures and their accompanying support infrastructure remain.
- The District will be utilizing this area in its entirety; therefore the District will maintain all ditches, culverts, and other diversion structures necessary.
- The District will be utilizing the existing raw water pond and expanding its area.
- The District must also receive a transfer of rights-of-way and easements pertaining to this property for roadway, ingress and egress, utilities, raw water line, etc., as well as any associated easements through adjacent properties pertaining to this parcel.

The District will be pleased to be able to complete this transaction as soon as possible so that the necessary work needed for our purposes can begin. Thank you for your help and consideration.

Sincerely,

Keith W. Cox, Chairman
Price River Water Improvement District

CLEAN WATER

Month Day, 2004

Mr. Mark Mackiewicz
Bureau of Land Management
125 South 600 West
Price, Utah 84501

Mr. Phil Palmer
PRWID
265 South Fairgrounds Road
Price, Utah 84501

Mr. William D. Krompel
Commissioner
120 East Main Street
Price, Utah 84501

Mr. Harold Cunningham
Utah Power and Light – Carbon Plant
Helper, Utah 84526

Mr. Gary Harwood
Helper City
P.O. Box 221
Helper, Utah 84526

Mr. Roger Wheeler
Director Land Management
700 Morrison Road
Gahanna, Ohio 43230-6642

Mr. Dave Levanger
Carbon County Planning and Zoning Commission
120 East Main Street
Price, Utah 84501

Re: **Industrial Post Mining Land Use, Price River Water Improvement District, Willow Creek Mine, C/007/038, Carbon County, Utah**

Dear Mr. Last Name:

In accordance with the requirements of R645-301-412.200, Plateau Mining Corporation (PMC) is notifying the surface landowners and local government agencies adjacent to the Willow Creek Mine that it has filed an application with the Utah Division of Oil, Gas and Mining for a change in the post mining land use to Permit C/007/038. The land use change will allow the Price River Water Improvement District (PRWID) use of the fee land where the preparation plant and coal handling facilities once were for their immediate and future expansion requirements under the provisions of the Utah Coal Mining and Reclamation Act pursuant to R645-301-413.300 of the Utah R645 Coal Rules.

The industrial land use boundary will contain 46.2 acres, more or less. Within this acreage, the warehouse/bathhouse/office/lab building, substation, access roads, flat lands, raw water pond, pump houses, and other appurtenant structures will remain to support the proposed land use. The surface owner of the land is PRWID.

Comments from the legal or equitable owner of record of the surface areas to be affected and from the Federal, Utah and local government agencies should be mailed to: Plateau Mining Corporation, Attention: Johnny Pappas, P.O. Box 30, 847 NW Highway 191, Helper, Utah 84526.

If you have any questions or need additional information, please do not hesitate to contact me at (435) 472-4741.

Sincerely,

Johnny Pappas
Sr. Environmental Engineer

Enclosure

Env: Willow Creek Mine-PMLUC
Chrono: JP030402.LTR

Public Notice

Application for Post Mining Land Use Change
Willow Creek Mine
Plateau Mining Corporation
Permit C/007/038, Approved 04/24/96
Carbon County, Utah

Notice is hereby given that Plateau Mining Corporation, P.O. Box 30, 847 Northwest Highway 191, Helper, Utah 84526, a subsidiary of RAG American Coal Company, 999 Corporate Blvd., Linthicum Heights, MD 21090, has filed an application with the Utah Department of Natural Resources, Division of Oil, Gas and Mining for a change in post mining land use to Permit C/007/038. The land use change will allow the Price River Water Improvement District (PRWID) use of the fee land where the preparation plant and coal handling facilities once were for their immediate and future expansion requirements under the provisions of the Utah Coal Mining and Reclamation Act pursuant to R645-301-413.300 of the Utah Coal Program Regulations. The portion of the permit area that is affected is located in Carbon County, Utah as follows:

Township 13 South, Range 9 East
Section 1: Portions of NE/4NW/4; NW/4NW/4

Township 12 South, Range 10 East
Section 35: Portions of E/2NE/4SE/4; NE/4SE/4SE/4; SE/4SE/4NE/4
Section 36: Portions of W/2SW/4;

(Containing a total of 46.2 acres more or less)

The permit area is shown on the Helper U.S. Geological Survey 7.5-minute map.

The Mining and Reclamation Plan is available for public review at: Utah Division of Oil, Gas and Mining, 1594 West North Temple, Suite 1210, Salt Lake City, Utah 84114-5801, and at the Carbon County Courthouse, 120 East Main Street, Price, Utah 84501.

