NOV-04-60 09:58 FROM:CYPRUS PLATEAU

CYPRUS PLATEAU MINING CORPORATION
A Cyprus Amax Company

Cyprus Plateau Mining Corporation
Post Office Drawer PMC
Price, Utah 84501
(801) 637-2875

November 4, 1996

Mr. Pete Hess
Utah Department of Natural Resources
Division of Oil, Gas and Mining
451 East 400 North
Price, Utah 84501

RECEIVED
NOV 0 4 1996
DIV. OF OIL, GAS & MINING

Dear Mr. Hess,

RE: WILLOW CREEK PERMIT MODIFICATION REVIEW RESPONSES
RAILROAD MODIFICATION

Enclosed are responses to the Division comments on the railroad permit modification. The responses have been prepared by Hansen, Allen and Luce. They are hand delivering four copies to the Salt Lake Division office today.

If you have further comments please contact me as soon as possible.

Respectfully,

Ben Grimes
Sr. Staff Project Engineer

Enclosures

C: DOGM- SLC
File: WCENV 2.5.2.12.5.1
Chron: BG961101

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

Michael O. Leavitt
Governor
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Executive Director
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Division Director

355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203
801-538-5340
801-359-3940 (Fax)
801-538-5319 (TDD)

November 5, 1996

TO: Pete Hess

FROM: Randy Harden

RE: RR2/RR2 Retaining Walls/Southern Embankment of Sediment Pond 12B, Castle Gate Preparation Plant, ACT/007/038-96-D, Folder #2, Carbon County, Utah

In response to your request for additional input on the re-construction of Sediment Pond 12B, I have reviewed the proposal and the revised information proposed as received by the Division on November 4, 1996.

Concerns and comments made in my October 11, 1996, memo were specifically addressed in that response.

Clarification of design parameters used for construction and pond embankment stability analysis has been revised to address conditions noted in that memo. The plan now adequately addresses those concerns and is adequate for approval by the Division.

Further analysis was performed in consideration of pond drawdown and vibrations from truck and train traffic adjacent to the pond. Comments and evaluations made addressing these concerns were also found to be adequate.

The plan now also indicates that saturation of the materials in the Hilfiker embankment and seepage loss through the Hilfiker walls were evaluated and incorporated into the design and that excessive seepage will not occur through the Hilfiker wall.

Foundation preparation and excavation requirements have been incorporated into Map 26B to ensure that the geotechnical requirements for construction will be accomplished.

My recommendation based on the review of the additional information is that amendment 96B be approved with regard to the engineering requirements for construction of the pond.

cc: J. Helfrich
D. Haddock

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

Michael O. Leavitt
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October 21, 1996

TO: File #2

THRU: Joe Helfrich, Permit Supervisor DQH for

FROM: Steven M. Johnson, Reclamation Specialist SMJ

RE: RR1/RR2 Retaining Walls/Southern Embankment of Sediment Pond 12B, Willow Creek Mine, Cyprus Plateau Mining Corp. ACT/007/038-96D, Folder #2, Carbon County, Utah

SUMMARY

The railroad adjacent to the Willow Creek Mine's Castle Gate facilities is being realigned so the grade will suit the trains' capabilities for loading. Because of this work Cyprus Plateau Mining Corp. (CPMC) will need to change the runoff and drainage control plan for effected areas. This is the hydrologic review of CPMC's intended changes.

ANALYSIS

HYDROLOGIC INFORMATION

Regulatory Reference: 30 CFR Sec. 773.17, 774.13, 784.14, 784.16, 784.29, 817.41, 817.42, 817.43, 817.45, 817.49, 817.56, 817.57; R645-300-140, -300-141, -300-142, -300-143, -300-144, -300-145, -300-146, -300-147, -300-147, -300-148, -301-512, -301-514, -301-521, -301-531, -301-532, -301-533, -301-536, -301-542, -301-720, -301-731, -301-732, -301-733, -301-742, -301-743, -301-750, -301-761, -301-764.

