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Figure



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Appendix

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### 3.4-6 Reclamation Plan

The Preparation Plant Area and Refuse Pile were reclaimed during 2004 according to the approved reclamation plan. Final seeding for these areas occurred during the Fall of 2004. All details regarding as-built reclamation of the site can be found in Appendix 3.4N. As-built topography can be seen on Exhibit 3.4-13AB. The reclamation treatment area can be seen on Exhibit 3.4-17AB. Watershed and ditch locations can be seen on Exhibit 3.4-16AB. Cross-sections and channel profiles can be seen on Exhibits 3.4-14AB and 3.4-15AB.

### 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 (approx. 46.2 acres) 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 (approx. 49.1 acres).

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 Maps 3.4-9 and 3.4-12. 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.

**EXHIBIT 19**
**APPENDIX 3.4N**

# WILLOW CREEK PREPARATION PLANT AND REFUSE DISPOSAL FACILITY AS-BUILT RECLAMATION

PLATEAU MINING CORPORATION
WILLOW CREEK MINE
Price, Utah

Prepared by

EARTHFAX ENGINEERING, INC.
Midvale, Utah

August 2005

**EXHIBIT 19**
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Exhibits



The maps listed above have been included in the map section of Exhibit 19 Section 3.4. The maps are not included in this appendix but are referenced here to indicate that as-built reclamation maps have been prepared.

# EXHIBIT 19
# APPENDIX 3.4N

## WILLOW CREEK PREPARATION PLANT AND REFUSE DISPOSAL FACILITY AS-BUILT RECLAMATION

### 3.4-6AB Reclamation Plan

The preparation plant area and refuse pile were reclaimed in the spring of 2004 according to the approved reclamation plan with the exception of the train loadout area. The train loadout area will be reclaimed during the summer/fall of 2005.

### 3.4-6(1)AB Postmining Land Use

The reclaimed preparation plant and refuse pile area have the postmining land use of wildlife habitat, grazing, and industrial uses. The postmining land use for the preparation plant area is industrial. Most of the Preparation Plant Area has been purchased by the Price River Water Improvement District (PRWID). PRWID purchased 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. 46.2 acres has been designated for industrial land use.

Proof of publication, 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 Exhibit 3.4-13AB, which includes the refuse pile area (46.76 acres) and Barn Canyon Shaft Facility Area (2.34 acres) have been reclaimed to its premining land use of wildlife habitat (approx. 49.1 acres). The Barn Canyon Shaft Facility was never built. Thus, there was no reclamation activities in Barn Canyon. Although PRWID has purchased most of the preparation plant area the majority of the area was still reclaimed. See Exhibit 3.4-17AB for reclamation treatment areas.

In order to facilitate the industrial postmining land use, primary roads P-1, P-2, P-4, and P-5 will be maintained in their entirety or portion there of as shown on Exhibits 3.4-13AB and 3.4-17AB. There are underground utilities such as: raw water, culinary water, and sewer that have been left in place. These 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 lines that traverses up Barn Canyon.

**3.4-6(2)AB Reclamation Work**

The as-built reclamation topography for the preparation plant area is shown on Exhibit 3.4-13AB (Preparation Plant Area and Refuse Pile Reclamation As-Built Topography Map). The as-built reclamation cross-sections are shown on Exhibits 3.4-14AB and 3.4-15AB (Preparation Plant Area and Refuse Pile As-Built Reclamation Cross-Sections). The as-built reclamation channel profiles are shown on Exhibit 3.4-15AB (Preparation Plant Area and Refuse Pile As-Built Reclamation Cross-Section and Profiles). Channel profiles have been generated for all channels associated with the Refuse Pile. The reclamation work consisted of the following: demolition, backfilling and grading, pond removal, topsoil placement, seeding and mulching.

A description of these activities follows.

**Demolition** - All existing structures which lie within the disturbed area boundary and do not support the postmining land uses have been removed. However, utilities within the utility corridor, along with a buried telephone cable parallel with the utility corridor, remain. Water supply intakes serving the preparation plant outside the disturbed area boundary will also remain. In addition, the diversions and culverts identified on Exhibit 3.4-13AB remain in place.

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

**Grading** - The area was graded to promote drainage and approximate the reclamation design topography shown on Exhibits 3.4-9, 3.4-10 and 3.4-10a. The as-built topography was achieved by blending the soil material into the adjacent area and creating landforms which resemble the surrounding topography. In many cases more of the pre-SMCRA cutslopes were covered than indicated in the approved reclamation design. The cross-sections shown on Exhibit 3.4-14AB compares the design reclamation surface to the as-built reclamation surface. The as-built topography shown on Exhibit 3.4-13AB meets the criteria set forth in R645-301-553, Backfilling and Grading.

A comparison of Exhibits 3.4-1 and 3.4-13AB indicate that all post-SMCRA and most pre-SMCRA cut slopes have been backfilled to the extent practical during reclamation. Those pre-SMCRA cut slopes which cannot practically be reclaimed are identified on Exhibit 3.4-13AB. 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 Exhibit 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 the backfilling and grading, the following work was performed:

- Elimination of berms and temporary diversions, except where 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 where necessary to support the post mining land use.
- Removal of Ponds 011, 012A and 012B, and 013.
- Maintain existing accesses and utility corridors
- Soil preparation, seeding, fertilizing and mulching.

Reclamation included the removal of all roads and culverts, except as noted on Exhibit 3.4-13AB which are necessary to support the postmining land use, and the establishment of permanent stream channels.

The reclamation topography plan for the Unit Train Loadout area is shown on Exhibit 3.4-9. A discussion of the reclamation plan is included in Section 3.8 of this exhibit. The Unit Train Loadout is scheduled to be reclaimed during the summer of 2005.

The as-built topography shown on Exhibit 3.4-13AB 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 as-built configuration of the refuse pile is suitable for the approved postmining land use of wildlife habit and grazing. Profiles and cross-sections of the refuse pile are shown on Exhibits 3.4-14AB and 3.4-15AB.

Grading has been done to establish stable drainage of the site and stabilize cutslopes. Sediment ponds remained in place as long as possible during the grading work. The planned sequence of removal of the sediment control structures as discussed in Section 3.4-6(2) of the permit was followed during reclamation activities.

**Resoiling** - Most of the 95.3 acres within the Disturbed Area Boundary in the Preparation Plant Area, Barn Canyon, and Refuse Pile Area which were 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 were 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 was used. Approximately 3 feet of soil was placed over any coal refuse.

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 above mentioned guideline. Hence, soil at the site was suitable for use in reclamation.

In March 2004, four soil pits were sampled and analyzed in the preparation plant and clean coal stockpiles areas to ensure suitability. The soil pit locations are shown on Exhibit 3.4-12 and the analyses presented in Appendix 3.4M. These soil samples along with those discussed in Volume 1, Section 3.1.1.5 and Chapter 8 show the subsoils to be suitable for use during reclamation. Therefore, this soil material was used in addition to the soil stored at Gravel Canyon.

The soils stored in Gravel Canyon were used to cover coal refuse at the site and to enhance the reclamation and wildlife habitat. The topsoil stored at Gravel Canyon was used in areas outside the industrial land use area. The use of the topsoil within the industrial land use area only to be disturbed at a later date by the Price River Water Improvement District was not felt to be the best utilization of the soil resource.

The refuse pile was covered with 36" of soil from the Gravel Canyon soil storage site and Pond 13 embankment during reclamation. Justification for use of less than 4' of cover on the refuse pile is the nontoxic nature of the refuse. Prior to placement of substitute topsoil on the refuse pile, the refuse was evaluated in accordance with the Division in order to prove non-toxicity.

Results of the tests were forwarded to DOGM for review and to be incorporated into Appendix 3.4M. The sample locations coincided with the station locations shown on Map 3.4-12.

During the construction of the Willow Creek Mine, approximately 450,000 tons of coal waste were removed from the mine portal face-up area and placed on the refuse pile. The coal waste at the portal face-up area was placed there by the Division of Oil, Gas and Mining's Abandoned Mined Lands (AML) Department during their cleanup of several coal waste sites along the Price River The location and depth of this material is shown on maps generated for MSHA in 1996 and 2000 (Appendix 3.4M). By overlaying these maps, it can be seen what the topography of the refuse pile surface was before the coal waste was placed, after it was placed, and what the surface was prior to reclamation.

It should be noted, that prior to removing this coal waste and placing it on the refuse pile, approximately 16 inches of growth media was salvaged and stockpiled for redistribution during reclamation. The Division of Oil, Gas and Mining did not analyze this coal waste for its toxic and acid generating potential, but instead, only covered it with a skiff of soil after they removed it from along the Price River and used it as backfill against a pre-SMCRA highwall and other cut-faces.

By contrast, the permittee has placed a minimum of three-feet of suitable cover material over this material where it is intercepted during the construction of the reclamation channel on the refuse pile to minimize the toxicity affects that may occur due to the elevated boron concentrations identified in the coal waste.

Any acid forming or toxic materials exposed during the grading operation were 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 was buried under at least three feet of nonacid- and nontoxic forming material as measured by the final reclamation grade.

The soil material placed on the refuse pile was 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. Exhibit 3.4-17AB "Preparation Plant Area and Refuse Pile As-Built Topography and Treatment Map" shows the areas deep gouged and mulched during reclamation. This includes portions of the preparation plant area that will support the industrial postmining land use.

**Seeding and Mulching** - Two revegetation seed mixes were 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 was seeded with the Upland Seed Mixture (Table 5.3-2b). The riparian areas shown on Exhibit 3.4-17AB will be seeded with species list #3. Following the placement of the growth media and prior to application of the reclamation seed mix, hay was incorporated into the growth media at a rate of 2 tons per acre. This was done to improve soil structure for aeration purposes, increase micropore space, and improve the water holding capacity of the soil. Incorporation of the mulch occurred during deep gouging. No fertilizer was used during the reseeding activities.

Following seeding, an additional 1.5 tons per acre of certified noxious weed free straw mulch was spread over the seeded growth media mostly by mechanical blowers with occasional hand spreading. The straw mulch was then 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 does the crimping technique.

**Reclamation Monitoring**

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

### 3.4-6(3)AB Reclamation Hydrology

**Reclamation Channel Design** - The reclamation channels for the Willow Creek Preparation Plant area were constructed 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 constructed with 2H:1V side slopes to ensure channel stability. However, existing stream channels, Castle Gate Ditches CGD-3 and CGD-4 were constructed with 1H:1V side slopes. These two ditches were previously designed for the operational hydrology of the Castle Gate area and were determined to be adequately designed for reclamation hydrology. The hydraulic slope of each channel was measured from electronic versions of Exhibit 3.4-16AB.

All calculations supporting the adequacy of the as-built reclamation hydrology structures are presented in Attachment 1 of this appendix. Curve numbers for the undisturbed drainage areas were based on professional judgement and typical tabulated values. The reclaimed areas were assumed to have a curve number of 75. The reclamation channel drainage areas for the Preparation Plant Area are presented on Exhibit 3.4-16AB.

Peak discharge rates used to verify 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, intermittent channels, and any channel associated with the refuse pile. All other channels were verified 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 Attachment 1. The as-built reclamation channel geometries and minimum riprap sizes are presented in Table 3.4-7AB.

The following general approach was used during verification of the as-built reclamation channels:

- The 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 capacity of the ephemeral reclamation channels was based on the 10-year 6-hour storm and the minimum channel slope.
- Riprap size was verified based on the 100-year 6-hour storm and the maximum channel slope for perennial channel, intermittent channels and all channels associated with the refuse pile.

- Riprap size was verified 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 (Abt et al., 1981):

$$n = 0.0456(D_{50}*\text{slope})^{0.159}$$

where, n = Manning's roughness coefficient
$D_{50}$ = median riprap diameter (ft)
Slope = channel slope (ft/ft)

- In areas where the as-built reclamation channel construction occured on rock, riprap was not used.

- When transitioning downstream from a steep channel slope to a flat channel slope, the larger riprap from the steep section was extended into the channel section with the flatter slope for at least 15 feet to minimize erosion (Simons, Li & Associates, 1982).

The riprap and filter blanket gradations for all channels were engineered based on methods presented in Barfield et al. (1981). The procedure presented by Searcy (1967) was used to design the riprap size for all channels. This design procedure assumes that the riprap is predominately angular in shape. The filter blanket consists of a properly graded coarse grained soil; a synthetic fabric was not used.

**Reclamation Culvert Design** - Calculations regarding verification of the Willow Creek preparation plant reclamation culverts are presented in Attachment 1 of this appendix. Summaries of the reclamation culvert discharges and designs are presented in Table 3.4-8AB.

Three operational culverts remain after reclamation. As indicated in Attachment 1, culvert CGC-1 is an adequately designed existing18 inch culvert which will remain after reclamation. No riprap is required at the CGC-1 outlet.

CGC-5 is an adequately designed existing 48-inch diameter culvert located under the road and the Utah Railway spur. CGC-5 extends to the Price River and was shortened during reclamation as shown on Exhibit 3.4-13AB. An average riprap size of 40 inches is at the outlet.

CGC-2 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 at the outlet.

### 3.4-6(4)AB Alternative Sediment Control 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 were removed during the reclamation grading operations. Therefore, alternative sediment control measures were implemented during reclamation of the site to reduce the quantity of sediment yield from the area. These ASCMs include the following practices in varying degrees:

1. Placement of growth media,
2. Incorporation of hay mulch into the growth media,
3. Deep gouging of the growth media,
4. Seeding the prepared soil,
5. Addition of more mulch following seeding, and
6. Chemically anchoring the final mulch layer.

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.

Mechanical treatment of slopes was by deep gouging the soil to a depth of 18" to 24". Mulch was applied at the rate of 2,000 pounds per acre. Upon completion of the grading and mechanical treatment of the soil, the reclaimed area was seeded with grasses, shrubs and forbs. Seeding was be performed in the spring of 2004. Areas in which the seed does not

germinate will be reseeded. Following seeding the area was straw mulched again at a rate of 1.5 tons per acre. The straw mulch was held in place with a tackifier.

The alternative sediment controls constructed during reclamation will be inspected quarterly or after every major storm event. 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 a gully greater than 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 regrading of the ground surface only as necessary to fill in nine inch gullies caused by erosion, and reseeding and mulching, as warranted, to reestablish vegetation.

### 3.4-7 Reclamation Timeline

Demolition of the site began in the fall of 2003. Reclamation of the Refuse pile began during the fall of 2003. Demolition at the site began in spring of 2004. Final reclamation of the site was completed in spring of 2004. Monitoring of the site will continue until Phase III bond release.

### 3.4-8 Reclamation Bond Release

As a result of the Postmining land use change the Preparation Plant area was changed to have an industrial use. This area was sold to Price River Water Improvement District ("PRIWID"). As the land owner PRIWID intends to make improvements to their property. PMC has reclaimed the site according to the approved reclamation plan and is requesting Phase III bond release for the Preparation Plant Area. The land use for the Refuse Pile area was not changed, nor was the property sold. Thus, only phase I bond release is being requested for the Refuse Pile Area. Bond release calculations can be found in Attachment 3.

### 3.4.9 References

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# TABLES

## TABLE 3.4-6AB

## PREPARATION PLANT
## RECLAMATION WATERSHED CHARACTERISTICS

| WATERSHED (CGRWS- ) | CURVE NUMBER | TIME OF CONCENTRATION (hr) | DRAINAGE AREA (acres) | PEAK FLOW (cfs)[a] |
|---|---|---|---|---|
| 1 | 71 | 0.463 | 263.49 | 31.19 |
| 2 | 75 | 0.100 | 11.19 | 4.13 |
| 3 | 75 | 0.081 | 5.22 | 1.99 |
| 4 | 75 | 0.073 | 4.74 | 1.84 |
| 5 | 75 | 0.081 | 6.10 | 2.33 |
| 6 | 71 | 0.108 | 3.02 | 0.08 |
| 7 | 87 | 0.160 | 4.81 | 1.96 |
| 8 | 88 | 0.259 | 6.68 | 2.71 |
| 9 | 76 | 0.180 | 19.1 | 1.32 |
| 10 | 83 | 0.043 | 3.92 | 1.22 |

(a) Peak flows based on the following design events:

| 10-year, 6-hour | 100-year, 6-hour |
|---|---|
| CGRWS-6 | CGRWS-1 |
| CGRWS-7 | CGRWS-2 |
| CGRWS-8 | CGRWS-3 |
| CGRWS-9 | CGRWS-4 |
| CGRWS-10 | CGRWS-5 |

TABLE 2-7AB

## AS-BUILT 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) [c] |
| 1 | 31.19 | 10 | 2:1 | 30.9 | 3.0 | 7.42 | 0.62 | 1.42 | 12 |
| 2 | 4.13 | 6 | 2.73:1 | 21.9 | 10.5 | 4.07 | 0.18 | 0.92 | 6 |
| 3 (MS)[b] | 1.99 | 3.5 | 2.25:1 | 12.0 | 7.0 | 3.73 | 0.16 | 1.0 | None |
| 3 (SS)[b] | 1.99 | 4.5 | 2.45:1 | 22.7 | 7.1 | 3.44 | 0.16 | 0.92 | 6 |
| 4 (MS)[b] | 1.84 | 10 | 2.5:1 | 10.3 | 4.0 | 2.40 | 0.10 | 1.0 | none |
| 4 (SS)[b] | 1.84 | 4.0 | 2.4:1 | 43.1 | 15.4 | 3.99 | 0.13 | 0.83 | 6 |
| 5 (MS)[b] | 2.33 | 10.0 | 3:1 | 11.3 | 2.5 | 2.70 | 0.13 | 1.5 | None |
| 5 (SS)[b] | 2.33 | 4.0 | 3:1 | 34.1 | 12.4 | 4.09 | 0.16 | 1.0 | 6 |
| 6 | 0.08 | 2.0 | 1:1 | 21.9 | 1.4 | 1.64 | 0.06 | 1.0 | None |
| 7 | 3.60 | 2.50 | 2.1:1 | 42.1 | 3.4 | 5.79 | 0.35 | 1.1 | 6 |
| 8 | 1.96 | 2.50 | 1.9:1 | 29.1 | 6.3 | 4.36 | 0.22 | 0.92 | 6 |
| 9 | 1.32 | 0 | 1:1 4.4:1 | 7.5 | 1.0 | 3.99 | 0.51 | 0.67 | None |
| 9a | 1.32 | 2.75 | 2.6:1 | 55.9 | 4.8 | 4.18 | 0.17 | 0.75 | 6 |
| 10 [d] | 1.10 | 0 | 1.5:1 | 8.3 | 4.4 | 4.38 | 0.69 | 1.0 | None |
| 10a | 2.71 | 2.0 | 1.75:1 | 2.7 | 0.3 | 3.46 | 0.70 | 1.0 | None |
| 11 | 1.22 | 0 | 1.2:1 4:1 | 1.3 | 0.4 | 2.05 | 0.60 | 1.17 | None |
| | | | | | | | | | |

(a) Minimum bottom width measured at mInimum 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.

## TABLE 3.4-8AB

## AS-BUILT 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 | 0.08 | 3.07 | None Req'd |
| 2 | 2-84" CMP | 5 | 222.90 | 14.29 | 30 |
| 5 | 60" Concrete | 10 | 32.52 | 20.37 | 40 |

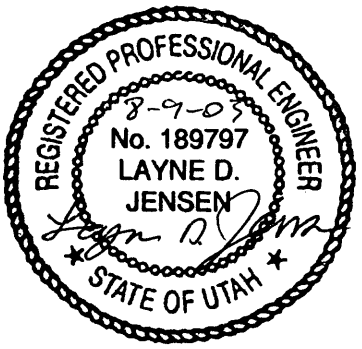
(a) Actual riprap size exceeds minimum requirements under reclamation

Note: The above culverts are existing operational culverts that have been 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.

# ATTACHMENT 1

## AS-BUILT RECLAMATION HYDROLOGY CALCULATIONS



**As-Build Hydrology Calculations**
**Willow Creek Preparation Plant**

The purpose of these calculations is to demonstrate that the constructed reclamation channels can handle the peak flow generated from the required storm event. Channels associated with the Refuse Pile are required to handle the 100-year 6-hour storm event. All other channels must be able to handle the 10-year 6-hour storm event. All channels will be shown to be capable of safely handling the design event.

To minimize confusion and ease review, watersheds and channels are labeled in the same manner as found in the design calculations in Appendix 3.4J.

Methodology

- Curve Number techniques of the U.S. SCS (1972)
- Triangular Unit Hydrograph approach of the U.S. SCS (1972) as programed by Hawkins and Marshall (1979)
- Drainage areas, slopes and hydraulic lengths determined from as-built aerial topography. See Exhibit 3.4-16ab for watershed location.