Written comments, objections and requests for information conferences on this proposal may be addressed to:

Utah Coal Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Closing date for submission of such comments, objections and requests for public hearing or information conference on this proposal must be submitted by Month Date, 2004

Published in the Sun Advocate - Month Day, Day, Day and Day

WILLOW CREEK MINE - PREPARATION PLANT PMLUC RECLAMATION OPTION BOND ESTIMATE

Permit No.	Item No.	Description	Quantity	Unit	Material Cost		Equipment Cost		Labor Cost		Project Cost	
					Per Unit	Total	Per Unit	Total	Per Unit	Total	Per Unit	Total
		PREPARATION PLANT AREA										
		DIRECT COST SUMMARY										
		Rough Grading Excavation Total										51,461
		Drainage Controls Total										4,552
		Topsoil Distribution Total										258,351
		Revegetation Total										60,892
		Monitoring Total										110,000
		Total Direct Costs										485,257
		PREPARATION PLANT AREA										
		INDIRECT COSTS										
		Mobilization/Demobilization (5%)	Average from 2000 OSM Reclamation Bond Amount Calculation Handbook and DOGM recommended									24,263
		Contingencies (4%)	Average from 2000 OSM Reclamation Bond Amount Calculation Handbook									19,410
		Engineering Redesign Fee (2.5%)	Minimum from 2000 OSM Reclamation Bond Amount Calculation Handbook									12,131
		Contractor Profit and Overhead (10%)										48,526
		Reclamation Management Fee (2.0% of inflated direct costs)	From 2000 OSM Reclamation Bond Amount Calculation Handbook									11,399
		Total Indirect Costs										115,729
		Subtotal Reclamation Cost										600,985
		Escalation - 17.45% (3.27%/yr over 5 yrs.)										104,872
											Preparation Plant Reclamation Cost	705,857
		REFUSE PILE RECLAMATION COST										
		Refuse Pile Earthwork	Nelson Construction Bid									940,387
		Refuse Pile Drainage Controls	Nelson Construction Bid									130,000
		Refuse Pile Revegetation	Nelson Construction Bid									142,318
		Refuse Pile Mobilization/Demobilization	Nelson Construction Bid									52,527
											Refuse Pile Reclamation Sub-total	1,265,232
											Winter Discount	160,624
											Refuse Pile Reclamation Total	1,104,608
		TOTAL RECLAMATION COST										**1,810,465**

WILLOW CREEK MINE - PREPARATION PLANT PMLUC RECLAMATION OPTION BOND ESTIMATE

Permit No.	Item No.	Description	Quantity	Unit	Material Cost		Equipment Cost		Labor Cost		Project Cost	
					Per Unit	Total	Per Unit	Total	Per Unit	Total	Per Unit	Total
		DEMOLITION										

Notes:

(a) Means Heavy Construction Cost Data, 2000 inflated by 9% to reflect 2003 costs

(b) This bond calculation represents the approved reclamation with the exception of the Pond 12A and 12B areas which are now accounted for in the Willow Creek Mine Bond. Previously separate bond calculations for the Clean Coal Storage pad extension, and culverts CGD - 10 and 11 have been incorporated into this calculation

WILLOW CREEK MINE - PREPARATION PLANT PMLUC RECLAMATION OPTION BOND ESTIMATE

Permit No.	Item No.	Description	Quantity	Unit	Material Cost		Equipment Cost		Labor Cost		Project Cost	
					Per Unit	Total	Per Unit	Total	Per Unit	Total	Per Unit	Total
		ROUGH GRADING										
		EXCAVATION - BACKFILLING AND GRADING										
	1	Cat D8R Dozer excavation with Ripper										
		Excavation and placement of 14,920 CY	0.3	MONTH			15885.00	4766			15885.00	4766
		Dozer operating cost assuming a 300' haul including operator	50.0	HRS					97.05	4853	97.05	4853
		(Dataquest bluebook 3Q03 pg 9-43 and 49)										
	2	Cat 988F Front End Loader,										
		Excavation and loading of 2,000 CY of cut	0.2	MONTH			12710.00	2542			12710.00	2542
		FEL operating cost including operator	35.0	HRS					87.55	3064	87.55	3064
		(Dataquest bluebook 3Q02 pg 9-27)										
	3	Rough grading with a 4 CY Excavator (CAT 345)										
		Excavation of 12,000 CY	0.2	MONTH			14945.00	2989			14945.00	2989
		Excavator operating cost including operator	30.0	HRS					101.10	3033	101.10	3033
		(Dataquest bluebook 3Q02 pg 10-8)										
	4	Hauling with 15 CY truck										
		Hauling of 2,000 CY of cut (assume 4 trucks)	0.2	MONTH			14360.00	2872			14360.00	2872
		truck operating cost assuming a 2000' round trip haul	35.0	HRS					66.10	2314	66.10	2314
		(Dataquest bluebook 2Q02 pg 20-1)										
	5	Compaction										
		Compaction of non-topsoil 26,920 CY	26920.0	CY			0.17	4576	0.10	2692	0.27	7268
		(Means 02315-300-5700)										
	6	Water Truck, 1/2 time operator	1	MO			3270.00	3270.00	4510.00	4510.00	7780.00	7,780
		(01590-400-7000)										
		Assume a half time operator at $205/day operation cost										
		Assume 22 operating days per month and 8 hours per day										