Analysis:

Diversion Designs

Additional pages have been proposed for Exhibit 13, Appendix D. These pages show the disturbed area culvert designs for C-18, C-19, C-23, C-25, C-26, C-27, and C-28. C-18, C-19, and C-23 are designed to convey the 25-year, 24-hour storm event, and C-25, C-26, C-27, and C-28 are designed for the 10-year, 6-hour storm event. Culverts C-26, C-27 and C-28 are referred to as culverts CGC-10, CGC-9 and CGC-11, respectively, in the text and on the maps. Table 13-11 has been updated to include culverts C-18, C-19, C-23, C-24, and C-25. C-24 is shown on Map 23E-1, in Table 13-11 and designs are in Appendix F.

The locations of Culverts C-18, C-19 and C-25 are shown on Maps 23D-1 and 23E-1. The remaining Culverts are not shown on any map. A culvert noted on Map 23D-1 at the Existing Box Culvert is not design as an operational culvert.

Sediment Pond Design

Sediment Pond 003 will not be constructed as part of the Willow Creek Mining operation because of the construction of railroad tracks in the location it was proposed. Cyprus Plateau Mining Company (CPMC) will replace sediment control initially intended for this area by increasing the containment volume of Sediment Pond 12B. The designs for Sediment Pond 12A and 12B are found in Exhibit 13 along with the other sediment pond designs. Appendix A-3 of Exhibit 13 (formerly "Sediment Pond 003 Calculations") contains the hydrologic modeling for Sediment Ponds 12A and 12B. These ponds are designed to treat the 10-year, 24-hour storm runoff and sediment accumulations for three years.

Findings:

The operational hydrologic information for the railroad modifications package is complete and accurate.

MAPS, PLANS, AND CROSS SECTIONS OF MINING OPERATIONS

Regulatory Reference: 30 CFR Sec. 784.23; R645-301-512, -301-521, -301-542, -301-632, -301-731, -302-323.

Hydrology Maps

Analysis:

Many maps have been submitted as part of this amendment. Some of the maps are replacing and updating previous versions while a few are new to the plan. In many cases the updated maps are black and white versions of color originals. These maps are difficult to read because the color was often important in identifying different characteristics.

Findings:

The maps and plans are complete and accurate for the railroad modification package.

RECOMMENDATIONS

The hydrologic information provided in this amendment should be approved. Analysis on bank stability is reliant on the reviews completed by a Division Engineer.

blb
CC: Daron Haddock, DOGM Permit Supervisor
Pete Hess, DOGM Reclamation Specialist
Randy Harden, DOGM Reclamation Engineer
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LIST OF MAPS

EXHIBIT 13

DRAINAGE AND SEDIMENT CONTROL PLAN
WILLOW CREEK MINE

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SUPERSEDED
EFFECTIVE:
NOV 06 1996
UTAH DIVISION OIL, GAS AND MINING

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1.0 GENERAL INTRODUCTION

1.1 INTRODUCTION

Cyprus Plateau Mining Corporation (CPMC) proposes to develop a new mine complex, designated as the Willow Creek Mine, in an area of known coal reserves east and south of the old town of Castle Gate in Carbon County, Utah. These coal reserves are located within the old permit boundary of the Price River Coal Company. Prior to the Cyprus Plateau Mining Corporation's proposed mine development permit application, the eastern coal reserve area of the old Price River Coal Company permit was controlled by the Blackhawk Coal Company (Blackhawk). Blackhawk designated the area as the Willow Creek Area in an effort to separate their holdings from the western portion of the old Price River Coal Company permit. By 1989, coal mining operations had ceased in the Willow Creek area and Blackhawk filed a Final Closure Plan with Utah Division of Oil, Gas and Mining (UDOGM). CPMC proposes to develop this new mine on lands were there has been significant previous mining activity, utilizing an existing face-up area, associated portals, access tunnels, coal preparation plant, and loadout facilities to the extent feasible.

The mine development plan involves underground mine portals on the north side of State Highway 191; transfer conveyors, a mine mouth coal stockpile; a raw coal transportation system between the mine mouth stockpile and the existing coal preparation plant facility; mine support facilities including office/bathhouse, maintenance shop, warehouse, open yard storage, electrical distribution system, and miscellaneous ancillary facilities; access and light-use roads; and drainage and sediment control structures.

This Drainage and Sediment Control Plan (Plan) addresses the proposed Willow Creek Mine as required under R645-301-740. The purpose of the Plan is to control surface runoff within, and around, the proposed Willow Creek Mine. By containing overland flows and sedimentation to the mine area, and preventing the mixing of disturbed and undisturbed flows, CPMC should effectively minimize negative environmental impacts to area aquatic resources from mine-related activities and comply with the requirements set forth in R645-301-750.