Rainfall Depths

| | |
|---|---|
| 10-year 6-hour | 1.4 inches |
| 100-year 6-hour | 2.1 inches |

Reclamation Curve Numbers

The curve number for each watershed is determined by an area weighted average between undisturbed and reclaimed areas. The same curve numbers for each vegetation type will be used as listed in Appendix 3.4D of Exhibit 19. Namely:

| | |
|---|---|
| Conifer | CN = 65 |
| Grassland Sage brush | CN = 70 |
| Mixed Brush | CN = 75 |
| Pinyon/Juniper | CN = 75 |
| Disturbed | CN = 90 |
| Reclaimed | CN = 75 See Exhibit 13, Appendix H-1, pg. 2 |
| Paved | CN = 98 |

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 | 237.58 | 71 | 25.91 | 75 | 0 | 90 | 71 |
| CGRWS-2 | 11.07 | 75 | 0.12 | 75 | 0 | 90 | 75 |
| CGRWS-3 | 4.84 | 75 | 0.38 | 75 | 0 | 90 | 75 |
| CGRWS-4 | 4.07 | 75 | 0.67 | 75 | 0 | 90 | 75 |
| CGRWS-5 | 4.89 | 75 | 1.21 | 75 | 0 | 90 | 75 |
| CGRWS-6 | 2.63 | 70 | 0.39 | 75 | 0 | 90 | 71 |
| CGRWS-7 | 0 | 75 | 0.95 | 75 | 3.86 | 90 | 87 |
| CGRWS-8 | 0 | 75 | 1.58 | 75 | 5.1 | 92 | 88 |
| CGRWS-9 | 7.03 | 75 | 10.78 | 75 | 1.29 | 93 | 76 |
| CGRWS-10 | 1.88 | 75 | 1.87 | 75 | 1.89 | 98 | 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**
**Summary of Watershed Data**

| Watershed Area | Drainage Area (ac) | Curve Number | S (in) | Y (%) | l (ft) | L (hr) | Time of Conc. (hr) | Peak Flow (cfs) |
|---|---|---|---|---|---|---|---|---|
| CGRWS-1 | 263.49 | 71 | 4.085 | 64 | 8175 | 0.277 | 0.463 | 31.19 |
| CGRWS-2 | 11.19 | 75 | 3.333 | 90 | 1725 | 0.060 | 0.100 | 4.13 |
| CGRWS-3 | 5.22 | 75 | 3.333 | 83.6 | 1265 | 0.049 | 0.081 | 1.99 |
| CGRWS-4 | 4.74 | 75 | 3.333 | 96.6 | 1201 | 0.043 | 0.073 | 1.84 |
| CGRWS-5 | 6.1 | 75 | 3.333 | 72.7 | 1145 | 0.048 | 0.081 | 2.33 |
| CGRWS-6 | 3.02 | 71 | 4.085 | 62 | 1294 | 0.064 | 0.108 | 0.08 |
| CGRWS-7 | 4.81 | 87 | 1.494 | 10 | 1272 | 0.096 | 0.160 | 1.96 |
| CGRWS-8 | 6.68 | 88 | 1.364 | 14.6 | 3072 | 0.155 | 0.259 | 2.71 |
| CGRWS-9 | 19.1 | 76 | 3.158 | 36.4 | 2100 | 0.108 | 0.180 | 1.32 |
| CGRWS-10 | 3.92 | 83 | 2.048 | 45.7 | 532 | 0.026 | 0.043 | 1.22 |

**Notes**

Watershed locations can be found on Exhibit 3.4-11 and attached map.
S = 1000/CN - 10
Y = average watershed slope = (length of contour lines)(contour interval)/(watershed area)
l = hydraulic length
L = watershed lag =( l^0.8(S+1)^0.7) / (1900(Y)^0.5)
Time of Concentration + 1.67L
Peak Flow is based on a 100-year 6-hour storm event for CGRWS-1 through 5 and a 10-year 6-hour storm for the remaining watersheds

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-1 100-YEAR 6 HOUR

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 263.49 acres |
| Depth = 2.10 inches | CN = 71.00 |
| Duration = 6.0 hrs | Time conc.= 0.46 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.307 inches
Initial abstr: 0.817 inches
Peak flow: 31.19 cfs ( 0.117 iph )
at time: 2.901 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-2 100-YEAR 6 HOUR

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 11.19 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: 4.13 cfs ( 0.366 iph )
at time: 2.520 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-3 100-YEAR 6 HOUR

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 5.22 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: 1.99 cfs ( 0.379 iph )
at time: 2.516 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-4 100-YEAR 6 HOUR

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 4.74 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: 1.84 cfs ( 0.384 iph )
at time: 2.511 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-5 100-YEAR 6 HOUR

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 6.10 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: 2.33 cfs ( 0.379 iph )
at time: 2.516 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-6 10-YEAR 6 HOUR

INPUT SUMMARY

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 3.02 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: 0.08 cfs ( 0.026 iph )
at time: 3.528 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-7 10-YEAR 6 HOUR

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 4.81 acres |
| Depth = 1.40 inches | CN = 87.00 |
| Duration = 6.0 hrs | Time conc.= 0.16 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.467 inches
Initial abstr: 0.299 inches
Peak flow: 1.96 cfs ( 0.405 iph )
at time: 2.539 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-8 10-YEAR 6-HOUR

INPUT SUMMARY

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 6.68 acres |
| Depth = 1.40 inches | CN = 88.00 |
| Duration = 6.0 hrs | Time conc.= 0.26 hrs |

OUTPUT SUMMARY

Runoff depth: 0.510 inches
Initial abstr: 0.273 inches
Peak flow: 2.71 cfs ( 0.402 iph )
at time: 2.590 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-9 10-YEAR 6 HOUR

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 19.10 acres |
| Depth = 1.40 inches | CN = 76.00 |
| Duration = 6.0 hrs | Time conc.= 0.18 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.150 inches
Initial abstr: 0.632 inches
Peak flow: 1.32 cfs ( 0.068 iph )
at time: 2.616 hrs

---

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CGRWS-10 10-YEAR 6 HOUR

INPUT SUMMARY

---

| STORM : | WATERSHED : |
|---|---|
| Dist.= SCS Type `b' | Area = 3.92 acres |
| Depth = 1.40 inches | CN = 83.00 |
| Duration = 6.0 hrs | Time conc.= 0.04 hrs |

---

OUTPUT SUMMARY

---

Runoff depth: 0.323 inches
Initial abstr: 0.410 inches
Peak flow: 1.22 cfs ( 0.309 iph )
at time: 2.505 hrs

---

## Channel Verification

Assumptions

1. All channels related to the Refuse Pile are verified for the 100-year 6-hour storm event. All other channels are verified for the 10-year 6-hour storm event,

2. When determining the adequacy of the riprap the method presented by Searcy, (1967) will be used,

3. Riprap thickness is twice the $D_{50}$,

4. A Mannings n for riprap channels will be determined using the method presented by Abt, S.R., et. al. (1987)

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

Where: D50 = median riprap size (inches)
Slope = (ft\ft)

5. A Mannings n for rocky ground will be assumed to be 0.035. The Mannings n for bare ground will be assumed to be 0.030

6. The channels are verified by assessing the erosional stability at the maximum slope and the capacity of the channel at the minimum slope.

The channels were measured in the fall of 2004. The channels were measured at the location of the minimum flow area. Thus, the channels typically have a greater capacity than indicated in this calculation. Calculation sheets can be found on pages 16 to 47 with a summary on page 15.

Channel cross-sections for each of the channels can be found on pages 48 through 63. Channel profiles can be found on Exhibit 3.4-15ab.

## AS-BUILT 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) [c] |
| 1 | 31.19 | 10 | 2:1 | 30.9 | 3.0 | 7.42 | 0.62 | 1.42 | 12 |
| 2 | 4.13 | 6 | 2.73:1 | 21.9 | 10.5 | 4.07 | 0.18 | 0.92 | 6 |
| 3 (MS)[b] | 1.99 | 3.5 | 2.25:1 | 12.0 | 7.0 | 3.73 | 0.16 | 1.0 | None |
| 3 (SS)[b] | 1.99 | 4.5 | 2.45:1 | 22.7 | 7.1 | 3.44 | 0.16 | 0.92 | 6 |
| 4 (MS)[b] | 1.84 | 10 | 2.5:1 | 10.3 | 4.0 | 2.40 | 0.10 | 1.0 | none |
| 4 (SS)[b] | 1.84 | 4.0 | 2.4:1 | 43.1 | 15.4 | 3.99 | 0.13 | 0.83 | 6 |
| 5 (MS)[b] | 2.33 | 10.0 | 3:1 | 11.3 | 2.5 | 2.70 | 0.13 | 1.5 | None |
| 5 (SS)[b] | 2.33 | 4.0 | 3:1 | 34.1 | 12.4 | 4.09 | 0.16 | 1.0 | 6 |
| 6 | 0.08 | 2.0 | 1:1 | 21.9 | 1.4 | 1.64 | 0.06 | 1.0 | None |
| 7 | 3.60 | 2.50 | 2.1:1 | 42.1 | 3.4 | 5.79 | 0.35 | 1.1 | 6 |
| 8 | 1.96 | 2.50 | 1.9:1 | 29.1 | 6.3 | 4.36 | 0.22 | 0.92 | 6 |
| 9 | 1.32 | 0 | 1:1 4.4:1 | 7.5 | 1.0 | 3.99 | 0.51 | 0.67 | None |
| 9a | 1.32 | 2.75 | 2.6:1 | 55.9 | 4.8 | 4.18 | 0.17 | 0.75 | 6 |
| 10 [d] | 1.10 | 0 | 1.5:1 | 8.3 | 4.4 | 4.38 | 0.69 | 1.0 | None |
| 10a | 2.71 | 2.0 | 1.75:1 | 2.7 | 0.3 | 3.46 | 0.70 | 1.0 | None |
| 11 | 1.22 | 0 | 1.2:1 4:1 | 1.3 | 0.4 | 2.05 | 0.60 | 1.17 | None |
| | | | | | | | | | |

(a) Minimum bottom width measured at mlnimum 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 | Willow Creek Prep I |
| Flow Element | Trapezoidal Chann |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.039 | |
| Slope | 0.030000 | ft/ft |
| Left Side Slope | 2.00 | H : V |
| Right Side Slope | 2.00 | H : V |
| Bottom Width | 10.00 | ft |
| Discharge | 31.19 | cfs |

$D_{50} = 12"$ Slope = 3%

| Results | | |
|---|---|---|
| Depth | 0.62 | ft |
| Flow Area | 7.0 | ft² |
| Wetted Perim | 12.79 | ft |
| Top Width | 12.50 | ft |
| Critical Depth | 0.64 | ft |
| Critical Slope | 0.027211 | ft/ft |
| Velocity | 4.45 | ft/s |
| Velocity Head | 0.31 | ft |
| Specific Energ | 0.93 | ft |
| Froude Numb | 1.05 | |
| Flow Type | Supercritical | |

< 1.42 ft freeboard = 0.8'



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# CGRD-1 MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.056 | |
| Slope | 0.309000 | ft/ft |
| Left Side Slope | 2.00 | H : V |
| Right Side Slope | 2.00 | H : V |
| Bottom Width | 10.00 | ft |
| Discharge | 31.19 | cfs |

$D_{50} = 12''$ Slope = 30.9 % $n = 0.0456(12 \times 0.309)^{0.159} = 0.056$

| Results | | |
|---|---|---|
| Depth | 0.39 | ft |
| Flow Area | 4.2 | ft² |
| Wetted Perim | 11.74 | ft |
| Top Width | 11.56 | ft |
| Critical Depth | 0.64 | ft |
| Critical Slope | 0.056887 | ft/ft |
| Velocity | 7.42 | ft/s |
| Velocity Head | 0.86 | ft |
| Specific Energ | 1.25 | ft |
| Froude Numb | 2.17 | |
| Flow Type | Supercritical | |

$< 10.7$ fps



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# CGRD-2 MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Chann |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.042 | $D_{50} = 6''$ |
| Slope | 0.105000 | ft/ft |
| Left Side Slope | 2.73 | H : V |
| Right Side Slope | 2.73 | H : V |
| Bottom Width | 6.00 | ft |
| Discharge | 4.13 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.18 | ft $< 0.92'$ ∴ OK freeboard = 0.74 ft |
| Flow Area | 1.2 | ft² |
| Wetted Perim | 7.07 | ft |
| Top Width | 7.00 | ft |
| Critical Depth | 0.24 | ft |
| Critical Slope | 0.044381 | ft/ft |
| Velocity | 3.47 | ft/s |
| Velocity Head | 0.19 | ft |
| Specific Ener | 0.37 | ft |
| Froude Numb | 1.48 | |
| Flow Type | Supercritical | |



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# CGRD-2 MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.048 | $D_{50} = 6''$ |
| Slope | 0.219000 | ft/ft |
| Left Side Slope | 2.73 | H : V |
| Right Side Slope | 2.73 | H : V |
| Bottom Width | 6.00 | ft |
| Discharge | 4.13 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.16 | ft |
| Flow Area | 1.0 | ft² |
| Wetted Perim | 6.92 | ft |
| Top Width | 6.86 | ft |
| Critical Depth | 0.24 | ft |
| Critical Slope | 0.055934 | ft/ft |
| Velocity | 4.07 | ft/s < 7.5 fps ∴ ok |
| Velocity Head | 0.26 | ft |
| Specific Energ | 0.41 | ft |
| Froude Numb | 1.86 | |
| Flow Type | Supercritical | |



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# CGRD-3 (MS) MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.035 | rocky ground |
| Slope | 0.070000 | ft/ft |
| Left Side Slope | 2.25 | H : V |
| Right Side Slope | 2.25 | H : V |
| Bottom Width | 3.50 | ft |
| Discharge | 1.99 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.16 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perim | 4.31 | ft |
| Top Width | 4.24 | ft |
| Critical Depth | 0.21 | ft |
| Critical Slope | 0.032185 | ft/ft |
| Velocity | 3.13 | ft/s |
| Velocity Head | 0.15 | ft |
| Specific Energ | 0.32 | ft |
| Froude Numb | 1.43 | |
| Flow Type | Supercritical | |

< 1.0 Fr ok  freeboard = 0.84 ft



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# CGRD-3 (MS) MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Chann |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.035 | rocky ground |
| Slope | 0.120000 | ft/ft |
| Left Side Slope | 2.25 | H : V |
| Right Side Slope | 2.25 | H : V |
| Bottom Width | 3.50 | ft |
| Discharge | 1.99 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.14 | ft |
| Flow Area | 0.5 | ft² |
| Wetted Perim | 4.19 | ft |
| Top Width | 4.13 | ft |
| Critical Depth | 0.21 | ft |
| Critical Slope | 0.032185 | ft/ft |
| Velocity | 3.73 | ft/s < 5 ft/s ∴ ok |
| Velocity Head | 0.22 | ft |
| Specific Energ | 0.36 | ft |
| Froude Numb | 1.83 | |
| Flow Type | Supercritical | |

# CGRD-3 (SS) MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.040 | $D_{50} = 6$ |
| Slope | 0.071000 | ft/ft |
| Left Side Slope | 2.45 | H : V |
| Right Side Slope | 2.45 | H : V |
| Bottom Width | 4.00 | ft |
| Discharge | 1.99 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.16 | ft |
| Flow Area | 0.7 | ft² |
| Wetted Perim | 4.86 | ft |
| Top Width | 4.80 | ft |
| Critical Depth | 0.19 | ft |
| Critical Slope | 0.042364 | ft/ft |
| Velocity | 2.78 | ft/s |
| Velocity Head | 0.12 | ft |
| Specific Energ | 0.28 | ft |
| Froude Numb | 1.27 | |
| Flow Type | Supercritical | |

$< 0.92$ ∴ ok freeboard = 0.76 ft



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# CGRD-3 (SS) MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.048 | $D_{50}$ = 6" |
| Slope | 0.227000 | ft/ft |
| Left Side Slope | 2.45 | H : V |
| Right Side Slope | 2.45 | H : V |
| Bottom Width | 4.50 | ft |
| Discharge | 1.99 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.12 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perim | 5.14 | ft |
| Top Width | 5.09 | ft |
| Critical Depth | 0.18 | ft |
| Critical Slope | 0.062349 | ft/ft |
| Velocity | 3.44 | ft/s < 7.5 ft/s ∴ ok |
| Velocity Head | 0.18 | ft |
| Specific Energ | 0.30 | ft |
| Froude Numb | 1.80 | |
| Flow Type | Supercritical | |



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# CGRD-4 (MS) MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Chann |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.035 | rocky ground |
| Slope | 0.040000 | ft/ft |
| Left Side Slope | 2.50 | H : V |
| Right Side Slope | 2.50 | H : V |
| Bottom Width | 10.00 | ft |
| Discharge | 1.84 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.10 | ft |
| Flow Area | 1.0 | ft² |
| Wetted Perim | 10.54 | ft |
| Top Width | 10.50 | ft |
| Critical Depth | 0.10 | ft |
| Critical Slope | 0.038855 | ft/ft |
| Velocity | 1.80 | ft/s |
| Velocity Head | 0.05 | ft |
| Specific Ener | 0.15 | ft |
| Froude Numb | 1.01 | |
| Flow Type | Supercritical | |

< 1.0 ft ∴ ok freeboard = 0.9 ft



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# CGRD-4 (MS) MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.035 | rocky ground |
| Slope | 0.103000 | ft/ft |
| Left Side Slope | 2.50 | H : V |
| Right Side Slope | 2.50 | H : V |
| Bottom Width | 10.00 | ft |
| Discharge | 1.84 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.08 | ft |
| Flow Area | 0.8 | ft² |
| Wetted Perim | 10.41 | ft |
| Top Width | 10.38 | ft |
| Critical Depth | 0.10 | ft |
| Critical Slope | 0.038849 | ft/ft |
| Velocity | 2.40 | ft/s < 5.0 ft/s ∴ ok |
| Velocity Head | 0.09 | ft |
| Specific Energ | 0.16 | ft |
| Froude Numb | 1.55 | |
| Flow Type | Supercritical | |



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# CGRD-4 (SS) MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Chann |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.045 | $D_{50} = 6''$ |
| Slope | 0.154000 | ft/ft |
| Left Side Slope | 2.40 | H : V |
| Right Side Slope | 2.40 | H : V |
| Bottom Width | 4.00 | ft |
| Discharge | 1.84 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.13 | ft $< 0.83$ ok freeboard = 0.7 ft |
| Flow Area | 0.6 | ft² |
| Wetted Perim | 4.69 | ft |
| Top Width | 4.64 | ft |
| Critical Depth | 0.18 | ft |
| Critical Slope | 0.055177 | ft/ft |
| Velocity | 3.19 | ft/s |
| Velocity Head | 0.16 | ft |
| Specific Energ | 0.29 | ft |
| Froude Numb | 1.60 | |
| Flow Type | Supercritical | |



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# CGRD-4 (SS) MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.053 | $D_{50} = 6''$ |
| Slope | 0.431000 | ft/ft |
| Left Side Slope | 2.40 | H : V |
| Right Side Slope | 2.40 | H : V |
| Bottom Width | 4.00 | ft |
| Discharge | 1.84 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.11 | ft |
| Flow Area | 0.5 | ft² |
| Wetted Perim | 4.56 | ft |
| Top Width | 4.52 | ft |
| Critical Depth | 0.18 | ft |
| Critical Slope | 0.076203 | ft/ft |
| Velocity | 3.99 | ft/s $< 7.5$ ft/s $\therefore$ ok |
| Velocity Head | 0.25 | ft |
| Specific Energ | 0.36 | ft |
| Froude Numb | 2.20 | |
| Flow Type | Supercritical | |



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# CGRD-5 (MS) MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Chann |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.035 | rocky ground |
| Slope | 0.025000 | ft/ft |
| Left Side Slope | 3.00 | H : V |
| Right Side Slope | 3.00 | H : V |
| Bottom Width | 10.00 | ft |
| Discharge | 2.33 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.13 | ft < 1.5' ok freeboard = 1.37 ft |
| Flow Area | 1.4 | ft² |
| Wetted Perim | 10.84 | ft |
| Top Width | 10.79 | ft |
| Critical Depth | 0.12 | ft |
| Critical Slope | 0.037016 | ft/ft |
| Velocity | 1.69 | ft/s |
| Velocity Head | 0.04 | ft |
| Specific Energ | 0.18 | ft |
| Froude Numb | 0.84 | |
| Flow Type | Subcritical | |



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# CGRD-5 (MS) MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.035 | rocky ground |
| Slope | 0.113000 | ft/ft |
| Left Side Slope | 3.00 | H : V |
| Right Side Slope | 3.00 | H : V |
| Bottom Width | 10.00 | ft |
| Discharge | 2.33 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.08 | ft |
| Flow Area | 0.9 | ft² |
| Wetted Perim | 10.53 | ft |
| Top Width | 10.51 | ft |
| Critical Depth | 0.12 | ft |
| Critical Slope | 0.037015 | ft/ft |
| Velocity | 2.70 | ft/s < 5.0 fps ∴ ok |
| Velocity Head | 0.11 | ft |
| Specific Energ | 0.20 | ft |
| Froude Numb | 1.66 | |
| Flow Type | Supercritical | |



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# CGRD-5 (SS) MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.043 | $D_{50} = 6''$ |
| Slope | 124000 | ft/ft |
| Left Side Slope | 3.00 | H : V |
| Right Side Slope | 3.00 | H : V |
| Bottom Width | 4.00 | ft |
| Discharge | 2.33 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.16 | ft $< 1.0'$ ∴ OK freeboard = 0.84 ft |
| Flow Area | 0.7 | ft² |
| Wetted Perim | 5.00 | ft |
| Top Width | 4.95 | ft |
| Critical Depth | 0.21 | ft |
| Critical Slope | 0.049173 | ft/ft |
| Velocity | 3.28 | ft/s |
| Velocity Head | 0.17 | ft |
| Specific Energ | 0.33 | ft |
| Froude Numb | 1.53 | |
| Flow Type | Supercritical | |



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# CGRD-5 (SS) MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Chann |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.051 | $D_{50} = 6''$ |
| Slope | 8.341000 | ft/ft |
| Left Side Slope | 3.00 | H : V |
| Right Side Slope | 3.00 | H : V |
| Bottom Width | 4.00 | ft |
| Discharge | 2.33 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.13 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perim | 4.82 | ft |
| Top Width | 4.78 | ft |
| Critical Depth | 0.21 | ft |
| Critical Slope | 0.067903 | ft/ft |
| Velocity | 4.09 | ft/s $< 7.5$ ft/s ∴ ok |
| Velocity Head | 0.26 | ft |
| Specific Energ | 0.39 | ft |
| Froude Numb | 2.09 | |
| Flow Type | Supercritical | |



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# CGRD-6 MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.035 | rocky ground w/ vegetation |
| Slope | 0.014000 | ft/ft |
| Left Side Slope | 1.00 | H : V |
| Right Side Slope | 1.00 | H : V |
| Bottom Width | 2.00 | ft |
| Discharge | 0.08 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.06 | ft < 1.0 ft ∴ ok freeboard = 0.94 ft |
| Flow Area | 0.1 | ft² |
| Wetted Perim | 2.16 | ft |
| Top Width | 2.11 | ft |
| Critical Depth | 0.04 | ft |
| Critical Slope | 0.055176 | ft/ft |
| Velocity | 0.71 | ft/s |
| Velocity Head | 0.01 | ft |
| Specific Energ | 0.06 | ft |
| Froude Numb | 0.54 | |
| Flow Type | Subcritical | |



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# CGRD-6 MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.035 | rocky ground + vegetation |
| Slope | 219000 | ft/ft |
| Left Side Slope | 1.00 | H : V |
| Right Side Slope | 1.00 | H : V |
| Bottom Width | 2.00 | ft |
| Discharge | 0.08 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.02 | ft |
| Flow Area | 4.9e-2 | ft² |
| Wetted Perim | 2.07 | ft |
| Top Width | 2.05 | ft |
| Critical Depth | 0.04 | ft |
| Critical Slope | 0.055173 | ft/ft |
| Velocity | 1.64 | ft/s < 5 ft/s ∴ ok |
| Velocity Head | 0.04 | ft |
| Specific Energ | 0.07 | ft |
| Froude Numb | 1.87 | |
| Flow Type | Supercritical | |