WILLOW CREEK MINE - PREPARATION PLANT PMLUC RECLAMATION OPTION BOND ESTIMATE

Permit No.	Item No.	Description	Quantity	Unit	Material Cost		Equipment Cost		Labor Cost		Project Cost	
					Per Unit	Total	Per Unit	Total	Per Unit	Total	Per Unit	Total
		EXCAVATION - BACKFILLING AND GRADING CONTINUED										
	7	Surveying, 2 person crew	5	DAY					545.00	2725.00	545.00	2,725
		(01107-700-0950)										
	8	Foreman - assume 12 month project (01310-700-0200)	1.0	MO					6471.80	6472	6471.80	6472
	9	Pickup Truck -assume 12 month project (01590-400-7200)	1.0	MO			784.40	784			784.40	784
		EXCAVATION AND ROUGH GRADING TOTAL										**51,461**
Note:		Fill volume includes 32,156 CY of topsoil from Gravel Canyon,										
		3,000 CY of concrete debris and 26,920 CY generated on-site										
		Total volume of Backfill equals 62,076 CY, not										
		including the refuse area.										
		Of the 26,920 CY of cut generated on-site, 12,000 is assumed to be										
		handled by the excavator, 2,000 CY is assumed to be loaded and										
		hauled by dump truck and the rest is moved by dozer including an										
		additional 2,000 CY to account for some double handling.										

WILLOW CREEK MINE - PREPARATION PLANT PMLUC RECLAMATION OPTION BOND ESTIMATE

Permit No.	Item No.	Description	Quantity	Unit	Material Cost		Equipment Cost		Labor Cost		Project Cost	
					Per Unit	Total	Per Unit	Total	Per Unit	Total	Per Unit	Total
		TOPSOIL DISTRIBUTION										
		SCHOOL HOUSE CANYON REFUSE PILE										
		HAULING TOPSOIL FROM GRAVEL CANYON										
		Total topsoil backfill equals 42,795 CY										
		10,639 CY for clean coal stockpile slope and 32,156 excess										
		topsoil not used for covering the refuse pile										
	3	Cat 988F Front End Loader,										
		Excavation and loading of 42,795 CY or 100% of topsoil	0.6	MONTH			12710.00	7626			12710.00	7626
		FEL operating cost including operator	115.0	HRS					78.80	9062	78.80	9062
		(Dataquest bluebook 3Q02 pg 9-27)										
	4	Hauling with 15 CY truck										
		Hauling of 42,795 CY or 100% of topsoil (assume 25 trucks)	0.6	MONTH			89750.00	53850			89750.00	53850
		truck operating cost assuming one round trip per hour	2860.0	HRS					59.49	170141	59.49	170141
		(Dataquest bluebook 2Q03 pg 20-1)										
	5	Cat D8R Dozer contouring without Ripper										
		Contouring of 42,795 CY or 100% of topsoil	0.5	MONTH			13620.00	6810			13620.00	6810
		Dozer operating cost assuming a 150' haul including operator	90.0	HRS					87.35	7861	87.35	7861
		(Dataquest bluebook 3Q02 pg 9- 43)										
	6	Surveying, 2 person crew	6	DAY					500.00	3000.00	500.00	3,000
		(01107-700-0950)										
		TOPSOIL DISTRIBUTION TOTAL										**258,351**