The proposed Willow Creek Mine facility is primarily situated on the north bank of Willow Creek, just upstream of the confluence with the Price River. The permit area will encompass existing facilities located along the Price River, including the existing Castle Gate preparation plant facilities and loadout. The area is approximately 2 miles north of the city of Helper, Utah. The Mine Surface Facilities Map, (Map 18), shows the general location of the proposed Willow Creek Mine facility. The Castle Gate facilities are covered under a separate permit and are not included in this drainage and sediment control plan. The Castle Gate facilities are discussed in Exhibit 19, Castle Gate Information. The mine surface support facilities will be constructed primarily on previously disturbed lands in the general vicinity of the former Castle Gate No.4 mine. In conjunction with the Blackhawk Closure Plan, portions of the area have undergone varying degrees of reclamation. Approximately 31 acres, of which all but 3.0 acres are located in the Willow Creek drainage, will be affected by the proposed mine and surface support facilities.

Six major (readily identifiable) and several minor ephemeral drainage basins, draining the topography of Willow Creek Canyon upslope of the proposed mine facility, transect the Willow Creek Mine area. The landscape is very rugged and steep. Soils are typically shallow to deep, well drained, gravelly and bouldery sandy loams and extremely bouldery loams. Elevations range from approximately 6,100 feet to 8,200 feet. Hillslopes typically have slopes ranging from 40 to 80 percent. Along Willow Creek, slopes of roughly 1 to 8 percent are common (USDA-SCS, 1988). Runoff from snowmelt and short-duration thunderstorms cause relatively brief, high velocity flows. Approximately 390 acres of undisturbed area are located upslope and adjacent to the proposed mine facility. The undisturbed area is primarily covered with four vegetation communities: pinion-juniper on south and west facing slopes; grass-sagebrush on mid-elevation topography; mixed brush on lower north and east facing slopes and along drainage channels; and mixed conifer stands on higher north-facing slopes (Mariah, 1981).

1.2 ENVIRONMENTAL PROTECTION

CPMC proposes an extensive drainage and sediment control system consisting of sedimentation ponds, diversion ditches, berms, and culverts to control surface runoff within the proposed CPMC - Willow Creek Mine facilities area boundary in order to limit contributions of suspended solids to receiving surface waters of the State. Effluent limitations set by R645-301-751 will not be exceeded since discharge resulting from precipitation from the 10-year 24-hour or smaller storm event will be effectively controlled.

Contributions of sediment to Willow Creek are minimized by diverting drainage from undisturbed area surface runoff around the proposed mine facility. A system of berms and ditches around and within the disturbed areas assure that disturbed-area flows do not mix with undisturbed-area flows. Design criteria for sediment control structures, diversions, and culverts comply with the requirements set forth in R645-301-742.

CPMC proposes to construct two sedimentation ponds and utilize one existing pond to control sediment generated from disturbed areas. All ponds are designed to retain the runoff volume resulting from the 10-year 24-hour storm event, while providing adequate capacity to store the sediment volume generated over three years from the contributing disturbed areas. The retention of storm runoff allows for the removal of suspended sediment particles from the runoff before the runoff is discharged into receiving waters. Temporary diversion ditches, culverts, and sediment pond inflow and outflow structures are designed to carrying peak discharges resulting from the 25-year 24-hour storm event. The typical design criteria used in developing carrying capacity for ditches relies on flow surface area verses ditch depth or width so that even with some sedimentation, the ability of a ditch to convey the design flows in not compromised.

The proposed sedimentation ponds and associated diversion structures have been designed utilizing the SEDCAD$^+$3 (Civil Software Design, 1992) and FlowMaster I (Haestad Methods, Inc., 1990) computer models. This Drainage and Sediment Control Plan discusses the methodology, assumptions, calculations, and results for the proposed Cyprus Plateau Mining Corporation - Willow Creek Mine development.

1.3 MAINTENANCE PROGRAM

Limited maintenance of sedimentation ponds, diversion ditches, and culverts will be required during the intended life of these structures to ensure that they continue to function as designed and to minimize any potential downstream hazards or environmental impacts.