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# CGRD-7 MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Chann |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.036 | $D_{50} = 6''$ |
| Slope | 0.034000 | ft/ft |
| Left Side Slope | 2.10 | H : V |
| Right Side Slope | 2.10 | H : V |
| Bottom Width | 2.50 | ft |
| Discharge | 3.60 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.35 | ft $< 1.1'$ ∴ ok freeboard = 0.75 ft |
| Flow Area | 1.1 | ft² |
| Wetted Perim | 4.11 | ft |
| Top Width | 3.95 | ft |
| Critical Depth | 0.36 | ft |
| Critical Slope | 0.029339 | ft/ft |
| Velocity | 3.23 | ft/s |
| Velocity Head | 0.16 | ft |
| Specific Ener | 0.51 | ft |
| Froude Numb | 1.07 | |
| Flow Type | Supercritical | |



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# CGRD-7 MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.053 | $D_{50}=6''$ |
| Slope | 0.421000 | ft/ft |
| Left Side Slope | 2.10 | H : V |
| Right Side Slope | 2.10 | H : V |
| Bottom Width | 2.50 | ft |
| Discharge | 3.60 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.21 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perim | 3.48 | ft |
| Top Width | 3.39 | ft |
| Critical Depth | 0.36 | ft |
| Critical Slope | 0.064537 | ft/ft |
| Velocity | 5.79 | ft/s $< 7.5$ ft/s $\therefore$ ok |
| Velocity Head | 0.52 | ft |
| Specific Energ | 0.73 | ft |
| Froude Numb | 2.38 | |
| Flow Type | Supercritical | |



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# CGRD-8 MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.039 | $D_{50} = 6''$ |
| Slope | 0.063000 | ft/ft |
| Left Side Slope | 1.90 | H : V |
| Right Side Slope | 1.90 | H : V |
| Bottom Width | 2.50 | ft |
| Discharge | 1.96 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.22 | ft $< 0.92$ ok freeboard = 0.7 ft |
| Flow Area | 0.6 | ft² |
| Wetted Perim | 3.43 | ft |
| Top Width | 3.33 | ft |
| Critical Depth | 0.25 | ft |
| Critical Slope | 0.038735 | ft/ft |
| Velocity | 3.10 | ft/s |
| Velocity Head | 0.15 | ft |
| Specific Energ | 0.37 | ft |
| Froude Numb | 1.25 | |
| Flow Type | Supercritical | |



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# CGRD-8 MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.050 | $D_{50} = 6''$ |
| Slope | 0.291000 | ft/ft |
| Left Side Slope | 1.90 | H : V |
| Right Side Slope | 1.90 | H : V |
| Bottom Width | 2.50 | ft |
| Discharge | 1.96 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.16 | ft |
| Flow Area | 0.4 | ft² |
| Wetted Perim | 3.19 | ft |
| Top Width | 3.11 | ft |
| Critical Depth | 0.25 | ft |
| Critical Slope | 0.063159 | ft/ft |
| Velocity | 4.36 | ft/s $< 7.5$ ft/s ∴ ok |
| Velocity Head | 0.30 | ft |
| Specific Energ | 0.46 | ft |
| Froude Numb | 2.02 | |
| Flow Type | Supercritical | |

# CGRD-9 MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.030 | bare ground |
| Slope | 0.010000 | ft/ft |
| Left Side Slope | 1.00 | H : V |
| Right Side Slope | 4.40 | H : V |
| Bottom Width | 0.00 | ft |
| Discharge | 1.32 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.51 | ft |
| Flow Area | 0.7 | ft² |
| Wetted Perim | 3.03 | ft |
| Top Width | 2.76 | ft |
| Critical Depth | 0.43 | ft |
| Critical Slope | 0.024765 | ft/ft |
| Velocity | 1.87 | ft/s |
| Velocity Head | 0.05 | ft |
| Specific Energ | 0.57 | ft |
| Froude Numb | 0.65 | |
| Flow Type | Subcritical | |

< 0.67 ft ok freeboard = 0.16 ft

Minimum depth occurs in an area of steeper slope and with less than half the flow. Thus, it is better than it looks.

# CGRD-9 MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.030 | bare ground |
| Slope | 0.075000 | ft/ft |
| Left Side Slope | 1.00 | H : V |
| Right Side Slope | 4.40 | H : V |
| Bottom Width | 0.00 | ft |
| Discharge | 1.32 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.35 | ft |
| Flow Area | 0.3 | ft² |
| Wetted Perim | 2.07 | ft |
| Top Width | 1.89 | ft |
| Critical Depth | 0.43 | ft |
| Critical Slope | 0.024765 | ft/ft |
| Velocity | 3.99 | ft/s < 5.0 ft/s ∴ ok |
| Velocity Head | 0.25 | ft |
| Specific Energ | 0.60 | ft |
| Froude Numb | 1.68 | |
| Flow Type | Supercritical | |



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# CGRD-9a MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Chann |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.038 | $D_{50} = 6''$ |
| Slope | 048000 | ft/ft |
| Left Side Slope | 2.60 | H : V |
| Right Side Slope | 2.60 | H : V |
| Bottom Width | 2.75 | ft |
| Discharge | 1.32 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.17 | ft $< 0.75$ ok freeboard = 0.58 ft |
| Flow Area | 0.5 | ft² |
| Wetted Perim | 3.70 | ft |
| Top Width | 3.64 | ft |
| Critical Depth | 0.18 | ft |
| Critical Slope | 0.038803 | ft/ft |
| Velocity | 2.42 | ft/s |
| Velocity Head | 0.09 | ft |
| Specific Energ | 0.26 | ft |
| Froude Numb | 1.10 | |
| Flow Type | Supercritical | |



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# CGRD-9a MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.055 | $D_{50} = 6''$ |
| Slope | 0.559000 | ft/ft |
| Left Side Slope | 2.60 | H : V |
| Right Side Slope | 2.60 | H : V |
| Bottom Width | 2.75 | ft |
| Discharge | 1.32 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.10 | ft |
| Flow Area | 0.3 | ft² |
| Wetted Perim | 3.33 | ft |
| Top Width | 3.29 | ft |
| Critical Depth | 0.18 | ft |
| Critical Slope | 0.084382 | ft/ft |
| Velocity | 4.18 | ft/s $< 7.5$ ft/s $\therefore$ ok |
| Velocity Head | 0.27 | ft |
| Specific Energ | 0.38 | ft |
| Froude Numb | 2.38 | |
| Flow Type | Supercritical | |

# CGRD 10 MINIMUM SLOPE
## Worksheet for Triangular Channel

| Project Description | |
|---|---|
| Worksheet | Triangular Channe |
| Flow Element | Triangular Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | | |
|---|---|---|---|
| Mannings Coeffic | 0.030 | | bare earth |
| Slope | 044000 | ft/ft | 4.4 % |
| Left Side Slope | 1.50 | V : H | |
| Right Side Slope | 1.50 | V : H | |
| Discharge | 1.10 | cfs | |

| Results | | | |
|---|---|---|---|
| Depth | 0.69 | ft | < 1.0' ok |
| Flow Area | 0.3 | ft² | |
| Wetted Perim | 1.66 | ft | |
| Top Width | 0.92 | ft | |
| Critical Depth | 0.70 | ft | |
| Critical Slope | 0.040812 | ft/ft | |
| Velocity | 3.45 | ft/s | |
| Velocity Head | 0.19 | ft | |
| Specific Energ | 0.88 | ft | |
| Froude Numb | 1.04 | | |
| Flow Type | Supercritical | | |



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# CGRD 10 MAXIMUM SLOPE
## Worksheet for Triangular Channel

| Project Description | |
|---|---|
| Worksheet | Triangular Channe |
| Flow Element | Triangular Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | | |
|---|---|---|---|
| Mannings Coeffic | 0.030 | | bare earth |
| Slope | 083000 | ft/ft | 8.3% |
| Left Side Slope | 1.50 | V : H | |
| Right Side Slope | 1.50 | V : H | |
| Discharge | 1.10 | cfs | |

| Results | | | |
|---|---|---|---|
| Depth | 0.61 | ft | |
| Flow Area | 0.3 | ft² | |
| Wetted Perim | 1.47 | ft | |
| Top Width | 0.82 | ft | |
| Critical Depth | 0.70 | ft | |
| Critical Slope | 0.040812 | ft/ft | |
| Velocity | 4.38 | ft/s | < 5.0 fps ∴ ok |
| Velocity Head | 0.30 | ft | |
| Specific Energ | 0.91 | ft | |
| Froude Numb | 1.39 | | |
| Flow Type | Supercritical | | |



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# CGRD-10A MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Trapezoidal Channe |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | | |
|---|---|---|---|
| Mannings Coeffic | 0.030 | | bare earth |
| Slope | 0.003000 | ft/ft | 0.3% |
| Left Side Slope | 1.75 | V : H | |
| Right Side Slope | 1.75 | V : H | |
| Bottom Width | 2.00 | ft | |
| Discharge | 2.71 | cfs | |

| Results | | | |
|---|---|---|---|
| Depth | 0.70 | ft | < 1.0 ' ∴ ok |
| Flow Area | 1.7 | ft² | |
| Wetted Perim | 3.60 | ft | |
| Top Width | 2.80 | ft | |
| Critical Depth | 0.37 | ft | |
| Critical Slope | 0.023400 | ft/ft | |
| Velocity | 1.62 | ft/s | |
| Velocity Head | 0.04 | ft | |
| Specific Energ | 0.74 | ft | |
| Froude Numb | 0.37 | | |
| Flow Type | Subcritical | | |



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# CGRD-10A MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Trapezoidal Chann |
| Flow Element | Trapezoidal Chann |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | | |
|---|---|---|---|
| Mannings Coeffic | 0.030 | | bare earth |
| Slope | 027000 | ft/ft | 2.7 % |
| Left Side Slope | 1.75 | V : H | |
| Right Side Slope | 1.75 | V : H | |
| Bottom Width | 2.00 | ft | |
| Discharge | 2.71 | cfs | |

| Results | | | |
|---|---|---|---|
| Depth | 0.36 | ft | |
| Flow Area | 0.8 | ft² | |
| Wetted Perim | 2.82 | ft | |
| Top Width | 2.41 | ft | |
| Critical Depth | 0.37 | ft | |
| Critical Slope | 0.023400 | ft/ft | |
| Velocity | 3.46 | ft/s | < 5.0' fps ∴ ok |
| Velocity Head | 0.19 | ft | |
| Specific Energ | 0.54 | ft | |
| Froude Numb | 1.07 | | |
| Flow Type | Supercritical | | |



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# CGRD-11 MINIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Chann |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.030 | bare ground |
| Slope | 0.004000 | ft/ft |
| Left Side Slope | 1.20 | H : V |
| Right Side Slope | 4.00 | H : V |
| Bottom Width | 0.00 | ft |
| Discharge | 1.22 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.60 | ft |
| Flow Area | 0.9 | ft² |
| Wetted Perim | 3.39 | ft |
| Top Width | 3.10 | ft |
| Critical Depth | 0.42 | ft |
| Critical Slope | 0.024774 | ft/ft |
| Velocity | 1.32 | ft/s |
| Velocity Head | 0.03 | ft |
| Specific Ener | 0.62 | ft |
| Froude Numb | 0.43 | |
| Flow Type | Subcritical | |

< 1.17 ft ∴ ok  freeboard = 0.57 ft



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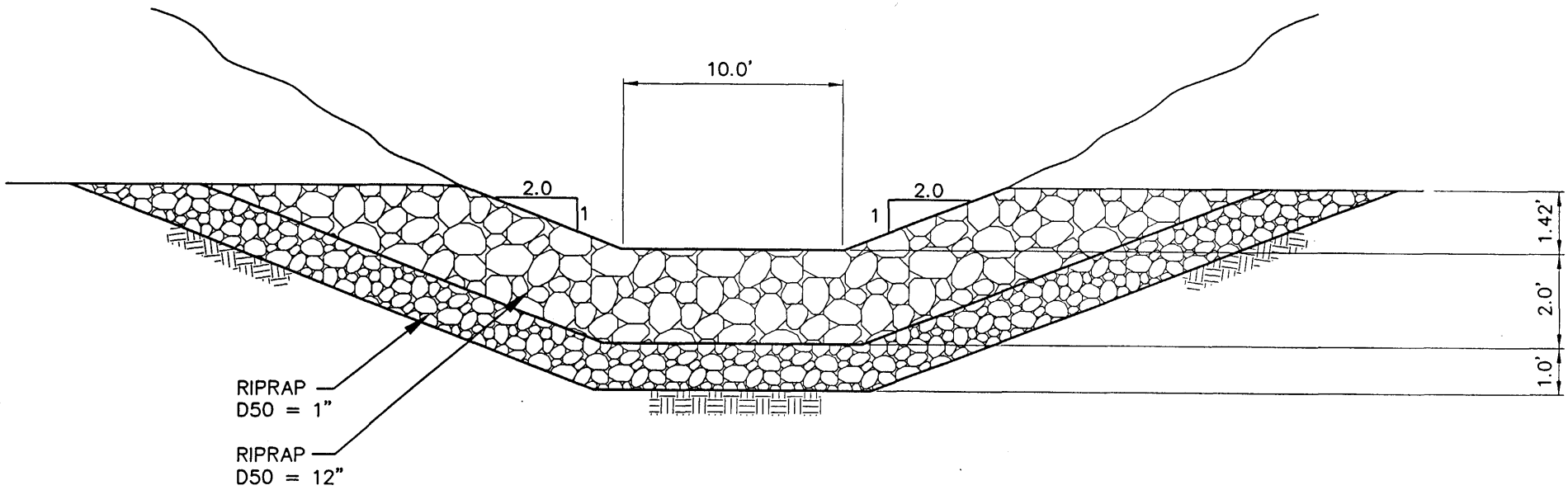
# CGRD-11 MAXIMUM SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Worksheet | Willow Creek Prep I |
| Flow Element | Trapezoidal Channe |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.030 | bare ground |
| Slope | 0.013000 | ft/ft |
| Left Side Slope | 1.20 | H : V |
| Right Side Slope | 4.00 | H : V |
| Bottom Width | 0.00 | ft |
| Discharge | 1.22 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.48 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perim | 2.72 | ft |
| Top Width | 2.49 | ft |
| Critical Depth | 0.42 | ft |
| Critical Slope | 0.024774 | ft/ft |
| Velocity | 2.05 | ft/s < 5.0 ft/sec ∴ ok |
| Velocity Head | 0.07 | ft |
| Specific Energ | 0.54 | ft |
| Froude Numb | 0.74 | |
| Flow Type | Subcritical | |




NO SCALE

CGRD–1 CHANNEL CROSS–SECTION

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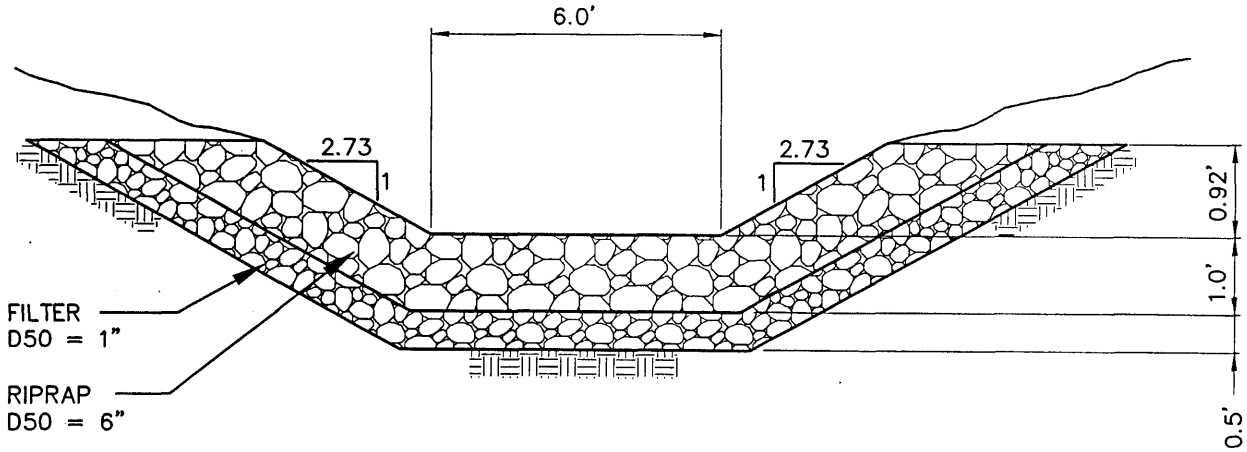
G:\UC709\23\HYDROLOGY\FIG-CGD-1.DWG