Production and rental rates assume 5 10-hour work days per week and 21 work days per month. Rental time has been rounded up to the nearest quarter month or greater.
The operating costs are based on the hours needed by the equipment to move the specified amount of material. Some double handling of the material is assumed.
Rental and operation rates for the front end loader, dozers, excavator, and trucks were obtained from Wayne Western of the Utah Division of Oil Gas and Mining.
Dozer production for excavation and ripping obtained from the Caterpiller Performance Handbook Edition 30. Excavation production for a D8R dozer assuming a 300' haul is 325 CY/hr
Dozer production for a D8R dozer with a 150' haul for contouring is an average of 500 CY/hr given varying slopes, based on the Catipiller Performance Handbook.
Excavator production for a 345BL excavator assuming a 75% efficiency is 450 CY/hr for loading trucks and excavating channels
The production for the 988F FEL is 540 CY/hr assuming 83% efficiency for the prep plant area work and 390 CY/hr assuming 60% efficiency for loading topsoil. (CAT performance handbook)
The production for 15 CY trucks assumes 4 round trips per hour or 60 CY/hr/truck for the prep plant area. The cost calc. assumes 4 trucks operating at the same time to keep the excavator efficient
The production for 15 CY trucks hauling topsoil from Gravel Canyon is 1 round trip per hour. 25 trucks are required to keep the FEL at least 60% efficient
The top 2' of backfill will not be compacted. Hence only 60% of fill is assumed to be compacted by a sheepsfoot compactor
Surveying is not required full time. Assume that 6 days of surveying by a 2 man crew for the topsoil handling and 10 days for rough grading, is needed.
The reclamation time table states it will take 24 months to reclaim the mine facilities and prep plant areas. This calculation assumes 12 months will be spent to reclaim the prep plant area.
The foreman, pickup and water truck for the entire project has been accounted for in the earthwork section of the bond calculation.
Costs associated with the reclamation of Gravel Canyon, other than moving the topsoil are accounted for in the Gravel Canyon Bond calculation.

WILLOW CREEK MINE - PREPARATION PLANT PMLUC RECLAMATION OPTION BOND ESTIMATE

Permit No.	Item No.	Description	Quantity	Unit	Material Cost		Equipment Cost		Labor Cost		Project Cost	
					Per Unit	Total	Per Unit	Total	Per Unit	Total	Per Unit	Total
		DRAINAGE CONTROLS										
		Assume channel excavations completed during rough grading										
		PREPARATION PLANT AREA										
	1	Filter Material (02620-400-0400)	100	CY	17.17	1717.00	0.85	85.00	2.42	242.00	20.44	2,044
	2	Riprap Placement (02370-300-0300)	200	TON	10.9	2180.00	1.09	218.00	0.55	110.00	12.54	2,508
		DRAINAGE CONTROLS TOTAL										**4,552**

WILLOW CREEK MINE - PREPARATION PLANT PMLUC RECLAMATION OPTION BOND ESTIMATE

Permit No.	Item No.	Description	Quantity	Unit	Material Cost		Equipment Cost		Labor Cost		Project Cost	
					Per Unit	Total	Per Unit	Total	Per Unit	Total	Per Unit	Total
		REVEGETATION										
	1	Seeding, hydro with mulch (35lb/acre)	765.00	MSF	18.03	13,792.95	8.56	6,548.40	8.05	6,158.25	34.64	26,499.60
		(02920-510-1700) pit and road										
	2	Straw mulch - 2 tons/acre incorporated into the soil	765.00	MSF	20.17	15,430.05	0.92	703.80	0.71	543.15	21.80	16,677.00
		during gouging										
		(02910-500-0350) pit and road										
	3	Deep gouging/mixing in mulch with excavator 2 CY (rental)	0.25	MONTH			9,205.00	2,301.25			9,205.00	2,301.25
		(Dataquest 3Q02 pg 10-8)										
		Operating costs (Dataquest 3Q02 pg 10-8)	40.00	HR			80.90	3,236.00			80.90	3,236.00
		REVEGETATION TOTAL										**48,713.85**
		Revegetation Subtotal										48,714
		Reseeding and Replanting (25%)										12,178
		REVEGETATION TOTAL										**60,892**

WILLOW CREEK MINE - PREPARATION PLANT PMLUC RECLAMATION OPTION BOND ESTIMATE

Permit No.	Item No.	Description	Quantity	Unit	Material Cost		Equipment Cost		Labor Cost		Project Cost	
					Per Unit	Total	Per Unit	Total	Per Unit	Total	Per Unit	Total
		MONITORING										
	1	Vegetation Monitoring	10	YEAR							4250.00	42,500
	2	Water Quality and Pond Inspections, Quarterly	10	YEAR							2500.00	25,000
	3	Site Maintenance	10	YEAR							4250.00	42,500
		MONITORING TOTAL										**110,000**

Map(s) is kept with this application located in the Public Information Center of our Salt Lake City office.

EXHIBIT 3.4-9 PREP PLANT AREA AND REFUSE PILE RECLAMATION

EXHIBIT 3.4-10 CROSS SECTION AND PROFILE

EXHIBIT 3.4-11 WATERSHED MAP

EXHIBIT 3/4-12 TOPOGRAPHY AND TREATMENT MAP