Ponds and associated embankments and spillways, inlet and drainage structures will be inspected for any indications of structural weakness or erosion, and repairs will be made as necessary. Accumulated sediment will be periodically removed from the sedimentation ponds to maintain adequate storage capacities. Diversion ditches, culverts, and pond inlets and spillways may periodically need to be cleaned and repaired to ensure that they operate as designed. CPMC will remove debris from ditches, culverts, inlets, and spillways and will repair any significant erosion as necessary. Vegetation growth on and around pond areas will be cut if necessary to facilitate inspection and repairs.

All inspections will be made by a qualified person designated by the mine operator in accordance with R645-301-514.300.

2.0 WATERSHED CHARACTERISTICS

2.1 AREA OVERVIEW

This section presents the physical characteristics that control the generation of runoff and sedimentation from both undisturbed and disturbed lands. The primary characteristics that determine runoff are the watershed curve number and precipitation amount. Soil type, vegetative cover, and slope steepness tend to control sedimentation.

2.2 WATERSHED CHARACTERISTICS

Drainages in the proposed Willow Creek Mine area were differentiated by whether they are disturbed by the mine operation and/or support facilities. Approximately 31 acres are expected to experience disturbance from mine activities and support facilities. Another 390 undisturbed acres are adjacent to and/or drain through the proposed mine portal and surface support facilities area. In addition to the primary facilities area, CPMC proposes to place the mine and fire water tank facility to the south of Willow Creek and State Highway 191, immediately across the valley from the mine fan facility area. This facility sits in an undisturbed drainage of approximately 425 acres. The disturbed drainage areas for the proposed Willow Creek Mine area are presented on the Facilities Area Hydrology Map, (Map 16). The primary mine area undisturbed watershed boundaries are delineated on the Regional Hydrology Map, (Map 15). Subwatershed boundaries are delineated on Map 16. A summary of disturbed drainage characteristics including acreage, time of concentration, curve number, and sedimentology by drainage area is presented in Table 13-1, Disturbed Drainage Characteristics. The summary of undisturbed drainage characteristics including acreage, time of concentration, and curve number by drainage area is presented in Table 13-2, Undisturbed Drainage Characteristics. Each drainage area is labeled according to whether it is disturbed or undisturbed. Any drainage area contributing to a sedimentation pond was labeled as being disturbed.

The following basin codes are used in this labeling system: Willow Creek - WC and Castle Gate Prep Plant - CG. The letters 'UD' and 'DW' are used to differentiate between predominately undisturbed and disturbed watersheds. Watersheds may be partitioned into subwatersheds based on their drainage configuration. The suffix letter 'a' represents the primary ephemeral channel draining the watershed, and suffix letters 'b', 'c', and 'd' represent secondary ephemeral channels, the suffix numbers 1, 2, 3, and 4 are used to signify a subwatershed of the watershed. These subwatersheds usually are a result of an interruption of the natural overland flow path or a drainage course due to a mining-related disturbance.

The soils of the area have been formed primarily by sedimentary bedrock weathering and colluvium mixed with sedimentary rocks. They vary in response to such host environments as geology, topography, climate, and vegetation (USDA-SCS, 1988). Three general soils types were identified as occurring within the boundaries of the proposed permit area (USDA-SCS, 1988):

- Type 7 - Strych-Gerst-Travessilla: Shallow to very deep, well drained, nearly level to moderately steep soils, on outwash plains, benches and mesas
- Type 10 - Travessilla-Rock outcrop-Midfork family: Shallow to very deep, well drained, steep and very steep soils, and Rock outcrop, on mountain slopes and canyonsides
- Type 14 - Beje-Trag-Senchert: Shallow to very deep, well drained, gently sloping to moderately steep soils, on plateaus and mountain valley floors

The major soil map units found in Willow Creek Mine area include: (1) Map Unit 13 - Cabba family-Guben-Rock Outcrop Complex, (2) Map Unit 47 - Guben-Rock Outcrop Complex, (3) Map Unit 62 - Midford Family-Comodore Complex (4) Map Unit 72 - Pathead-Curecanti Family Association, (5) Map Unit 107 - Shurpert-Winetti Complex, and (6) Map Unit 121 - Travessilla-Rock Outcrop-Gerst Complex (USDA-SCS, 1988). Detailed descriptions of each of the primary soil types and the soil map units as described by the USDA-SCS are contained in Section 3.1, Soils Information, and in Exhibit 5, Soils Information.