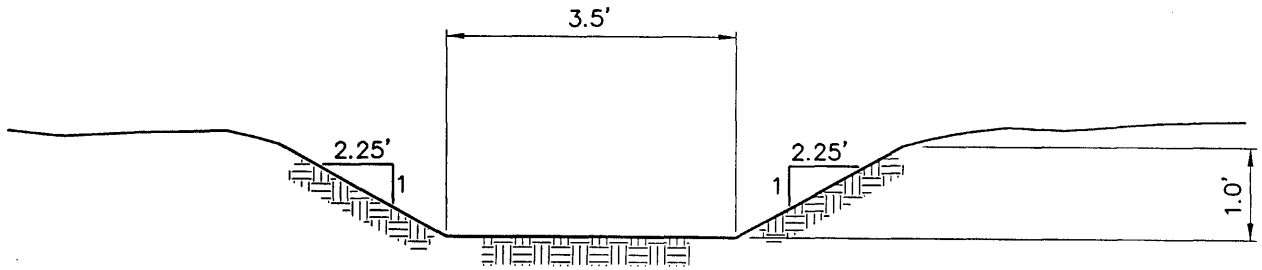



NO SCALE

CGRD-2 CHANNEL CROSS-SECTION

EarthFax

G:\UC709\23\HYDROLOGY\FIG-CGRD-2.DWG



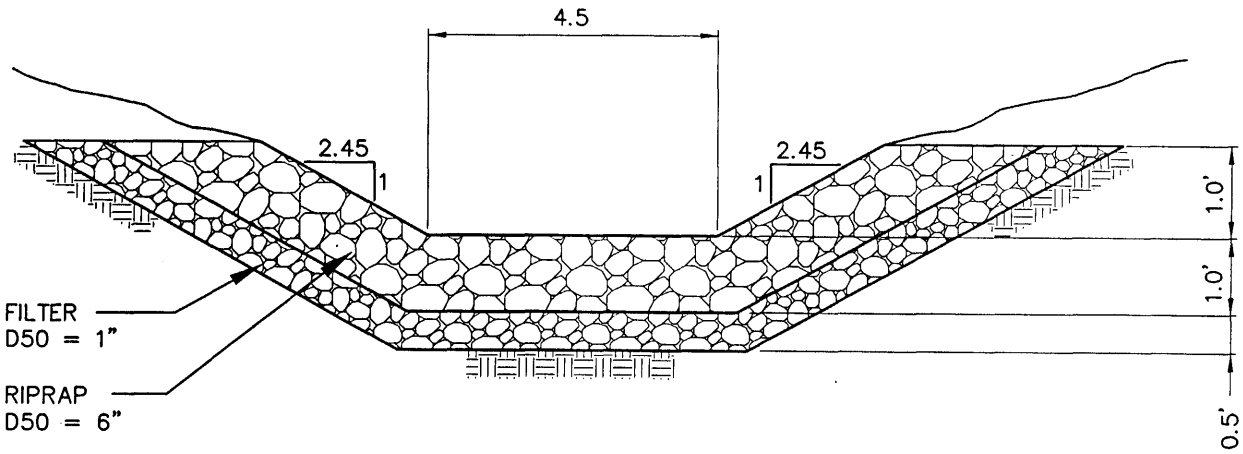

NO SCALE

CGRD–3 (NON–RIPRAPPED PORTION) CHANNEL CROSS–SECTION

EarthFax



G:\UG709\23\HYDROLOGY\FIG-CGRD-3MS.DW

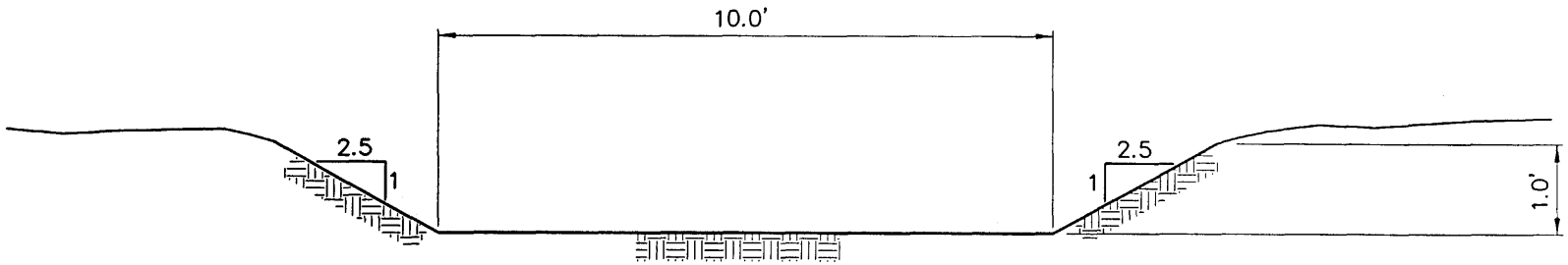



NO SCALE

CGRD–3 (RIPRAPPED PORTION) CHANNEL CROSS–SECTION

EarthFax

G:\UC2096\23\HYDROLOGY\FIG-CGRD-3SS.DWG

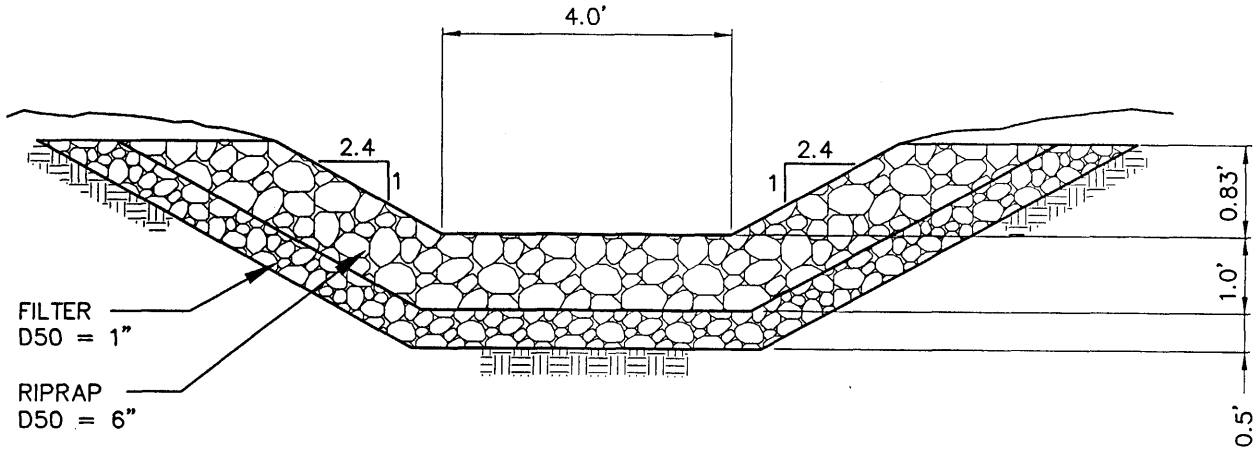



NO SCALE

CGRD–4 (NON–RIPRAPPED PORTION) CHANNEL CROSS–SECTION

EarthFax

G:\UC709\23\HYDROLOGY\FIG-CGRD-4MS.DWG

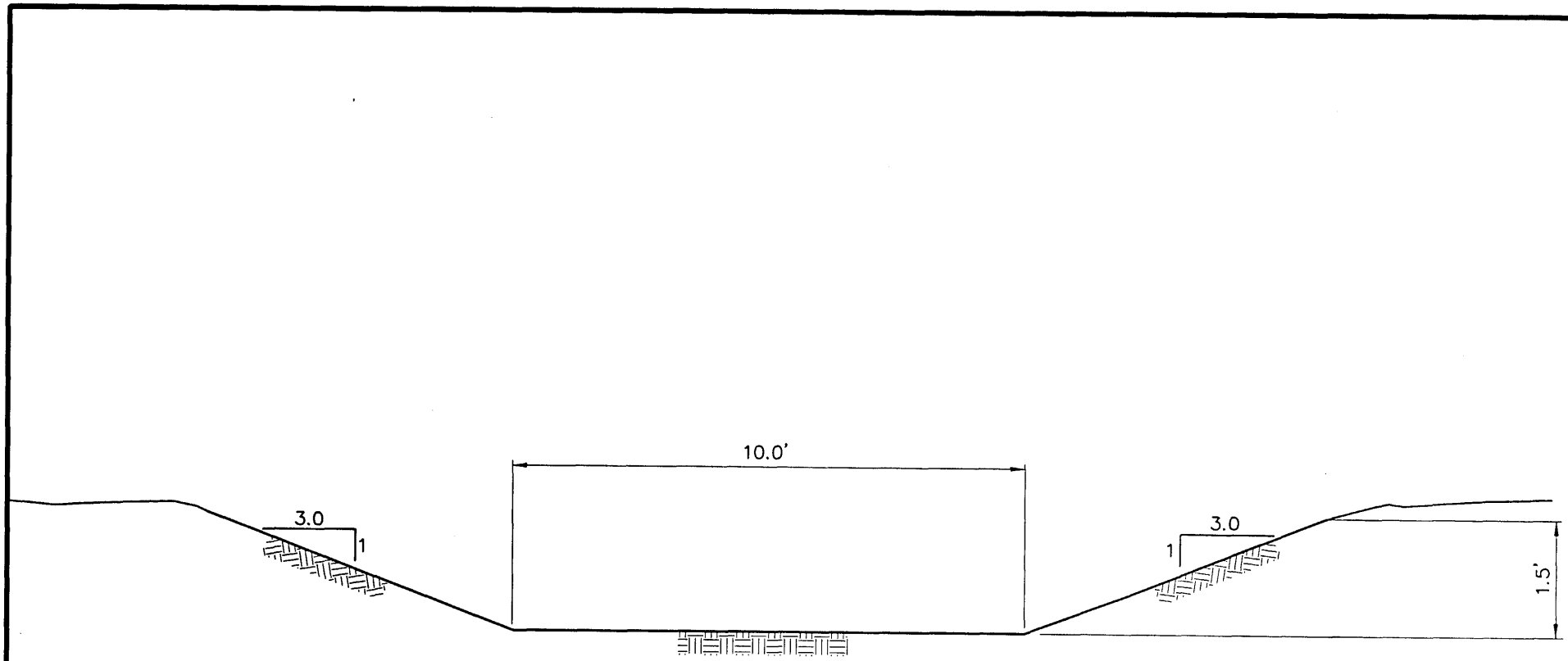



NO SCALE

CGRD–4 (RIPRAPPED PORTION) CHANNEL CROSS–SECTION

EarthFax

G:\UC709.23\HYDROLOGY\FIG-CGRD-4.DWG

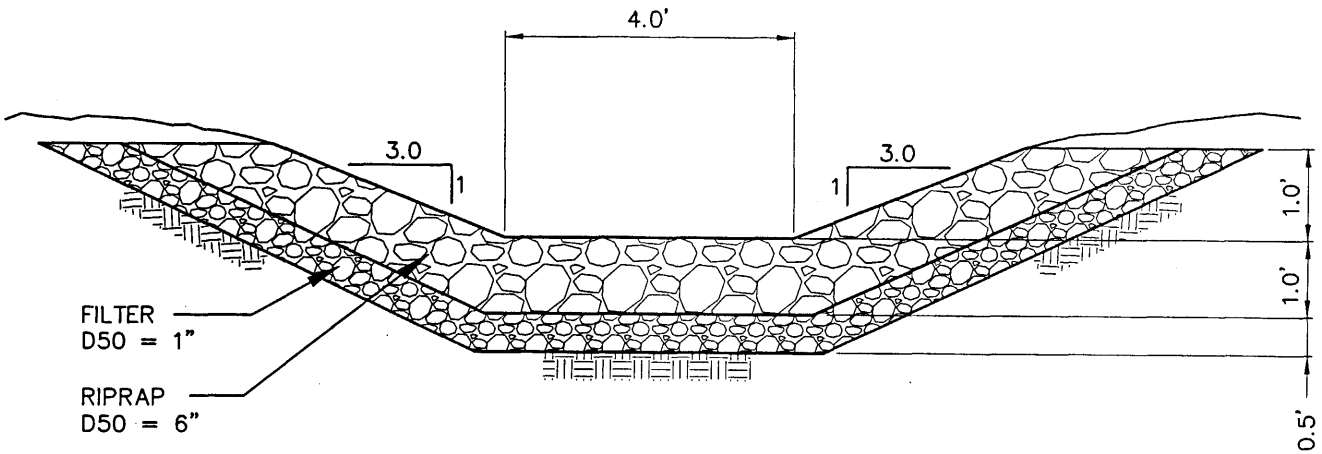



NO SCALE

CGRD–5 (NON–RIPRAPPED PORTION) CHANNEL CROSS–SECTION

EarthFax

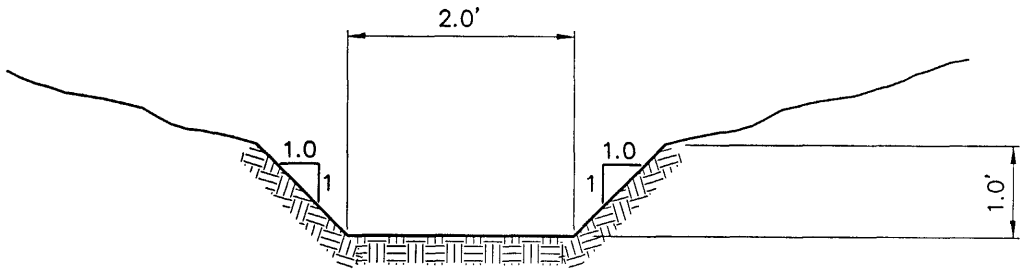
G:\UC709\23\HYDROLOGY\FIG-CGRD-5MS.DW




NO SCALE

CGRD–5 (RIPRAPPED PORTION) CHANNEL CROSS–SECTION

EarthFax



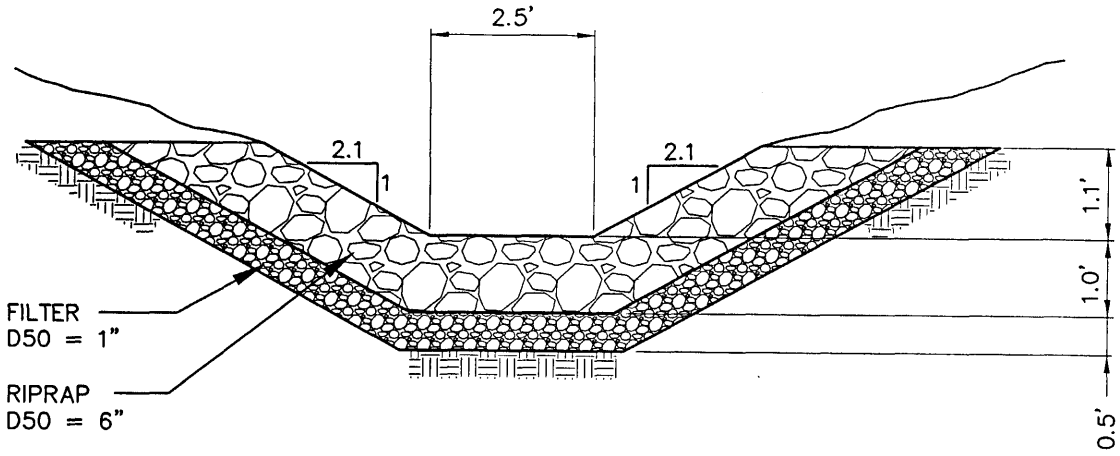

NO SCALE

CGRD-6 CHANNEL CROSS-SECTION

EarthFax



G:\UC709\23\HYDROLOGY\FIG-CGRD-6.DWG

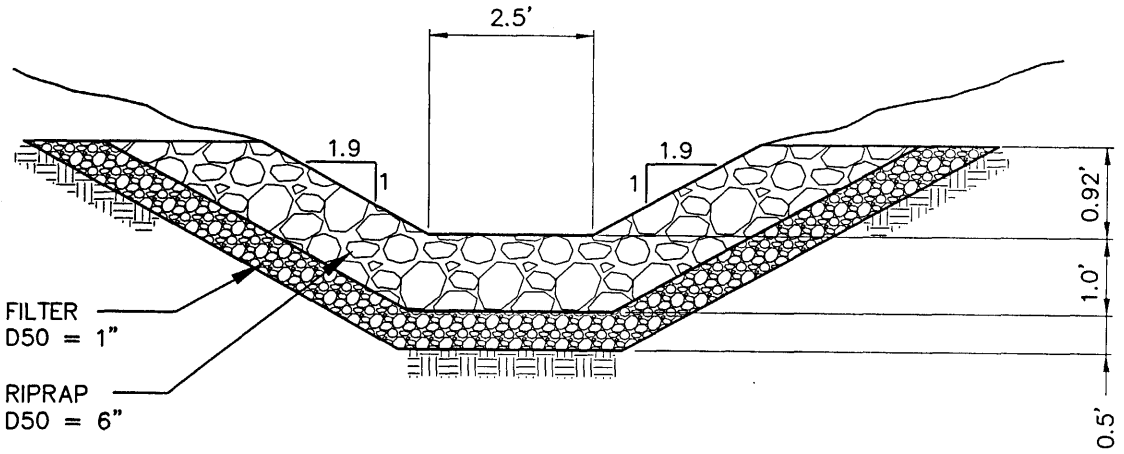



NO SCALE

CGRD–7 CHANNEL CROSS–SECTION

EarthFax

G:\UC709\23\HYDROLOGY\FIG-CGRD-7.DW

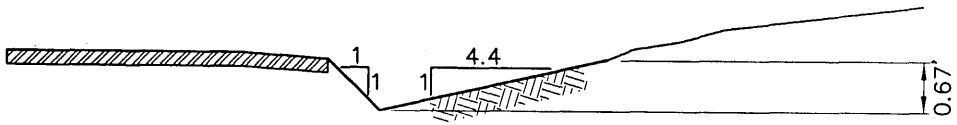



NO SCALE

CGRD-8 CHANNEL CROSS-SECTION

EarthFax

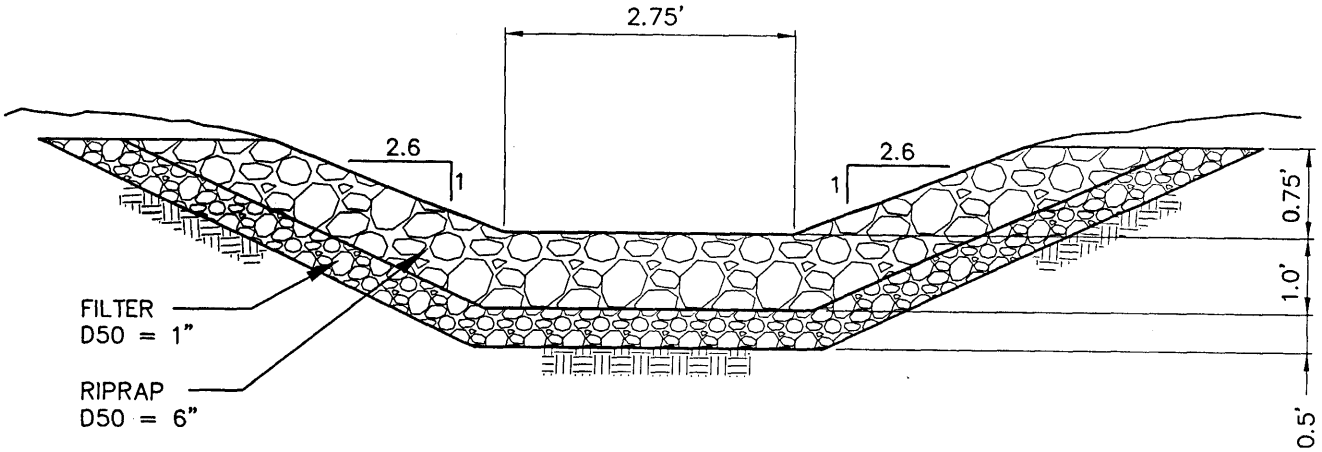
G:\UC709\23\HYDROLOGY\FIG-CGRD-8.DWG




NO SCALE

CGRD–9 CHANNEL CROSS–SECTION

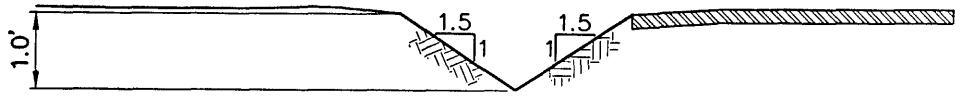
EarthFax




NO SCALE

CGRD–9a CHANNEL CROSS–SECTION

EarthFax

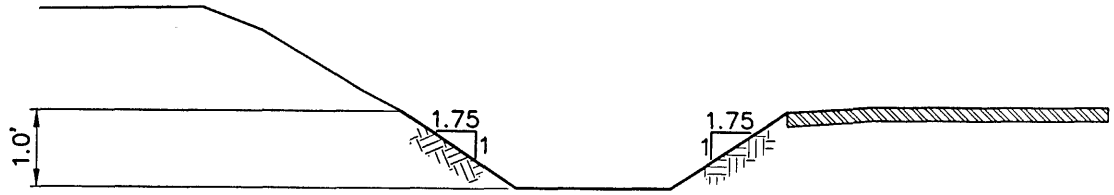



NO SCALE

CGRD–10 CHANNEL CROSS–SECTION

EarthFax

G:\UC709\23\HYDROLOGY\FIG-CGRD-10.DW

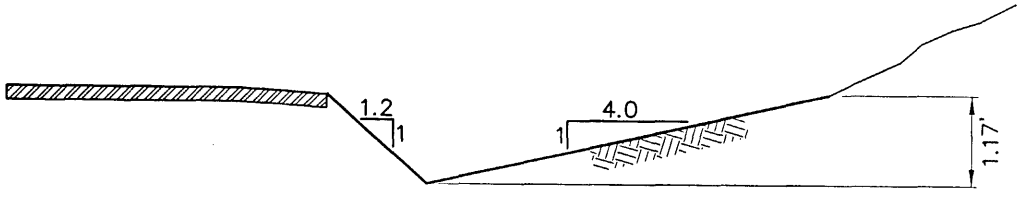



NO SCALE

CGRD-10A CHANNEL CROSS-SECTION

EarthFax

G:\UC709\23\HYDROLOGY\FIG-CGRD-10A.DW




NO SCALE

CGRD–11 CHANNEL CROSS–SECTION

EarthFax

G:\UC709\23\HYDROLOGY\FIG-CGRD-11.DWG

## Culvert Verification

Three operational culverts were left in place as part of reclamation due to the need to convey runoff below the road and railroad tracks to the Price River. These calculations will verify that these culverts can handle the design flow.

Assumptions

1. Culverts CGC-2 and CGC-5 are verified for the 100-year 6-hour storm event. Culvert CGC-1 is verified for the 10-year 6-hour storm event,

2. When determining the adequacy of the outlet riprap the method presented by Searcy, (1967) will be used,

3. Riprap thickness is twice the $D_{50}$,

4. A Mannings n for culverts is 0.024

CGC-1

Peak Flow = 0.08 (CGRWS-6)

Culvert Size = 18"

Culvert Slope = 17%

Inlet Capacity = 5.6 cfs

Maximum flow velocity = 3.07 fps no riprap required

Maximum flow depth = 0.06 ft

CGC-2

Peak Flow = 222.9 cfs

Culvert Size = (2) 84"

Culvert Slope = 5%

Inlet Capacity = 260 cfs each

Maximum flow velocity = 14.29 fps Outlet riprap must be 30" or larger

Maximum flow depth = 1.8 ft

CGC-5

Peak Flow = 32.52 (CGRWS-1 to CGRWS-5 and CGRWS-9)

Culvert Size = 60"

Culvert Slope = 10%

Inlet Capacity = 110 cfs

Maximum flow velocity = 20.37 Outlet riprap must be 40" or larger

Maximum flow depth = 0.68

# CGC-1
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | Circular Channel |
| Flow Element | Circular Channel |
| Method | Manning's Formu |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.024 | CMP |
| Slope | 170000 | ft/ft |
| Diameter | 18 | in |
| Discharge | 0.08 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.06 | ft |
| Flow Area | 2.6e-2 | ft² |
| Wetted Perime | 0.62 | ft |
| Top Width | 0.61 | ft |
| Critical Depth | 0.10 | ft |
| Percent Full | 4.3 | % |
| Critical Slope | 0.021340 | ft/ft |
| Velocity | 3.07 | ft/s |
| Velocity Head | 0.15 | ft |
| Specific Energ | 0.21 | ft |
| Froude Numbe | 2.61 | |
| Maximum Disc | 25.23 | cfs |
| Discharge Full | 23.46 | cfs |
| Slope Full | 0.000002 | ft/ft |
| Flow Type | Supercritical | |



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# CGC-2
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | Circular Channel |
| Flow Element | Circular Channel |
| Method | Manning's Formu |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.024 | CMP |
| Slope | 050000 | ft/ft |
| Diameter | 84 | in |
| Discharge | 111.45 | cfs |

Half of total flow ... are two culverts

| Results | | |
|---|---|---|
| Depth | 1.80 | ft |
| Flow Area | 7.8 | ft² |
| Wetted Perime | 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 |
| Velocity Head | 3.17 | ft |
| Specific Energ | 4.97 | ft |
| Froude Numbe | 2.23 | |
| Maximum Disc | 832.29 | cfs |
| Discharge Full | 773.71 | cfs |
| Slope Full | 0.001037 | ft/ft |
| Flow Type | Supercritical | |

# CGC-5
## Worksheet for Circular Channel

| Project Description | |
|---|---|
| Worksheet | Circular Channel |
| Flow Element | Circular Channel |
| Method | Manning's Formu |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coeffic | 0.013 | Concrete |
| Slope | 100000 | ft/ft |
| Diameter | 60 | in |
| Discharge | 32.52 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.68 | ft |
| Flow Area | 1.6 | ft² |
| Wetted Perime | 3.77 | ft |
| Top Width | 3.42 | ft |
| Critical Depth | 1.59 | ft |
| Percent Full | 13.6 | % |
| Critical Slope | 0.003286 | ft/ft |
| Velocity | 20.37 | ft/s |
| Velocity Head | 6.45 | ft |
| Specific Energ | 7.13 | ft |
| Froude Numbe | 5.26 | |
| Maximum Disc | 885.89 | cfs |
| Discharge Full | 823.55 | cfs |
| Slope Full | 0.000156 | ft/ft |
| Flow Type | Supercritical | |

**ATTACHMENT 2**

PUBLIC NOTICE AND LETTERS TO AGENCY AND LAND OWNERS

Public Notice

# Application for Phase I Bond Release for the Coal Refuse Pile and Phase III Bond Release for the Preparation Plant Plateau Mining Corporation Willow Creek Mine Permit C/007/038, Approved 04/24/2001 Carbon County, Utah

Plateau Mining Corporation, P.O. Box 30, Helper, UT 84526, has completed Phase I of the approved reclamation plan for the approximately 49.1 acres of land related to the Coal Refuse Pile and Phase III of the approved reclamation plan for approximately 46.2 acres of land related to the Preparation Plant at the Willow Creek Mine. The Phase I portion of the bond release application is based on completing the demolition, backfilling and grading and drainage control requirements in accordance with the approved reclamation plan and the Phase III portion of the bond release is based on an alternative post mining land use wherein this land was sold to the Price River Water Improvement District for industrial use. The reclamation work applicable to this bond release application was completed in the spring of 2004

In accordance with the requirements of R645-301-880, of the State of Utah R645-Coal Mining Rules, notice is hereby given to the general public that Plateau Mining Corporation is applying for partial release of the performance bond posted for this operation.

The surety bond posted for the Willow Creek Mine is $7,866,000 of which $2,706,000 is designated for the Coal Refuse Pile and Preparation Plant. Plateau Mining Corporation is seeking Phase I release of $682,000 from the Coal Refuse Pile portion of the bond and Phase III release of $ 1,479,000 from the Preparation Plant portion of the bond.

The Refuse Pile and Preparation Plant are located on the Helper, Utah, U.S. Geological Survey 7.5 minute quadrangle map. This reclaimed land is located in Price Canyon approximately 3.5 miles north of Helper, Utah on the following described lands:

Township 12 South, Range 9 East, SLB&M, Utah

| | |
|---|---|
| Section 36: Portions of the | NE1/4, NW1/4, SE1/4, NW1/4, SW1/4, NW1/4, and SW1/4. |
| Section 35: Portions of the | NE1/4, SE1/4, SE1/4, SE1/4, and SE1/4, NE1/4. |

Township 13 South, Range 9 East, SLB&M, Utah

Section 1: Portions of the NW1/4, NW1/4,

The Utah Division of Oil, Gas and Mining will now evaluate the proposal to determine whether it meets all the criteria of the Permanent Program Performance Standards according to the requirements of the Utah Coal Mining Rules.

Written comments, objections and requests for public hearing or informal conference 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 informal conference on this proposal must be submitted by November 13, 2005.

Published in the Sun Advocate – September 22, September 29, October 6, October 13, 2005

**PLATEAU MINING CORPORATION**

Willow Creek Mine
P.O. Box 30
Helper, Utah 84526

September 19, 2005

Mr. Hugh Kirkham
State of Utah
Department of Transportation
940 South Carbon Avenue
Price, Utah 84501

**Re: Notification of Application for Phase I Bond Release for the Coal Refuse Pile and Phase III Bond Release for the Preparation Plant, Plateau Mining Corporation, Willow Creek Mine, C/007/038, Carbon County, Utah**

Dear Mr. Kirkham:

Plateau Mining Corporation, P.O. Box 30, Helper, UT 84526, has completed Phase I of the approved reclamation plan for the approximately 49.1 acres of land related to the Coal Refuse Pile and Phase III of the approved reclamation plan for approximately 46.2 acres of land related to the Preparation Plant at the Willow Creek Mine. The Phase I portion of the bond release application is based on completing the demolition, backfilling and grading and drainage control requirements in accordance with the approved reclamation plan and the Phase III portion of the bond release is based on an alternative post mining land use wherein this land was sold to the Price River Water Improvement District for industrial use. The reclamation work applicable to this bond release application was completed in the spring of 2004

In accordance with the requirements of R645-301-880, of the State of Utah R645-Coal Mining Rules, notice is hereby given to the general public that Plateau Mining Corporation is applying for partial release of the performance bond posted for this operation.

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The Refuse Pile and Preparation Plant are located on the Helper, Utah, U.S. Geological Survey 7.5 minute quadrangle map. This reclaimed land is located in Price Canyon approximately 3.5 miles north of Helper, Utah on the following described lands:

Township 12 South, Range 9 East, SLB&M, Utah

Section 36: Portions of the NE1/4, NW1/4,
SE1/4, NW1/4,
SW1/4, NW1/4, and
SW1/4.

Section 35: Portions of the NE1/4, SE1/4,
SE1/4, SE1/4, and
SE1/4, NE1/4.

Township 13 South, Range 9 East, SLB&M, Utah

Section 1: Portions of the NW1/4, NW1/4,

Comments concerning bond release from the legal or equitable owner of record of the surface areas to be affected and from the Federal, Utah and local government agencies with would have to initiate, implement, approve or authorize the proposed use of the land following reclamation should be mailed to: Plateau Mining Corporation, Attention: Dennis Ware, P.O. Box 30 Helper, Utah 84526.

Sincerely,

Dennis Ware
Controller and Administrative Manager
(435) 472-4737
dware@foundationcoal.com

Mailed to:

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

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

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

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

Carbon County Commissioners
120 East Main Street
Price, Utah 84501

Mr. Phil Palmer
Price River Water Improvement District
P.O. Box 903
265 South Fairgrounds Road
Price, Utah 84501

Mr. Patrick Gubbins
Bureau of Land Management
125 South 600 West
Price, Utah 84501

Mr. Kevin S. Carter
Director
School and Institutional Trust Lands Administration
675 East 500 South, Suite 500
Salt Lake City, Utah 84102-2818

Mr. Hugh Kirkham
State of Utah
Department of Transportation
940 South Carbon Avenue
Price, Utah 84501

# ATTACHMENT 3

BOND RELEASE CALCULATIONS

## PREPARATION PLANT AND REFUSE PILE
## BOND RELEASE CALCULATIONS

The total bond for the Preparation Plant area is $2,706,000 as shown in Exhibit 17 of the MRP. When bond calculations were made the Prep. Plant area, the Refuse Pile area and the Loadout area were all included in the this single bond calculation. Of the total bond amount a portion, the Prep. Plant area is eligible for phase III bond release, a portion, the Refuse Pile area is eligible for phase I bond release and a portion, the Loadout area is not eligible for any bond release.

The Prep. Plant area which excludes the Refuse Pile area and the Loadout area is eligible for phase III bond release. As a result of the Post Mining Land Use Change for the Prep. Plant area the land use for the Prep. Plant area was changed to an industrial use. Price River Water Improvement District ("PRWID") has purchased the Preparation Plant area and intends to improve the site for its use. The Refuse Pile area is only eligible for phase I bond release and the Loadout area, which has not been reclaimed, is not eligible for any bond release. The entire site, with the exception of the Loadout area, has been reclaimed. Any structures remaining, with the exception of the Loadout, have been left at the request of PRWID.

In order to determine the amount of bond reduction which will be allowed, the total bond amount ($2,706,000) must be broken out between the three areas which have differing percentages of bond reduction eligibility. These areas and their percentage of bond release eligibility are:

The Prep. Plant area eligible for 100% bond release (Phase III)
The Refuse Pile area eligible for 60% bond release (Phase I)
The Loadout area eligible for 0% bond release (not yet reclaimed)

### Total Preparation Plant Bond Summarized by Major Category

The total bond amount for the Preparation Plant from Exhibit 17 is $2,706,000 comprised of the following subcategory totals:

| | | |
|---|---|---|
| Demolition | $ 614,133 | |
| Backfilling and Grading | $ 420,334 | |
| Revegetation | $ 795,983 | (Reveg. $556,048, Drainage Control $239,935) |
| Direct Costs | $1,830,450 | |
| Indirect Costs (26.8%) | $ 490,562 | |
| Total Cost (2001 Dollars) | $2,321,012 | |
| Escalation (3.12% / 5 years) | $ 385,388 | |
| Total Bond (2006 Dollars) | $2,706,400 | |

**Breakout of Bond Amount (Prep. Plant, Refuse Pile, Loadout)**

The attached "Breakout of Bond Amount" worksheet separates the total bond cost ($2,706,000) by the three areas (Prep. Plant, Refuse Pile, Loadout) in order to determine the amount of bond release the Permittee is eligible for. The various components of the bond by area were derived according to the following methodology:

The **breakout of the demolition** bond amount by area is a straight forward segregation of the demolition cost from Exhibit 17. The segregation of the demolition cost is shown in detail on the attached "Demolition Cost Breakout" schedule.

The **breakout of backfilling and grading and revegetation bond amount** is accomplished by an allocation of the total acres revegetated for each area as a percentage of the total acres revegetated for the entire reclamation site. Revegetated acres, rather than total acres, was used for this allocation because revegetated acres it that acreage where earthwork was performed. The allocation percentage for each area is calculated as follows:

| Area | Reveg. Acres | Percent | |
|---|---|---|---|
| Prep. Plant | 18.27 | 40.17% | (Phase III) |
| Refuse Pile | 26.01 | 57.19% | (Phase I) |
| Loadout | 1.20 | 2.64% | (expected to be completed in 2006) |
| Total | 45.48 | 100.00% | |

The bond amount for the **indirect costs** by area is then a simple calculation whereby the total direct bond costs (demolition, backfilling and grading and revegetation) are multiplying the indirect bond cost percentage of 26.8% from Exhibit 17 to arrive at the indirect bond costs by area. This calculation results in a bond cost by area in 2001 dollars.

The **escalation** from Exhibit 17, which is 3.12% for five years, is then applied to the bond amount by area in 2001 dollars resulting in a bond amount by area in 2006 dollars.

The breakout of the total bond amount by area, utilizing the above methodology, results in the following bond amounts:

| Bond Area | Bond |
|---|---|
| Prep. Plant | $1,503,260 (Phase III) |
| Refuse Pile | $1,054,103 (Phase I) |
| Loadout | $ 148,917 (expected to be completed in 2006) |
| Totals | $2,706,400 |

**Bond Reduction Calculation**

The bond amount by area in 2006 dollars is then multiplied by the percentage of bond reduction allowed which is 100% (phase III) for the Prep. Plant, 60% (phase I) for the Refuse Pile and 0% for the Loadout. The total bond amount by area, the bond reduction amount by area and the remaining bond by area is show below.

| Bond Area and Phase | Bond Amount | Percent Reduction | Bond Reduction | Bond Remaining |
|---|---|---|---|---|
| Prep. Plant - Phase III | $1,503,260 | 100.00% | $1,503,260 | $ 0 |
| Refuse Pile - Phase I | $1,054,103 | 60.00% | $ 632,534 | $421,689 |
| Loadout - NA | $ 148,917 | 0.00% | $ 0 | $148,917 |
| Totals | $2,706,400 | | $2,135,794 | $570,606 |

# Breakout of Bond Amount

Preparation Plant Bond from Exhibit 17 of the MRP

| | | Breakout by Area | | | |
|---|---|---|---|---|---|
| | Exhibit 17 | Phase III | Phase I | | |
| Direct Costs | Bond Cost | Prep Plant | Refuse Pile | Loadout | |
| Demolition | $614,133 | $528,123 | $17,403 | $68,607 | (see note 1 below) |
| Backfilling and Grading | $420,334 | $168,848 | $240,389 | $11,097 | (see note 2 below) |
| Revegetation: | | | | | |
| Drainage Controls | $239,935 | $96,382 | $137,219 | $6,334 | (see note 2 below) |
| Revegetation | $556,048 | $223,364 | $318,004 | $14,680 | (see note 2 below) |
| Total Direct Costs | $1,830,450 | $1,016,717 | $713,015 | $100,718 | |
| Indirect Costs | | | | | |
| Mob/Demob (10.0%) | $183,046 | $101,672 | $71,302 | $10,072 | |
| Contingency (5.0%) | $91,523 | $50,836 | $35,651 | $5,036 | |
| Engineering Redesign (2.5%) | $45,761 | $25,418 | $17,825 | $2,518 | |
| Main Office Expense (6.8%) | $124,471 | $69,137 | $48,485 | $6,849 | |
| Project Management Fee (2.5$) | $45,761 | $25,418 | $17,825 | $2,518 | |
| Subtotal Indirect Costs (26.8%) | $490,562 | $272,481 | $191,088 | $26,993 | |
| Costs in 2001 Dollars | $2,321,012 | $1,289,198 | $904,103 | $127,711 | |
| Escalation (3.12% / 5 years) | $385,388 | $214,062 | $150,120 | $21,206 | |
| Reclamation Cost in 2006 Dollars | $2,706,400 | $1,503,260 | $1,054,223 | $148,917 | |
| Bond Reduction % | | 100.00% | 60.00% | 0.00% | |
| Bond Reduction | $2,135,794 | $1,503,260 | $632,534 | $0 | |
| Remaining Bond | $570,606 | $0 | $421,689 | $148,917 | |

Note 1: The demolition cost for the Willow Creek Mine Prep. Plant is detailed in Exhibit 17 of the MRP and broken down as to the Prep. Plant, Refuse Pile and Loadout on the attached "Demolition Cost Breakout" worksheet.

Note 2: The backfilling and grading, drainage controls and revegetation detailed in Exhibit 17 of the MRP has been allocated to the Prep. Plant, Refuse Pile and Loadout based on the number of acres revegetated as shown below.

| Area | Reveg. Acres | Percent |
|---|---|---|
| Prep. Plant | 18.27 | 40.17% |
| Refuse Pile | 26.01 | 57.19% |
| Loadout | 1.2 | 2.64% |
| Total | 45.48 | 100.00% |

# Demolition Cost Breakout

Preparation Plant Bond from Exhibit 17 of the MRP

| | Unit Train Loadout | Refuse Pile | Prep. Plant | Total |
|---|---|---|---|---|
| | | | | |
| Bond Reduction Phase | None | Phase I | Phase III | |
| | | | | |
| Belt Line SC 5 001 | | $17,403 | | $17,403 |
| Crusher Building 002 | | | $28,426 | $28,426 |
| Road Salt Shed 003 | | | $1,504 | $1,504 |
| Raw Water Pond 004 | | | $695 | $695 |
| Concrete Retaining Wall 005 | | | $5,717 | $5,717 |
| Raw Coal Silo Belt SC6 006 | | | $13,533 | $13,533 |
| Raw Coal Silo 007 | | | $18,162 | $18,162 |
| Coal Prep Plant Belt SC7 008 | | | $27,969 | $27,969 |
| Thickener Overflow Pond 009 | | | $1,509 | $1,509 |
| Coal Prep Plant 010 | | | $265,970 | $265,970 |
| Thickener Tank 011 | | | $8,285 | $8,285 |
| Rail Cars Tank 012 | | | $1,622 | $1,622 |
| Belt Line SC8 and SC9 013 | | | $25,494 | $25,494 |
| Sampling Building 014 | | | $12,620 | $12,620 |
| Warehouse Bathhouse Shop 015 | | | $230 | $230 |
| Potable Water Tank 016 | | | $613 | $613 |
| Barn Canyon Storage Bld 017 | | | $1,427 | $1,427 |
| Barn Canyon Substation 018 | | | $18,805 | $18,805 |
| Water Treatment Plant 019 | | | $18,203 | $18,203 |
| Belt Line SC 10 021 | | | $13,578 | $13,578 |
| Clean Coal Tube 022 | | | $20,728 | $20,728 |
| Unit Train Loadout SC 11 023 | $24,701 | | | $24,701 |
| Unit Train Loadout 024 | $43,906 | | | $43,906 |
| Water Pump Buildings 025 | | | $1,446 | $1,446 |
| Power Poles 026 | | | $12,248 | $12,248 |
| Culverts 027 | | | $1,802 | $1,802 |
| Culvert Inlets 028 | | | $39 | $39 |
| Guard Rails 029 | | | $5,200 | $5,200 |
| Asphalt Demo 030 | | | $6,876 | $6,876 |
| Hydrants 031 | | | $4,510 | $4,510 |
| Combustible Materials 032 | | | $0 | $0 |
| Sed Pond 011 033 | | | $912 | $912 |
| Misc 034 | | | $10,000 | $10,000 |
| | | | | |
| | $68,607 | $17,403 | $528,123 | $614,133 |

**ATTACHMENT 4**

ADDITIONAL INFORMATION

The State of Utah

Department of Natural Resources

Division of Oil, Gas & Mining

ROBERT L. MORGAN
*Executive Director*

LOWELL P. BRAXTON
*Division Director*

OLENE S. WALKER
*Governor*

GAYLE F. McKEACHNIE
*Lieutenant Governor*

# Inspection Report

| Representatives Present During the Inspection: | |
|---|---|
| Company | Dennis Ware Controller |
| OGM | Joe Helfrich Environmental Scientist III |

| | |
|---|---|
| Permit Number: | C0070038 |
| Inspection Type: | TECHNICAL |
| Inspection Date: | Wednesday, April 06, 2005 |
| Start Date/Time: | 4/6/2005 11:00:00 AM |
| End Date/Time: | 4/6/2005 2:00:00 PM |
| Last Inspection: | Thursday, March 17, 2005 |

Inspector: Joe Helfrich, Environmental Scientist III

Weather: sunny 55

InspectionID Report Number: 592

Accepted by: whedberg
5/5/2005

Permitee: **PLATEAU MINING CORP**
Operator: **PLATEAU MINING CORP**
Site: **WILLOW CREEK MINE**
Address: **847 NW HWY 191, HELPER UT 84526**
County: **CARBON**
Permit Type: **PERMANENT COAL PROGRAM**
Permit Status: **ACTIVE**

**Current Acreages**

| | |
|---|---|
| 14,670.00 | **Total Permitted** |
| 161.55 | **Total Disturbed** |
| | **Phase I** |
| | **Phase II** |
| | **Phase III** |

**Mineral Ownership**

- [x] **Federal**
- [ ] **State**
- [ ] **County**
- [x] **Fee**
- [x] **Other**

**Types of Operations**

- [x] **Underground**
- [ ] **Surface**
- [x] **Loadout**
- [ ] **Processing**
- [ ] **Reprocessing**

**Report summary and status for pending enforcement actions, permit conditions, Division Orders, and amendments:**

The purpose of this site visit was to evaluate the erosion potential on the property being turned over to the Price River Water district. The permittee is preparing a phase three application for bond release on this property. I was accompanied by Dennis Ware, controller for the company. The property to be evaluated for erosion potential was walked in it's entirety and photos were taken.

**Inspector's Signature** /S/ **Date** Tuesday, April 26, 2005

Joe Helfrich, Environmental Scientist III
Inspector ID Number: 1

Note: This inspection report does not constitute an affidavit of compliance with the regulatory program of the Division of Oil, Gas and Mining.

***REVIEW OF PERMIT, PERFORMANCE STANDARDS PERMIT CONDITION REQUIREMENTS***

1. *Substantiate the elements on this inspection by checking the appropriate performance standard.*
   a. *For COMPLETE inspections provide narrative justification for any elements not fully inspected unless element is not appropriate to the site, in which case check Not Applicable.*
   b. *For PARTIAL inspections check only the elements evaluated.*
2. *Document any noncompliance situation by reference the NOV issued at the appropriate performance standard listed below.*
3. *Reference any narratives written in conjunction with this inspection at the appropriate performace standard listed below.*
4. *Provide a brief status report for all pending enforcement actions, permit conditions, Divison Orders, and amendments.*

| | Evaluated | Not Applicable | Comment | Enforcement |
|---|---|---|---|---|
| 1. Permits, Change, Transfer, Renewal, Sale | ☐ | ☐ | ☐ | ☐ |
| 2. Signs and Markers | ☐ | ☐ | ☐ | ☐ |
| 3. Topsoil | ☐ | ☐ | ☐ | ☐ |
| 4.a Hydrologic Balance: Diversions | ☑ | ☐ | ☑ | ☐ |
| 4.b Hydrologic Balance: Sediment Ponds and Impoundments | ☐ | ☐ | ☐ | ☐ |
| 4.c Hydrologic Balance: Other Sediment Control Measures | ☐ | ☐ | ☐ | ☐ |
| 4.d Hydrologic Balance: Water Monitoring | ☐ | ☐ | ☐ | ☐ |
| 4.e Hydrologic Balance: Effluent Limitations | ☐ | ☐ | ☐ | ☐ |
| 5. Explosives | ☐ | ☐ | ☐ | ☐ |
| 6. Disposal of Excess Spoil, Fills, Benches | ☐ | ☐ | ☐ | ☐ |
| 7. Coal Mine Waste, Refuse Piles, Impoundments | ☐ | ☐ | ☐ | ☐ |
| 8. Noncoal Waste | ☐ | ☐ | ☐ | ☐ |
| 9. Protection of Fish, Wildlife and Related Environmental Issues | ☐ | ☐ | ☐ | ☐ |
| 10. Slides and Other Damage | ☐ | ☐ | ☐ | ☐ |
| 11. Contemporaneous Reclamation | ☐ | ☐ | ☐ | ☐ |
| 12. Backfilling And Grading | ☐ | ☐ | ☐ | ☐ |
| 13. Revegetation | ☐ | ☐ | ☐ | ☐ |
| 14. Subsidence Control | ☐ | ☐ | ☐ | ☐ |
| 15. Cessation of Operations | ☐ | ☐ | ☐ | ☐ |
| 16.a Roads: Construction, Maintenance, Surfacing | ☐ | ☐ | ☐ | ☐ |
| 16.b Roads: Drainage Controls | ☐ | ☐ | ☐ | ☐ |
| 17. Other Transportation Facilities | ☐ | ☐ | ☐ | ☐ |
| 18. Support Facilities, Utility Installations | ☐ | ☐ | ☐ | ☐ |
| 19. AVS Check | ☐ | ☐ | ☐ | ☐ |
| 20. Air Quality Permit | ☐ | ☐ | ☐ | ☐ |
| 21. Bonding and Insurance | ☐ | ☐ | ☐ | ☐ |
| 22. Other | ☐ | ☐ | ☐ | ☐ |

**4.a Hydrologic Balance: Diversions**

The eastern portion of the property slopes toward the reclaimed roughened area and a well graded rip rapped diversion ditch. Recent storms have shown no signs of erosion. The remaining portion of the property slopes to the south west into a portion of the reclaimed area and a well vegetated ditch. Runoff from all locations on this property will remain inside the reclaimed area and does not show signs of developing erosion.

# APPENDIX 3.4K

## RECLAMATION PERIOD ALTERNATIVE SEDIMENT CONTROL CALCULATIONS

# 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.

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

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%

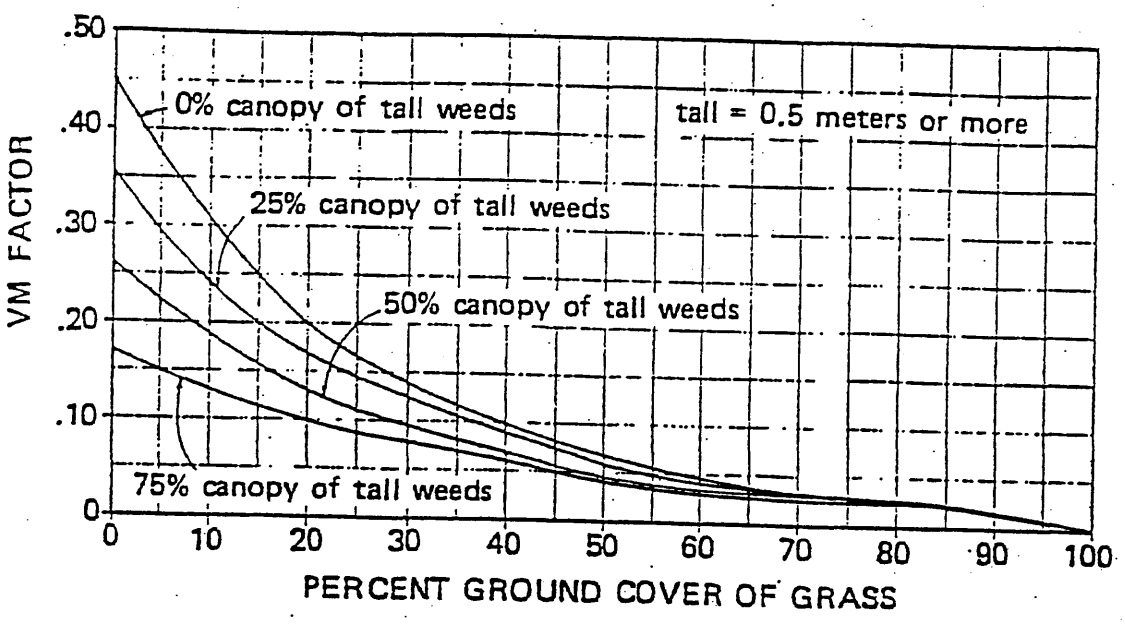



Figure 7. Relationship between grass density and VM factor.

Israelsen et. al. (1984)

VM = 0.17

*Immediate Post Reclamation*

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

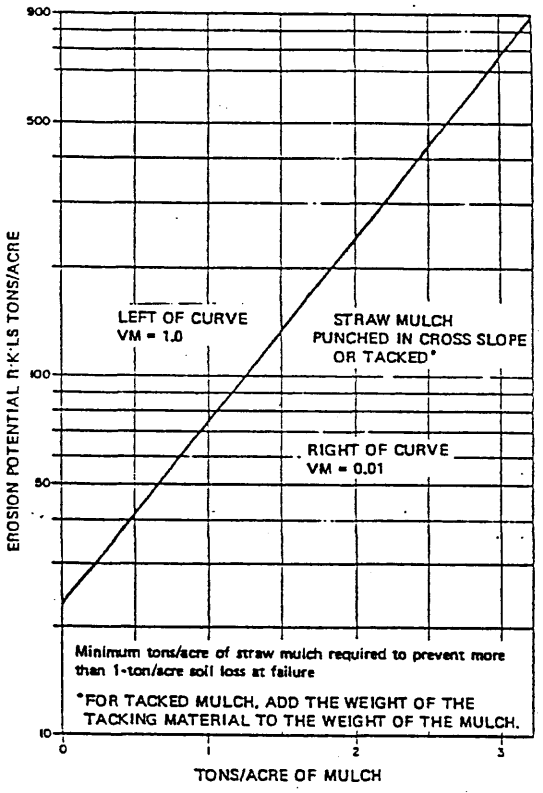



Figure 4. Straw mulch anchored vs. R·K·LS.

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.

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

May 30, 2006

Dennis N. Ware
Controller and Administrative Manager
Plateau Mining Corporation
P.O. Box 30
Helper, Utah 84526

Dear Mr. Ware,

I am writing this letter to officially inform Plateau Mining Corporation (PMC) that the Price River Water Improvement District (PRWID) did, concurrent with the purchase of land from PMC (Purchase Agreement dated April 23, 2004), take over the operation and maintenance responsibility for the Raw Water Pond Located in the E ½ of Section 35, Township 12 South, Range 9 East, SLB&M, Carbon County Utah.

In addition to taking over responsibility for the operations and maintenance of the raw water pond, PRWID has also taken over maintenance responsibility for certain roads that exist on the land PRWID purchased from PMC. The roads which PRWID have responsibility for include Primary Roads 1, 2, 4 and 5 as shown on PMC's Willow Creek Permit exhibit 3, 4-9 "Prep. Plant Area and Refuse Pile Reclamation Topography Map" dated December 2003. PRWID's responsibility for maintenance of these roads is restricted to that portion of these roads that exist on land owned by PRWID.

Sincerely,

Phillip P. Palmer
District Manager
Price River Water Improvement District
P.O. Box 903
265 S. Fairgrounds Road
Price, Utah 84501
(435)637-6350

CLEAN WATER

June 12, 2006

EarthFax

EarthFax
Engineering, Inc.
Engineers/Scientists
7324 So. Union Park Ave.
Suite100
Midvale, Utah 84047
Telephone 801-561-1555
Fax 801-561-1861
www.earthfax.com

Dennis N. Ware
Plateau Mining Corporation
P.O. Box 30
Helper, UT 84526

Subject: Willow Creek Raw Water Pond Permanent Impoundment Adequacy

Dear Dennis:

Pursuant to your request, I have evaluated the adequacy of the Raw Water Pond at the Willow Creek preparation plant for retention as a permanent impoundment under the rules of the Utah Division of Oil, Gas and Mining (specifically, the requirements of R645-301-733.200). The Raw Water Pond is designed to contain water diverted from the adjacent Price River. Prior to site reclamation, this water was used in the preparation plant for process purposes. Plateau has transferred ownership of this pond to the Price River Water Improvement District ("PRWID"), who currently utilizes the pond to provide a raw water source for the Willow Creek Mine buildings in Willow Creek Canyon.

The pond has been in place for at least 20 years, as evidenced by aerial photographs of the site. It is designed to hold approximately 4.3 acre-feet of water below the overflow device (a 15-inch diameter corrugated metal pipe that discharges to the Price River). The embankment of the pond extends a minimum of 2 feet above the overflow pipe.

I conducted an inspection of the pond on June 1, 2006 and observed no signs of instability. My casual observations of the pond over the past several years have also indicated no concerns with respect to the structural stability of the pond. In accordance with the requirements of R645-301-733.210, I also evaluated the minimum static safety factor of the pond embankment with normal pool for steady state seepage saturation conditions. Results of this evaluation are presented in Attachment A. These calculations were performed assuming the conservative condition that the embankment was saturated from the normal operating pool to the toe, with the phreatic surface extending at a constant slope from embankment toe to the Price River. Furthermore, in keeping with prior analyses of embankment stability at the preparation plant, the following conservative soil properties were assumed based on an evaluation of soils in the embankment:

| | |
|---|---|
| Moist unit weight = | 115 $lb/ft^3$ |
| Saturated unit weight = | 135 $lb/ft^3$ |
| Cohesion intercept = | 100 $lb/ft^2$ |
| Friction angle = | $34^o$ |

Using these conservative assumptions, the minimum static safety factor for the embankment is 4.698 (see Attachment A). Hence, the pond embankment meets the requirements of R645-301-733.210.

The following factors indicate that the Raw Water Pond also meets the requirements of R645-301-733.220 for use as a permanent impoundment:

- Size and configuration: The pond will be used as a storage impoundment by PRWID to meet the incidental raw-water needs of the Willow Creek Mine buildings under future operation by the College of Eastern Utah. These water needs are substantially lower than the past needs of the Willow Creek preparation plant, which was adequately serviced by the Raw Water Pond. Hence, in accordance with R645-301-733.221, the size and configuration of the pond are adequate for their intended use.
- Water quality: The quality of water diverted from the Price River to the Raw Water Pond is sufficient for the needs of the Willow Creek Mine buildings. Furthermore, any discharges from the pond will re-enter the Price River immediately downstream from the initial point of diversion. Since the pond is intended only for storage, the quality of any water discharged from the pond will be the same as that of the river into which it is discharged. Hence, the requirements of R645-301-733.222 will be satisfied after site reclamation is completed.
- Water level: PRWID will be both the owner and operator of the pond. Hence, they will maintain the pond level as necessary for their intended use. Thus, the pond will satisfy the requirements of R645-301-733.223.
- Final grading: No additional grading of the pond area is anticipated. The Raw Water Pond has operated adequately at its current configuration for over 20 years. As such, this configuration will be adequate to provide safe access for proposed water users, indicating that the pond will meet the requirements of R645-301-733.224.
- Diminution of water quality and quantity: Rights for use of this water have existed for several years. These or equivalent rights will be used by PRWID for future operation of the pond. Hence, downstream users will not be adversely affected by future use of the pond. Furthermore, as discussed above, use of the pond will not adversely affect downstream water quality. Thus, the pond will meet the requirements of R645-301-733.226.
- Suitability: The approved post-mining land use includes future operation of the Willow Creek Mine buildings. The Raw Water Pond is of a suitable capacity to supply the raw water needed at this facility. Hence, the requirements of R645-301-733.226 are met by the pond.

In accordance with the requirements of R645-301-743, I also evaluated the adequacy of the overflow pipe to safely handle runoff flowing into the pond. Results of this evaluation are presented in Attachment B. As indicated, the spillway system will safely convey the peak runoff into the pond from both the 25-year, 6-hour precipitation event and the 100-year, 6-hour precipitation event. As further indicated, the amount of water entering the pond during the 25- and 100-year events will be 2.5% and 5.1% of the storage volume below the invert of the

outflow pipe. Given the settling capacity of the pond and the effects of dilution, no adverse impacts to water quality in the Price River are anticipated from runoff entering the pond.

I also evaluated the ability of the Raw Water Pond to contain runoff from the 10-year, 24-hour precipitation event. The results of this evaluation, which are provided in Attachment A, indicate that runoff from this event equals 0.13 acre-foot. With a capacity of approximately 4.3 acre-feet, the pond can more than adequately contain runoff from the 10-year, 24-hour event. In the event that the pond is full to the invert of the outflow pipe, the calculations in Attachment A also indicate that the outflow pipe can adequately handle the peak flow from this event.

Based on these evaluations, it is my opinion that the Raw Water Pond meets the permanent impoundment requirements of R645-301-733 and other applicable regulations. Specifically, the size and configuration of this permanent impoundment is adequate for its intended purpose; the quality of impounded water will be suitable on a permanent basis for its intended use; any discharge from the impoundment will not degrade the quality of the receiving waters; the impoundment will not result in the diminution of the quality and quantity of water utilized by adjacent or surrounding landowners for agricultural, industrial, recreational or domestic uses; the water level will be sufficiently stable and be capable of supporting the approved post mining land use; final grading provides adequate safety and access for the proposed water users; and the embankment construction was designed to achieve necessary stability with an adequate margin of safety.

Please contact me if you have any questions.

Sincerely,

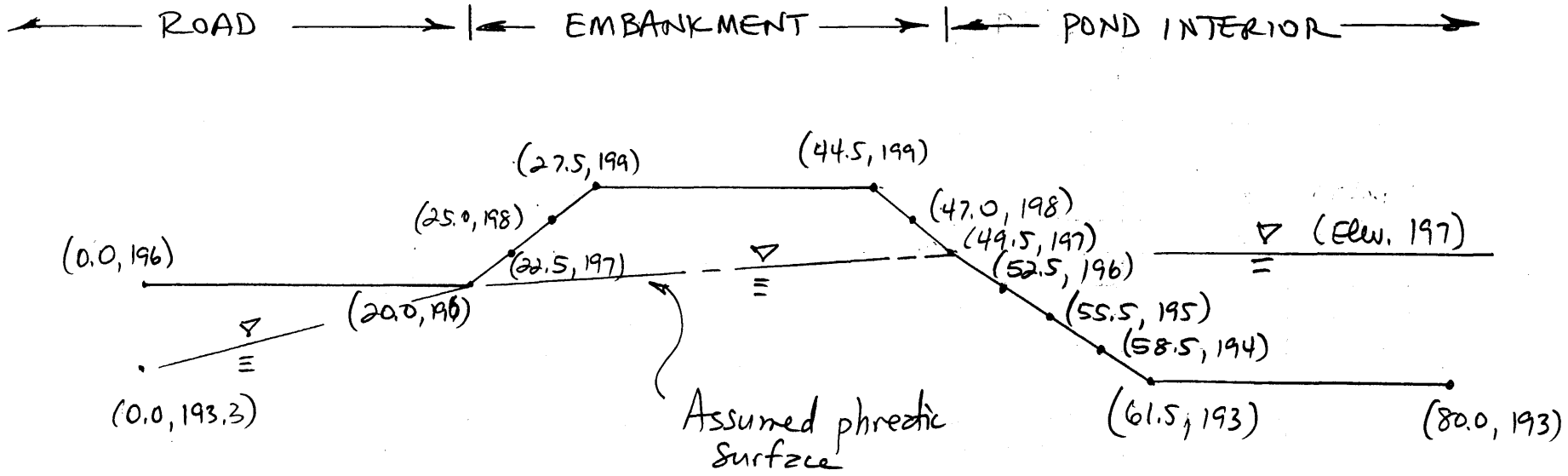
Richard B. White, P.E.
President

Attachments

**ATTACHMENT A**

Slope Stability Calculations

PROJECT 11C-709-23 PAGE 1 OF 1
COMPUTED TDN DATE 12 Jun 2008
CHECKED _____ DATE _____




# RAW WATER POND EMBANKMENT

CROSS SECTION THRU SW CORNER

SCALE: 1" = 10' (H.); 1" = 5' (V.)
(VIEW TO NORTH)

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

**********
*****  GeoSlope  *****
*****  Version 5.00  *****
*****  *****
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Problem Title : Raw Water Pond
Description : Determination of minimum slope safety factor
Remarks : Pond to remain as permanent impoundment

**********
*****  INPUT DATA  *****
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Profile Boundaries

Number of Boundaries : 12
Number of Top Boundaries : 12

| Boundary No. | X-Left (ft) | Y-Left (ft) | X-Right (ft) | Y-Right (ft) | Soil Type Below Bnd |
|---|---|---|---|---|---|
| 1 | 0.00 | 196.00 | 20.00 | 196.00 | 1 |
| 2 | 20.00 | 196.00 | 22.50 | 197.00 | 1 |
| 3 | 22.50 | 197.00 | 25.00 | 198.00 | 1 |
| 4 | 25.00 | 198.00 | 27.50 | 199.00 | 1 |
| 5 | 27.50 | 199.00 | 44.50 | 199.00 | 1 |
| 6 | 44.50 | 199.00 | 47.00 | 198.00 | 1 |
| 7 | 47.00 | 198.00 | 49.50 | 197.00 | 1 |
| 8 | 49.50 | 197.00 | 52.50 | 196.00 | 1 |
| 9 | 52.50 | 196.00 | 55.50 | 195.00 | 1 |
| 10 | 55.50 | 195.00 | 58.50 | 194.00 | 1 |
| 11 | 58.50 | 194.00 | 61.50 | 193.00 | 1 |
| 12 | 61.50 | 193.00 | 80.00 | 193.00 | 1 |

Soil Parameters

Number of Soil Types : 1

| Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant (psf) | Piez. Surface No. |
|---|---|---|---|---|---|---|---|
| 1 | 115.0 | 135.0 | 100.0 | 34.0 | 0.00 | 0.0 | 0 |

Piezometric Surfaces

Number of Surfaces : 1
Unit Weight of Water : 62.40 pcf

Piezometric Surface No. : 1
Number of Coordinate Points : 4

| Point No. | X-Water (ft) | Y-Water (ft) |
|---|---|---|
| 1 | 0.00 | 193.30 |
| 2 | 20.00 | 196.00 |
| 3 | 49.50 | 197.00 |
| 4 | 80.00 | 197.00 |

**********
***** TRIAL SURFACE GENERATION *****
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Data for Generating Circular Surfaces

Number of Initiation Points : 10
Number of Surfaces From Each Point : 10
Left Initiation Point : 10.00 ft
Right Initiation Point : 20.00 ft
Left Termination Point : 28.00 ft
Right Termination Point : 40.00 ft
Minimum Elevation : 190.00 ft
Segment Length : 1.00 ft
Positive Angle Limit : 0.00 deg
Negative Angle Limit : 0.00 deg

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***** RESULTS *****
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Surface No. : 1
Factor of Safety : 4.698
Circle Center X : 22.24 ft
Circle Center Y : 203.37 ft
Circle Radius : 8.10 ft

| Slice | X (ft) | Y (ft) | Width (ft) | Weight (lbs) | Load (lbs) | Water (lbs) | Normal (lbs) | Shear (lbs) |
|---|---|---|---|---|---|---|---|---|
| 1 | 19.03 | 195.94 | 0.29 | 1.8 | 0.0 | 0.0 | 4.8 | 7.3 |
| 2 | 19.50 | 195.77 | 0.64 | 17.3 | 0.0 | 0.0 | 25.5 | 18.3 |
| 3 | 19.91 | 195.62 | 0.18 | 7.7 | 0.0 | 0.0 | 9.2 | 5.2 |
| 4 | 20.40 | 195.50 | 0.79 | 60.0 | 0.0 | 0.0 | 68.5 | 27.3 |
| 5 | 21.29 | 195.35 | 0.99 | 133.7 | 0.0 | 0.0 | 139.5 | 41.3 |
| 6 | 22.14 | 195.29 | 0.71 | 128.4 | 0.0 | 0.0 | 128.2 | 33.6 |
| 7 | 22.64 | 195.29 | 0.29 | 58.4 | 0.0 | 0.0 | 58.3 | 14.5 |
| 8 | 23.28 | 195.36 | 0.99 | 223.0 | 0.0 | 0.0 | 218.0 | 52.6 |
| 9 | 24.26 | 195.55 | 0.97 | 240.2 | 0.0 | 0.0 | 233.9 | 54.9 |
| 10 | 24.87 | 195.72 | 0.25 | 64.6 | 0.0 | 0.0 | 63.6 | 14.9 |
| 11 | 25.34 | 195.91 | 0.68 | 173.6 | 0.0 | 0.0 | 170.9 | 40.0 |
| 12 | 25.83 | 196.12 | 0.30 | 75.1 | 0.0 | 0.0 | 75.7 | 18.0 |
| 13 | 26.26 | 196.36 | 0.58 | 143.5 | 0.0 | 0.0 | 144.5 | 34.9 |
| 14 | 26.96 | 196.81 | 0.81 | 184.0 | 0.0 | 0.0 | 191.6 | 48.8 |
| 15 | 27.43 | 197.17 | 0.13 | 27.7 | 0.0 | 0.0 | 30.2 | 8.2 |
| 16 | 27.80 | 197.51 | 0.60 | 103.1 | 0.0 | 0.0 | 109.8 | 33.2 |
| 17 | 28.42 | 198.17 | 0.64 | 61.7 | 0.0 | 0.0 | 60.3 | 29.9 |
| 18 | 28.89 | 198.77 | 0.29 | 7.6 | 0.0 | 0.0 | -3.0 | 11.0 |

Surface No. : 2
Factor of Safety : 4.832
Circle Center X : 23.31 ft
Circle Center Y : 200.99 ft
Circle Radius : 5.98 ft

| Slice | X (ft) | Y (ft) | Width (ft) | Weight (lbs) | Load (lbs) | Water (lbs) | Normal (lbs) | Shear (lbs) |
|---|---|---|---|---|---|---|---|---|
| 1 | 20.44 | 195.76 | 0.88 | 41.9 | 0.0 | 0.0 | 64.1 | 29.6 |
| 2 | 21.35 | 195.35 | 0.94 | 128.7 | 0.0 | 0.0 | 150.8 | 41.7 |
| 3 | 22.16 | 195.13 | 0.68 | 135.0 | 0.0 | 0.0 | 142.7 | 34.2 |
| 4 | 22.65 | 195.05 | 0.31 | 71.2 | 0.0 | 0.0 | 75.0 | 16.9 |
| 5 | 23.31 | 195.02 | 1.00 | 264.4 | 0.0 | 0.0 | 264.4 | 57.6 |
| 6 | 24.30 | 195.11 | 0.99 | 296.3 | 0.0 | 0.0 | 290.1 | 61.2 |
| 7 | 24.90 | 195.23 | 0.21 | 64.8 | 0.0 | 0.0 | 63.9 | 13.4 |
| 8 | 25.37 | 195.39 | 0.74 | 234.0 | 0.0 | 0.0 | 231.0 | 48.4 |
| 9 | 26.18 | 195.76 | 0.88 | 273.3 | 0.0 | 0.0 | 279.0 | 59.6 |
| 10 | 26.76 | 196.12 | 0.30 | 87.9 | 0.0 | 0.0 | 95.4 | 21.1 |
| 11 | 27.15 | 196.43 | 0.49 | 136.8 | 0.0 | 0.0 | 147.9 | 33.5 |
| 12 | 27.45 | 196.68 | 0.10 | 26.7 | 0.0 | 0.0 | 31.6 | 7.5 |
| 13 | 27.78 | 197.05 | 0.57 | 127.7 | 0.0 | 0.0 | 148.2 | 38.3 |
| 14 | 28.34 | 197.79 | 0.54 | 75.0 | 0.0 | 0.0 | 87.9 | 33.0 |
| 15 | 28.77 | 198.60 | 0.33 | 15.3 | 0.0 | 0.0 | -2.2 | 17.5 |

Surface No. : 3
Factor of Safety : 5.065
Circle Center X : 21.74 ft
Circle Center Y : 206.25 ft
Circle Radius : 11.44 ft

| Slice | X (ft) | Y (ft) | Width (ft) | Weight (lbs) | Load (lbs) | Water (lbs) | Normal (lbs) | Shear (lbs) |
|---|---|---|---|---|---|---|---|---|
| 1 | 17.06 | 195.83 | 0.78 | 15.5 | 0.0 | 0.0 | 25.9 | 20.3 |
| 2 | 17.52 | 195.63 | 0.13 | 5.8 | 0.0 | 0.0 | 8.1 | 4.0 |
| 3 | 18.06 | 195.44 | 0.95 | 61.5 | 0.0 | 0.0 | 75.1 | 29.7 |
| 4 | 19.01 | 195.16 | 0.97 | 94.4 | 0.0 | 0.0 | 105.5 | 33.8 |
| 5 | 19.75 | 195.00 | 0.50 | 57.7 | 0.0 | 0.0 | 61.1 | 18.1 |
| 6 | 20.24 | 194.92 | 0.49 | 66.1 | 0.0 | 0.0 | 69.8 | 19.0 |
| 7 | 20.99 | 194.85 | 1.00 | 177.2 | 0.0 | 0.0 | 180.5 | 43.8 |
| 8 | 21.99 | 194.83 | 1.00 | 226.0 | 0.0 | 0.0 | 225.0 | 49.7 |
| 9 | 22.49 | 194.84 | 0.01 | 3.5 | 0.0 | 0.0 | 3.4 | 0.7 |
| 10 | 22.99 | 194.89 | 0.98 | 259.3 | 0.0 | 0.0 | 255.0 | 53.4 |
| 11 | 23.97 | 195.05 | 0.98 | 286.7 | 0.0 | 0.0 | 280.9 | 57.2 |
| 12 | 24.73 | 195.22 | 0.54 | 165.6 | 0.0 | 0.0 | 162.9 | 32.8 |
| 13 | 25.21 | 195.36 | 0.42 | 131.6 | 0.0 | 0.0 | 129.5 | 25.9 |
| 14 | 25.89 | 195.61 | 0.93 | 294.5 | 0.0 | 0.0 | 293.2 | 58.8 |
| 15 | 26.80 | 196.01 | 0.90 | 279.5 | 0.0 | 0.0 | 283.4 | 57.5 |
| 16 | 27.26 | 196.24 | 0.03 | 8.1 | 0.0 | 0.0 | 8.4 | 1.7 |
| 17 | 27.39 | 196.32 | 0.22 | 68.3 | 0.0 | 0.0 | 71.0 | 14.7 |
| 18 | 27.80 | 196.57 | 0.60 | 168.7 | 0.0 | 0.0 | 174.9 | 37.2 |
| 19 | 28.51 | 197.05 | 0.81 | 181.0 | 0.0 | 0.0 | 191.4 | 45.2 |
| 20 | 29.28 | 197.67 | 0.75 | 114.6 | 0.0 | 0.0 | 121.1 | 35.9 |
| 21 | 30.00 | 198.36 | 0.69 | 50.4 | 0.0 | 0.0 | 45.9 | 25.9 |
| 22 | 30.46 | 198.86 | 0.22 | 3.4 | 0.0 | 0.0 | -2.7 | 6.6 |

Surface No. : 4
Factor of Safety : 5.077
Circle Center X : 21.51 ft
Circle Center Y : 204.19 ft
Circle Radius : 8.33 ft

| Slice | X (ft) | Y (ft) | Width (ft) | Weight (lbs) | Load (lbs) | Water (lbs) | Normal (lbs) | Shear (lbs) |
|---|---|---|---|---|---|---|---|---|
| 1 | 20.00 | 196.00 | 0.00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 20.50 | 195.94 | 0.99 | 29.6 | 0.0 | 0.0 | 32.8 | 24.0 |
| 3 | 21.49 | 195.88 | 1.00 | 82.9 | 0.0 | 0.0 | 83.0 | 30.7 |
| 4 | 22.25 | 195.91 | 0.51 | 57.9 | 0.0 | 0.0 | 56.3 | 17.5 |
| 5 | 22.74 | 195.96 | 0.49 | 63.3 | 0.0 | 0.0 | 61.7 | 17.8 |
| 6 | 23.25 | 196.06 | 0.52 | 74.5 | 0.0 | 0.0 | 71.7 | 20.1 |
| 7 | 23.73 | 196.17 | 0.45 | 68.4 | 0.0 | 0.0 | 66.1 | 17.9 |
| 8 | 24.43 | 196.40 | 0.94 | 147.3 | 0.0 | 0.0 | 142.8 | 38.7 |
| 9 | 24.95 | 196.61 | 0.11 | 16.6 | 0.0 | 0.0 | 16.4 | 4.5 |
| 10 | 25.39 | 196.84 | 0.78 | 118.8 | 0.0 | 0.0 | 116.8 | 32.9 |
| 11 | 26.20 | 197.32 | 0.83 | 110.1 | 0.0 | 0.0 | 109.8 | 34.3 |
| 12 | 26.99 | 197.93 | 0.75 | 74.7 | 0.0 | 0.0 | 73.5 | 29.5 |
| 13 | 27.43 | 198.34 | 0.14 | 10.1 | 0.0 | 0.0 | 9.2 | 5.3 |
| 14 | 27.76 | 198.71 | 0.53 | 17.8 | 0.0 | 0.0 | 8.1 | 16.6 |

Surface No. : 5
Factor of Safety : 5.247
Circle Center X : 23.50 ft
Circle Center Y : 204.61 ft
Circle Radius : 10.34 ft

| Slice | X (ft) | Y (ft) | Width (ft) | Weight (lbs) | Load (lbs) | Water (lbs) | Normal (lbs) | Shear (lbs) |
|---|---|---|---|---|---|---|---|---|
| 1 | 17.98 | 195.88 | 0.41 | 5.8 | 0.0 | 0.0 | 13.2 | 10.8 |
| 2 | 18.41 | 195.62 | 0.45 | 19.5 | 0.0 | 0.0 | 31.1 | 14.0 |
| 3 | 19.09 | 195.27 | 0.90 | 75.5 | 0.0 | 0.0 | 98.4 | 31.7 |
| 4 | 19.77 | 194.98 | 0.46 | 53.9 | 0.0 | 0.0 | 63.5 | 17.4 |
| 5 | 20.24 | 194.81 | 0.48 | 71.4 | 0.0 | 0.0 | 83.2 | 20.5 |
| 6 | 20.97 | 194.60 | 0.97 | 199.2 | 0.0 | 0.0 | 217.3 | 47.0 |
| 7 | 21.95 | 194.40 | 0.99 | 270.1 | 0.0 | 0.0 | 281.6 | 55.3 |
| 8 | 22.47 | 194.33 | 0.06 | 18.1 | 0.0 | 0.0 | 18.3 | 3.5 |
| 9 | 22.97 | 194.30 | 0.94 | 312.0 | 0.0 | 0.0 | 315.6 | 58.5 |
| 10 | 23.94 | 194.30 | 1.00 | 376.8 | 0.0 | 0.0 | 374.3 | 67.2 |
| 11 | 24.72 | 194.36 | 0.56 | 228.0 | 0.0 | 0.0 | 224.7 | 39.7 |
| 12 | 25.21 | 194.43 | 0.43 | 180.4 | 0.0 | 0.0 | 177.8 | 31.1 |
| 13 | 25.91 | 194.57 | 0.97 | 424.0 | 0.0 | 0.0 | 418.6 | 72.9 |
| 14 | 26.87 | 194.85 | 0.94 | 423.3 | 0.0 | 0.0 | 422.6 | 73.4 |
| 15 | 27.42 | 195.05 | 0.15 | 69.4 | 0.0 | 0.0 | 70.7 | 12.3 |
| 16 | 27.88 | 195.26 | 0.75 | 324.5 | 0.0 | 0.0 | 330.3 | 58.3 |
| 17 | 28.69 | 195.69 | 0.86 | 329.4 | 0.0 | 0.0 | 344.3 | 63.3 |
| 18 | 29.39 | 196.13 | 0.54 | 178.8 | 0.0 | 0.0 | 193.3 | 37.6 |
| 19 | 29.80 | 196.42 | 0.27 | 79.8 | 0.0 | 0.0 | 85.8 | 17.4 |
| 20 | 30.31 | 196.85 | 0.75 | 185.7 | 0.0 | 0.0 | 207.0 | 45.7 |
| 21 | 31.02 | 197.55 | 0.68 | 114.4 | 0.0 | 0.0 | 129.2 | 35.7 |
| 22 | 31.67 | 198.31 | 0.61 | 48.7 | 0.0 | 0.0 | 47.2 | 25.1 |
| 23 | 32.07 | 198.85 | 0.19 | 3.2 | 0.0 | 0.0 | -3.9 | 6.2 |

Surface No. : 6
Factor of Safety : 5.367
Circle Center X : 21.38 ft
Circle Center Y : 208.62 ft
Circle Radius : 13.90 ft

| Slice | X (ft) | Y (ft) | Width (ft) | Weight (lbs) | Load (lbs) | Water (lbs) | Normal (lbs) | Shear (lbs) |
|---|---|---|---|---|---|---|---|---|
| 1 | 16.02 | 195.81 | 0.92 | 20.5 | 0.0 | 0.0 | 31.7 | 22.6 |
| 2 | 16.57 | 195.58 | 0.19 | 9.1 | 0.0 | 0.0 | 11.3 | 5.1 |
| 3 | 17.05 | 195.42 | 0.76 | 50.4 | 0.0 | 0.0 | 60.7 | 22.5 |
| 4 | 17.91 | 195.17 | 0.97 | 92.4 | 0.0 | 0.0 | 103.6 | 31.7 |
| 5 | 18.89 | 194.96 | 0.98 | 118.2 | 0.0 | 0.0 | 126.5 | 34.5 |
| 6 | 19.69 | 194.83 | 0.62 | 83.5 | 0.0 | 0.0 | 86.5 | 22.5 |
| 7 | 20.19 | 194.78 | 0.37 | 55.6 | 0.0 | 0.0 | 57.4 | 14.2 |
| 8 | 20.87 | 194.74 | 1.00 | 185.1 | 0.0 | 0.0 | 186.7 | 42.1 |
| 9 | 21.87 | 194.74 | 1.00 | 231.1 | 0.0 | 0.0 | 229.6 | 47.5 |
| 10 | 22.44 | 194.76 | 0.13 | 32.8 | 0.0 | 0.0 | 32.3 | 6.5 |
| 11 | 22.93 | 194.82 | 0.87 | 234.6 | 0.0 | 0.0 | 231.1 | 45.3 |
| 12 | 23.86 | 194.95 | 0.98 | 293.3 | 0.0 | 0.0 | 288.1 | 54.8 |
| 13 | 24.67 | 195.12 | 0.65 | 205.5 | 0.0 | 0.0 | 202.4 | 37.9 |
| 14 | 25.16 | 195.25 | 0.32 | 103.0 | 0.0 | 0.0 | 101.5 | 18.9 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 15 | 25.79 | 195.45 | 0.95 | 312.9 | 0.0 | 0.0 | 310.7 | 57.7 |
| 16 | 26.73 | 195.80 | 0.92 | 307.1 | 0.0 | 0.0 | 308.7 | 57.4 |
| 17 | 27.34 | 196.07 | 0.31 | 102.5 | 0.0 | 0.0 | 104.8 | 19.7 |
| 18 | 27.61 | 196.20 | 0.23 | 73.2 | 0.0 | 0.0 | 74.9 | 14.2 |
| 19 | 27.91 | 196.35 | 0.35 | 108.0 | 0.0 | 0.0 | 110.3 | 21.3 |
| 20 | 28.51 | 196.70 | 0.86 | 227.3 | 0.0 | 0.0 | 236.0 | 48.3 |
| 21 | 29.35 | 197.24 | 0.82 | 165.8 | 0.0 | 0.0 | 174.0 | 40.5 |
| 22 | 30.15 | 197.84 | 0.78 | 103.3 | 0.0 | 0.0 | 107.0 | 32.1 |
| 23 | 30.90 | 198.50 | 0.73 | 41.9 | 0.0 | 0.0 | 35.7 | 23.1 |
| 24 | 31.34 | 198.92 | 0.14 | 1.3 | 0.0 | 0.0 | -2.1 | 3.7 |

Surface No. : 7
Factor of Safety : 5.394
Circle Center X : 24.24 ft
Circle Center Y : 203.45 ft
Circle Radius : 9.17 ft

| Slice | X (ft) | Y (ft) | Width (ft) | Weight (lbs) | Load (lbs) | Water (lbs) | Normal (lbs) | Shear (lbs) |
|---|---|---|---|---|---|---|---|---|
| 1 | 18.99 | 195.94 | 0.19 | 1.4 | 0.0 | 0.0 | 4.7 | 4.9 |
| 2 | 19.41 | 195.67 | 0.65 | 24.7 | 0.0 | 0.0 | 41.8 | 19.5 |
| 3 | 19.87 | 195.40 | 0.27 | 18.6 | 0.0 | 0.0 | 25.1 | 8.7 |
| 4 | 20.31 | 195.17 | 0.63 | 68.8 | 0.0 | 0.0 | 88.7 | 24.1 |
| 5 | 21.10 | 194.85 | 0.94 | 172.0 | 0.0 | 0.0 | 199.0 | 43.4 |
| 6 | 22.03 | 194.56 | 0.93 | 241.6 | 0.0 | 0.0 | 261.2 | 50.5 |
| 7 | 22.52 | 194.44 | 0.04 | 11.5 | 0.0 | 0.0 | 12.4 | 2.3 |
| 8 | 23.03 | 194.37 | 0.99 | 324.1 | 0.0 | 0.0 | 335.0 | 60.4 |
| 9 | 24.03 | 194.29 | 1.00 | 381.5 | 0.0 | 0.0 | 383.2 | 66.5 |
| 10 | 24.76 | 194.30 | 0.47 | 194.8 | 0.0 | 0.0 | 192.7 | 32.9 |
| 11 | 25.26 | 194.35 | 0.53 | 227.5 | 0.0 | 0.0 | 225.1 | 37.9 |
| 12 | 26.02 | 194.47 | 0.98 | 444.6 | 0.0 | 0.0 | 438.7 | 73.4 |
| 13 | 26.98 | 194.71 | 0.95 | 447.8 | 0.0 | 0.0 | 446.0 | 74.3 |
| 14 | 27.48 | 194.87 | 0.04 | 18.5 | 0.0 | 0.0 | 18.8 | 3.1 |
| 15 | 27.94 | 195.07 | 0.88 | 396.1 | 0.0 | 0.0 | 402.6 | 68.1 |
| 16 | 28.81 | 195.51 | 0.87 | 347.4 | 0.0 | 0.0 | 364.0 | 64.1 |
| 17 | 29.64 | 196.05 | 0.79 | 267.0 | 0.0 | 0.0 | 291.0 | 54.5 |
| 18 | 30.04 | 196.35 | 0.02 | 5.9 | 0.0 | 0.0 | 6.4 | 1.2 |
| 19 | 30.42 | 196.69 | 0.74 | 195.8 | 0.0 | 0.0 | 223.0 | 46.4 |
| 20 | 31.12 | 197.41 | 0.66 | 121.0 | 0.0 | 0.0 | 142.1 | 36.3 |
| 21 | 31.73 | 198.19 | 0.57 | 53.5 | 0.0 | 0.0 | 56.6 | 25.6 |
| 22 | 32.13 | 198.80 | 0.22 | 5.1 | 0.0 | 0.0 | -4.0 | 8.0 |

Surface No. : 8
Factor of Safety : 5.431
Circle Center X : 23.89 ft
Circle Center Y : 200.72 ft
Circle Radius : 6.88 ft

| Slice | X (ft) | Y (ft) | Width (ft) | Weight (lbs) | Load (lbs) | Water (lbs) | Normal (lbs) | Shear (lbs) |
|---|---|---|---|---|---|---|---|---|
| 1 | 18.96 | 195.93 | 0.14 | 1.1 | 0.0 | 0.0 | 5.3 | 4.2 |
| 2 | 19.33 | 195.60 | 0.59 | 27.6 | 0.0 | 0.0 | 57.5 | 22.0 |
| 3 | 19.81 | 195.20 | 0.37 | 34.4 | 0.0 | 0.0 | 51.6 | 14.7 |
| 4 | 20.23 | 194.92 | 0.45 | 61.3 | 0.0 | 0.0 | 88.4 | 21.1 |
| 5 | 20.90 | 194.55 | 0.90 | 188.0 | 0.0 | 0.0 | 231.7 | 47.2 |
| 6 | 21.83 | 194.18 | 0.95 | 280.3 | 0.0 | 0.0 | 311.9 | 57.1 |
| 7 | 22.40 | 194.01 | 0.19 | 65.1 | 0.0 | 0.0 | 67.8 | 12.0 |
| 8 | 22.90 | 193.93 | 0.80 | 295.2 | 0.0 | 0.0 | 307.6 | 53.0 |
| 9 | 23.80 | 193.86 | 1.00 | 420.5 | 0.0 | 0.0 | 421.6 | 70.8 |
| 10 | 24.65 | 193.90 | 0.70 | 320.8 | 0.0 | 0.0 | 316.6 | 52.4 |
| 11 | 25.14 | 193.97 | 0.29 | 134.9 | 0.0 | 0.0 | 133.2 | 21.9 |
| 12 | 25.77 | 194.12 | 0.96 | 463.0 | 0.0 | 0.0 | 459.9 | 75.5 |
| 13 | 26.70 | 194.46 | 0.91 | 442.5 | 0.0 | 0.0 | 451.7 | 74.5 |
| 14 | 27.33 | 194.78 | 0.34 | 162.1 | 0.0 | 0.0 | 173.7 | 29.0 |
| 15 | 27.75 | 195.05 | 0.50 | 229.2 | 0.0 | 0.0 | 245.4 | 41.5 |
| 16 | 28.38 | 195.53 | 0.76 | 301.5 | 0.0 | 0.0 | 345.6 | 61.3 |
| 17 | 28.95 | 196.09 | 0.39 | 130.2 | 0.0 | 0.0 | 163.1 | 31.2 |
| 18 | 29.28 | 196.46 | 0.26 | 77.3 | 0.0 | 0.0 | 95.8 | 19.4 |
| 19 | 29.68 | 197.04 | 0.54 | 121.0 | 0.0 | 0.0 | 164.5 | 38.8 |
| 20 | 30.15 | 197.92 | 0.41 | 50.9 | 0.0 | 0.0 | 65.3 | 26.5 |
| 21 | 30.45 | 198.69 | 0.18 | 6.4 | 0.0 | 0.0 | -13.2 | 10.4 |

Surface No. : 9
Factor of Safety : 5.448
Circle Center X : 21.91 ft
Circle Center Y : 202.92 ft
Circle Radius : 9.39 ft

| Slice | X (ft) | Y (ft) | Width (ft) | Weight (lbs) | Load (lbs) | Water (lbs) | Normal (lbs) | Shear (lbs) |
|---|---|---|---|---|---|---|---|---|
| 1 | 15.87 | 195.74 | 0.63 | 18.5 | 0.0 | 0.0 | 40.4 | 19.9 |
| 2 | 16.25 | 195.42 | 0.15 | 9.7 | 0.0 | 0.0 | 17.2 | 5.6 |
| 3 | 16.75 | 195.09 | 0.83 | 87.5 | 0.0 | 0.0 | 127.3 | 34.1 |
| 4 | 17.61 | 194.58 | 0.89 | 144.7 | 0.0 | 0.0 | 184.0 | 41.1 |
| 5 | 18.52 | 194.17 | 0.93 | 195.8 | 0.0 | 0.0 | 228.0 | 46.6 |
| 6 | 19.47 | 193.86 | 0.97 | 237.2 | 0.0 | 0.0 | 259.3 | 50.5 |
| 7 | 19.97 | 193.73 | 0.05 | 13.3 | 0.0 | 0.0 | 13.8 | 2.7 |
| 8 | 20.47 | 193.65 | 0.94 | 273.3 | 0.0 | 0.0 | 285.0 | 52.7 |
| 9 | 21.44 | 193.55 | 1.00 | 347.2 | 0.0 | 0.0 | 350.7 | 61.8 |
| 10 | 22.22 | 193.54 | 0.56 | 217.0 | 0.0 | 0.0 | 215.3 | 37.0 |
| 11 | 22.72 | 193.57 | 0.43 | 175.5 | 0.0 | 0.0 | 174.2 | 29.5 |
| 12 | 23.43 | 193.66 | 0.99 | 420.7 | 0.0 | 0.0 | 414.9 | 69.7 |
| 13 | 24.40 | 193.88 | 0.96 | 430.5 | 0.0 | 0.0 | 427.0 | 71.2 |
| 14 | 24.94 | 194.03 | 0.12 | 52.2 | 0.0 | 0.0 | 52.6 | 8.8 |
| 15 | 25.41 | 194.22 | 0.82 | 369.9 | 0.0 | 0.0 | 373.1 | 62.3 |
| 16 | 26.26 | 194.61 | 0.89 | 396.8 | 0.0 | 0.0 | 411.5 | 69.3 |

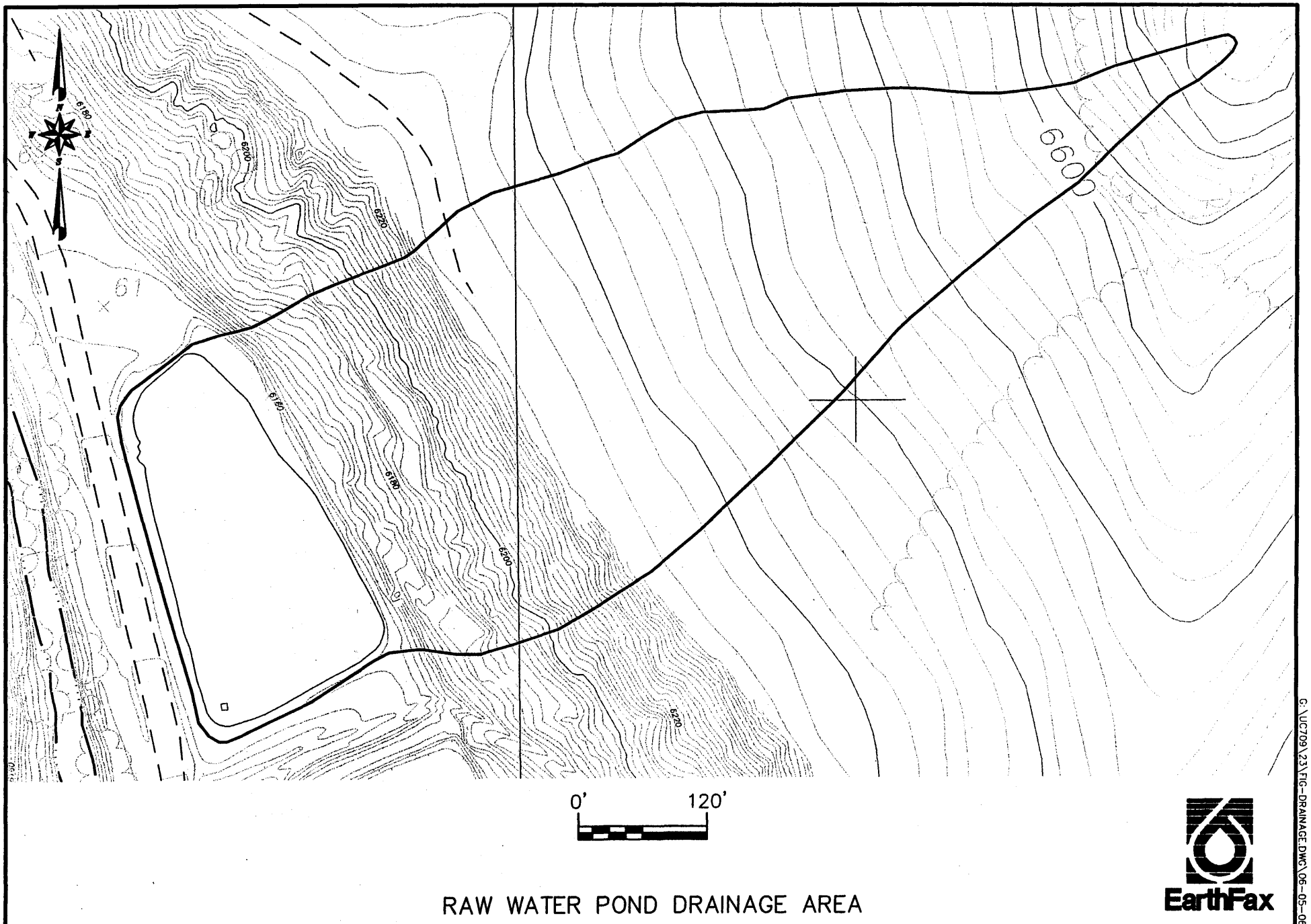
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 17 | 27.10 | 195.11 | 0.80 | 342.9 | 0.0 | 0.0 | 369.9 | 63.4 |
| 18 | 27.52 | 195.39 | 0.03 | 13.7 | 0.0 | 0.0 | 14.7 | 2.6 |
| 19 | 27.92 | 195.72 | 0.77 | 290.0 | 0.0 | 0.0 | 328.4 | 59.0 |
| 20 | 28.42 | 196.16 | 0.24 | 79.8 | 0.0 | 0.0 | 95.8 | 18.3 |
| 21 | 28.77 | 196.52 | 0.45 | 128.4 | 0.0 | 0.0 | 152.8 | 30.8 |
| 22 | 29.30 | 197.15 | 0.62 | 130.9 | 0.0 | 0.0 | 163.4 | 38.6 |
| 23 | 29.88 | 197.97 | 0.53 | 62.6 | 0.0 | 0.0 | 74.3 | 27.6 |
| 24 | 30.29 | 198.70 | 0.29 | 10.2 | 0.0 | 0.0 | -1.7 | 12.2 |

Surface No. : 10
Factor of Safety : 5.479
Circle Center X : 22.01 ft
Circle Center Y : 200.73 ft
Circle Radius : 7.14 ft

| Slice | X (ft) | Y (ft) | Width (ft) | Weight (lbs) | Load (lbs) | Water (lbs) | Normal (lbs) | Shear (lbs) |
|---|---|---|---|---|---|---|---|---|
| 1 | 16.87 | 195.80 | 0.40 | 9.2 | 0.0 | 0.0 | 26.1 | 13.5 |
| 2 | 17.23 | 195.45 | 0.31 | 19.6 | 0.0 | 0.0 | 40.1 | 12.9 |
| 3 | 17.78 | 195.00 | 0.80 | 92.3 | 0.0 | 0.0 | 141.0 | 35.6 |
| 4 | 18.62 | 194.47 | 0.88 | 155.0 | 0.0 | 0.0 | 199.4 | 42.8 |
| 5 | 19.53 | 194.06 | 0.94 | 209.1 | 0.0 | 0.0 | 240.8 | 47.9 |
| 6 | 20.00 | 193.88 | 0.00 | 0.5 | 0.0 | 0.0 | 0.6 | 0.1 |
| 7 | 20.49 | 193.77 | 0.98 | 272.1 | 0.0 | 0.0 | 290.3 | 54.0 |
| 8 | 21.48 | 193.63 | 1.00 | 339.6 | 0.0 | 0.0 | 345.1 | 60.7 |
| 9 | 22.24 | 193.61 | 0.52 | 197.9 | 0.0 | 0.0 | 196.2 | 33.7 |
| 10 | 22.74 | 193.64 | 0.47 | 188.3 | 0.0 | 0.0 | 186.6 | 31.6 |
| 11 | 23.46 | 193.76 | 0.98 | 408.3 | 0.0 | 0.0 | 402.9 | 67.9 |
| 12 | 24.42 | 194.03 | 0.94 | 404.6 | 0.0 | 0.0 | 405.5 | 68.2 |
| 13 | 24.95 | 194.23 | 0.11 | 45.7 | 0.0 | 0.0 | 47.4 | 8.0 |
| 14 | 25.39 | 194.46 | 0.78 | 330.8 | 0.0 | 0.0 | 343.3 | 58.3 |
| 15 | 26.18 | 194.96 | 0.81 | 327.6 | 0.0 | 0.0 | 359.1 | 62.5 |
| 16 | 26.95 | 195.60 | 0.72 | 263.7 | 0.0 | 0.0 | 311.5 | 56.6 |
| 17 | 27.40 | 196.07 | 0.19 | 63.3 | 0.0 | 0.0 | 82.5 | 15.8 |
| 18 | 27.53 | 196.22 | 0.05 | 17.2 | 0.0 | 0.0 | 22.4 | 4.4 |
| 19 | 27.74 | 196.49 | 0.37 | 107.5 | 0.0 | 0.0 | 138.4 | 28.1 |
| 20 | 28.18 | 197.16 | 0.50 | 105.7 | 0.0 | 0.0 | 148.0 | 36.5 |
| 21 | 28.62 | 198.06 | 0.37 | 40.5 | 0.0 | 0.0 | 48.2 | 24.2 |
| 22 | 28.86 | 198.76 | 0.12 | 3.2 | 0.0 | 0.0 | -15.1 | 7.1 |

**ATTACHMNT B**

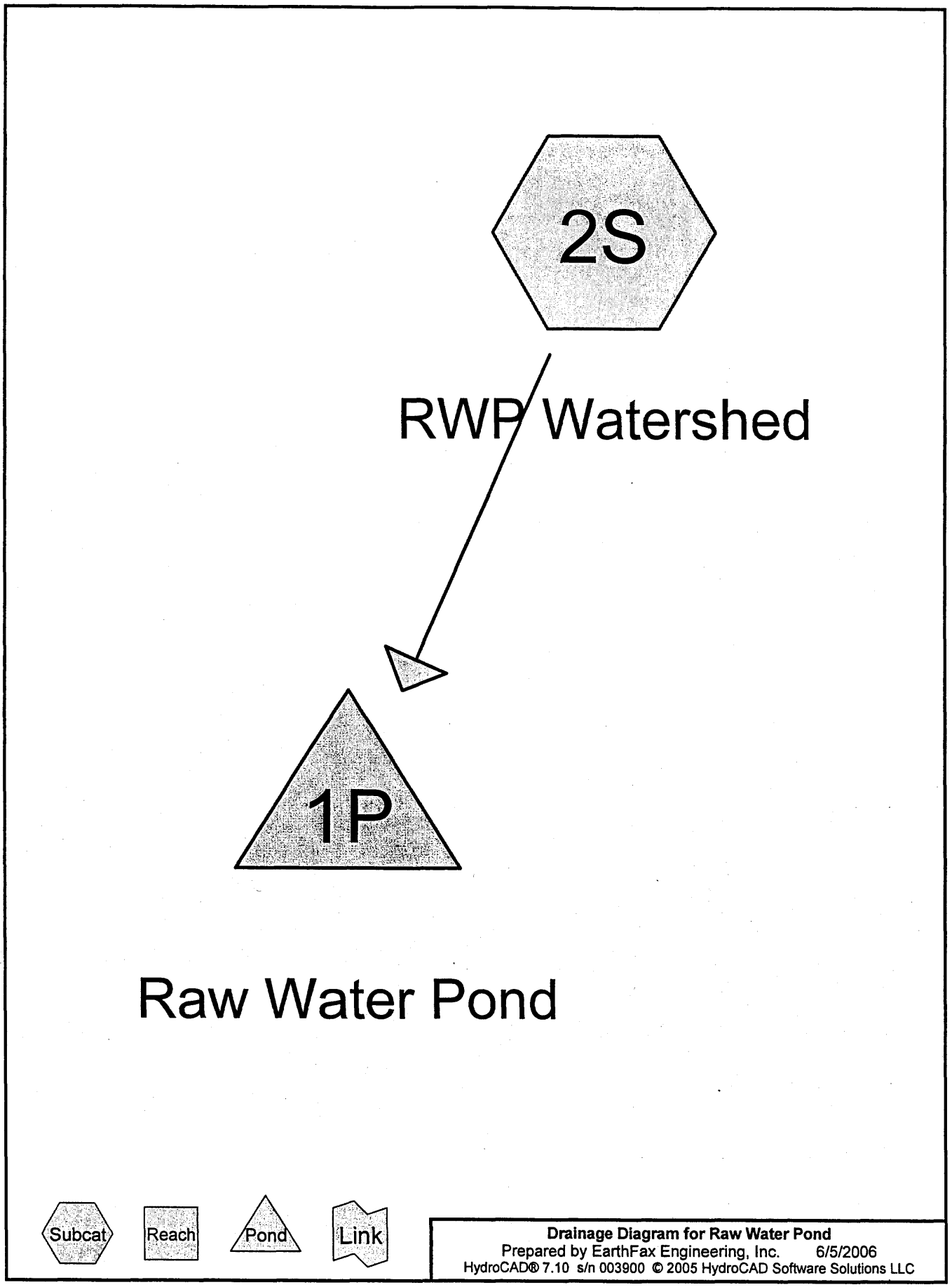
HydroCAD Calculations




RAW WATER POND DRAINAGE AREA

EarthFax

G:\UC709\23\FIG-DRAINAGE.DWG\06-05-06




**Drainage Diagram for Raw Water Pond**
Prepared by EarthFax Engineering, Inc. 6/5/2006

## Subcatchment 2S: RWP Watershed

Runoff = 1.20 cfs @ 3.39 hrs, Volume= 0.114 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type II 24-hr 6.00 hrs 25-yr, 6-hr Rainfall=1.60"

| Area (ac) | CN | Description |
|---|---|---|
| 5.580 | 70 | Drainage area |
| 1.110 | 100 | Pond area |
| 6.690 | 75 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 26.4 | 6,400 | 0.3800 | 4.0 | | **Lag/CN Method, Raw water pond watershed** |

## Pond 1P: Raw Water Pond

Inflow Area = 6.690 ac, Inflow Depth = 0.20" for 25-yr, 6-hr event
Inflow = 1.20 cfs @ 3.39 hrs, Volume= 0.114 af
Outflow = 0.02 cfs @ 6.63 hrs, Volume= 0.033 af, Atten= 98%, Lag= 194.6 min
Primary = 0.02 cfs @ 6.63 hrs, Volume= 0.033 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Starting Elev= 197.00' Surf.Area= 1.112 ac Storage= 4.299 af
Peak Elev= 197.10' @ 6.63 hrs Surf.Area= 1.117 ac Storage= 4.408 af (0.109 af above start)
Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= 552.4 min ( 805.3 - 252.8 )

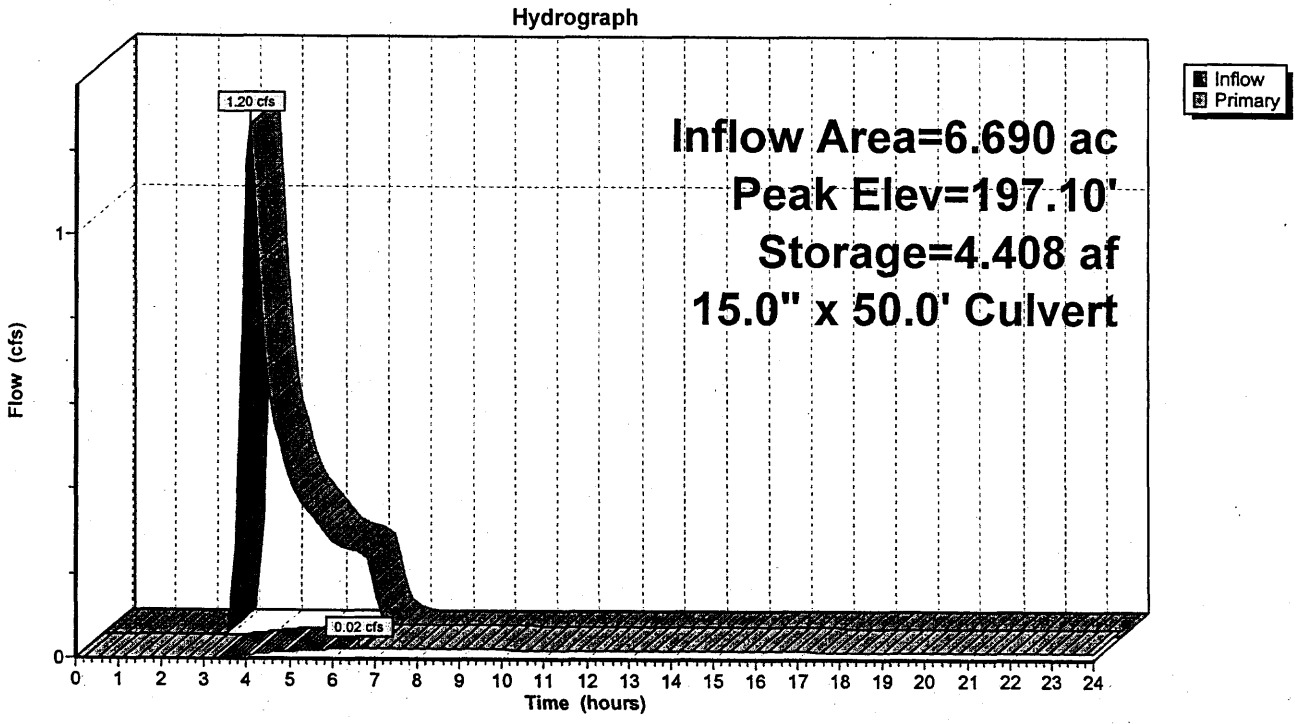
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 192.00' | 6.631 af | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (acres) | Inc.Store (acre-feet) | Cum.Store (acre-feet) |
|---|---|---|---|
| 192.00 | 0.413 | 0.000 | 0.000 |
| 193.00 | 0.647 | 0.530 | 0.530 |
| 194.00 | 0.847 | 0.747 | 1.277 |
| 195.00 | 0.988 | 0.918 | 2.195 |
| 196.00 | 1.054 | 1.021 | 3.216 |
| 197.00 | 1.112 | 1.083 | 4.299 |
| 198.00 | 1.165 | 1.139 | 5.437 |
| 199.00 | 1.223 | 1.194 | 6.631 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 197.00' | **15.0" x 50.0' long Culvert** CMP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 196.50' S= 0.0100 '/' Cc= 0.900 n= 0.025 Corrugated metal |

**Primary OutFlow** Max=0.02 cfs @ 6.63 hrs HW=197.10' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.02 cfs @ 0.8 fps)

## Pond 1P: Raw Water Pond



## Subcatchment 2S: RWP Watershed

Runoff = 3.14 cfs @ 3.35 hrs, Volume= 0.240 af, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type II 24-hr 6.00 hrs 100-yr, 6-hr Rainfall=2.10"

| Area (ac) | CN | Description |
|---|---|---|
| 5.580 | 70 | Drainage area |
| 1.110 | 100 | Pond area |
| 6.690 | 75 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 26.4 | 6,400 | 0.3800 | 4.0 | | **Lag/CN Method, Raw water pond watershed** |

## Pond 1P: Raw Water Pond

Inflow Area = 6.690 ac, Inflow Depth = 0.43" for 100-yr, 6-hr event
Inflow = 3.14 cfs @ 3.35 hrs, Volume= 0.240 af
Outflow = 0.10 cfs @ 6.47 hrs, Volume= 0.108 af, Atten= 97%, Lag= 187.1 min
Primary = 0.10 cfs @ 6.47 hrs, Volume= 0.108 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Starting Elev= 197.00' Surf.Area= 1.112 ac Storage= 4.299 af
Peak Elev= 197.20' @ 6.47 hrs Surf.Area= 1.122 ac Storage= 4.520 af (0.221 af above start)
Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= 496.8 min ( 741.6 - 244.8 )

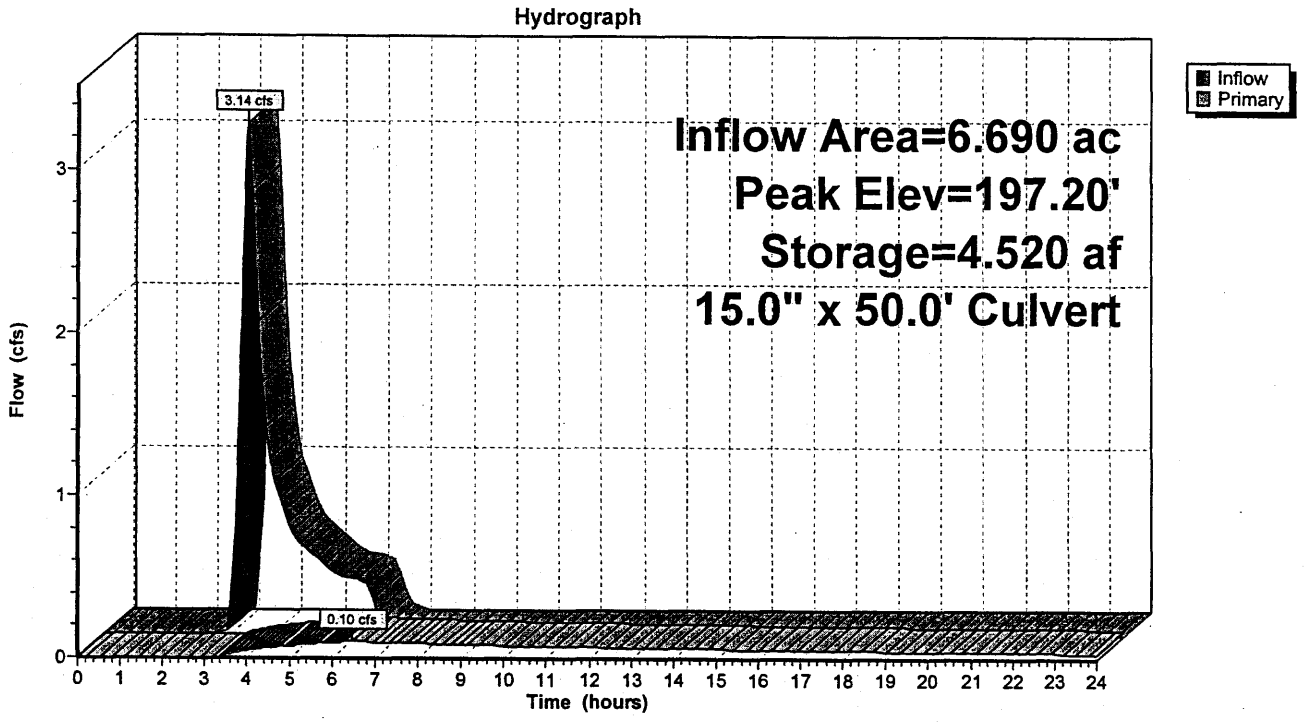
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 192.00' | 6.631 af | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (acres) | Inc.Store (acre-feet) | Cum.Store (acre-feet) |
|---|---|---|---|
| 192.00 | 0.413 | 0.000 | 0.000 |
| 193.00 | 0.647 | 0.530 | 0.530 |
| 194.00 | 0.847 | 0.747 | 1.277 |
| 195.00 | 0.988 | 0.918 | 2.195 |
| 196.00 | 1.054 | 1.021 | 3.216 |
| 197.00 | 1.112 | 1.083 | 4.299 |
| 198.00 | 1.165 | 1.139 | 5.437 |
| 199.00 | 1.223 | 1.194 | 6.631 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 197.00' | **15.0" x 50.0' long Culvert** CMP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 196.50' S= 0.0100 '/' Cc= 0.900 n= 0.025 Corrugated metal |

**Primary OutFlow** Max=0.10 cfs @ 6.47 hrs HW=197.20' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.10 cfs @ 1.2 fps)

## Pond 1P: Raw Water Pond



## Subcatchment 2S: RWP Watershed

Runoff = 1.24 cfs @ 12.27 hrs, Volume= 0.160 af, Depth= 0.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-42.00 hrs, dt= 0.10 hrs
Type II 24-hr 10-yr, 24-hr Rainfall=1.80"

| Area (ac) | CN | Description |
|---|---|---|
| 5.580 | 70 | Drainage area |
| 1.110 | 100 | Pond area |
| 6.690 | 75 | Weighted Average |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 26.4 | 6,400 | 0.3800 | 4.0 | | **Lag/CN Method, Raw water pond watershed** |

## Pond 1P: Raw Water Pond

Inflow Area = 6.690 ac, Inflow Depth = 0.29" for 10-yr, 24-hr event
Inflow = 1.24 cfs @ 12.27 hrs, Volume= 0.160 af
Outflow = 0.04 cfs @ 24.32 hrs, Volume= 0.065 af, Atten= 97%, Lag= 723.1 min
Primary = 0.04 cfs @ 24.32 hrs, Volume= 0.065 af

Routing by Stor-Ind method, Time Span= 0.00-42.00 hrs, dt= 0.10 hrs
Starting Elev= 197.00' Surf.Area= 1.112 ac Storage= 4.299 af
Peak Elev= 197.12' @ 24.32 hrs Surf.Area= 1.118 ac Storage= 4.433 af (0.134 af above start)
Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= 712.5 min ( 1,635.1 - 922.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 192.00' | 6.631 af | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (acres) | Inc.Store (acre-feet) | Cum.Store (acre-feet) |
|---|---|---|---|
| 192.00 | 0.413 | 0.000 | 0.000 |
| 193.00 | 0.647 | 0.530 | 0.530 |
| 194.00 | 0.847 | 0.747 | 1.277 |
| 195.00 | 0.988 | 0.918 | 2.195 |
| 196.00 | 1.054 | 1.021 | 3.216 |
| 197.00 | 1.112 | 1.083 | 4.299 |
| 198.00 | 1.165 | 1.139 | 5.437 |
| 199.00 | 1.223 | 1.194 | 6.631 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 197.00' | **15.0" x 50.0' long Culvert** CMP, end-section conforming to fill, Ke= 0.500<br>Outlet Invert= 196.50' S= 0.0100 '/' Cc= 0.900 n= 0.025 Corrugated metal |

**Primary OutFlow** Max=0.04 cfs @ 24.32 hrs HW=197.12' (Free Discharge)
**1=Culvert** (Barrel Controls 0.04 cfs @ 0.9 fps)

## Pond 1P: Raw Water Pond