TABLE 13-1
DISTURBED WATERSHEDS - DRAINAGE CHARACTERISTICS
(Page 1 of 3)

Drainage[1]	Area (acres)[2]	Time of Concentration[3]	Curve Number[4]	Sedimentology			
				K factor	Average Length (ft)	Average Slope (%)	C factor
WC-DW1a	1.49	0.069	90	0.31	15	40	0.89
WC-DW1b	0.74	0.015	90	0.31	20	47	0.89
WC-DW1c	0.37	0.041	90	0.22	33	1.5	1.05
WC-DW1d	0.37	0.006	90	0.31	15	40	0.89
WC-DW1e	0.66	0.015	90	0.31	28	55	0.89
WC-DW1f	0.29	0.04	90	0.22	33	6.1	1.05
WC-DW2a	0.52	0.026	90	0.31	50	52	0.89
WC-DW2b	0.92	0.041	90	0.22	47	4.3	1.05
WC-DW3a[5]	2.82	0.024	78	0.35	200	71	0.16
WC-DW3b[5]	2.1	0.012	78	0.35	200	75	0.16
WC-DW4a	0.46	0.006	90	0.31	100	42.5	0.89
WC-DW4b	1.91	0.07	90	0.22	150	4.5	1.05
WC-DW4b_1	0.37	0.034	90	0.22	45	1	1.05
WC-DW4c	1.6	0.065	90	0.22	90	1.2	1.05
WC-DW5a	0.98	0.109	90	0.31	50	83	0.89
WC-DW5b	2.91	0.175	90	0.22	135	0.5	1.05
WC-DW6a	0.49	0.001	90	0.35	50	80	0.89
WC-DW6b[6]	0.59	0.003	70	0.28	80	31	0.89
WC-DW6c	0.35	0.01	90	0.22	44	2.3	1.05
WC-DW6d	0.42	0.003	90	0.31	49	54	0.89
WC-DW6e	0.22	0.014	90	0.22	32	4.7	1.05
WC-DW6f	0.48	0.02	90	0.22	55	1.8	1.05
WC-DW7a	0.44	0.004	90	0.22	50	2	1.05
WC-DW7b	0.32	0.023	90	0.22	56	2.7	1.05

TABLE 13-1
DISTURBED WATERSHEDS - DRAINAGE CHARACTERISTICS
(Page 2 of 3)

Drainage[1]	Area (acres)[2]	Time of Concentration[3]	Curve Number[4]	Sedimentology			
				K factor	Average Length (ft)	Average Slope (%)	C factor
WC-DW8a	0.32	0.054	90	0.31	20	50	0.89
WC-DW8b	1.32	0.054	90	0.22	65	3.2	1.05
WC-DW9a	0.61	0.044	90	0.22	170	4.3	1.05
WC-DW9b	0.65	0.012	90	0.22	125	2.4	1.05
WC-DW10	0.91	0.021	90	0.22	175	8.6	1.05
WC-DW11	0.79	0.03	90	0.22	40	5.5	1.05
WC-DW12	0.64	0.027	90	0.22	40	5	1.05
WC-DW13	0.18	0	90	0.22	50	8	1.05
WC-DW14a	0.1	0	90	0.31	4	50	0.89
WC-DW14b	0.32	0.021	90	0.22	30	67	1.05
WC-DW14c	0.88	0.008	90	0.31	25	64	0.89
WC-DW15a	0.44	0.004	90	0.22	60	3.3	1.05
WC-DW15b	0.24	0.008	90	0.31	45	89	0.89
WC-DW16a	0.36	0.007	90	0.31	80	83	0.89
WC-DW16b_1	0.24	0.1	90	0.22	38	5.3	1.05
WC-DW16b_2	0.13	0.009	90	0.22	38	5	1.05
WC-DW16c	0.32	0.018	90	0.22	60	1.7	1.05
WC-DW16d	0.35	0.009	90	0.35	100	86	0.89
WC-DW16e	1.13	0.012	90	0.35	50	75	0.89
WC-DW16f	0.32	0.034	90	0.22	30	2.7	1.05
CG-DW17a[7]							
CG-DW17b	0.6	0.025	90	0.22	25	2	1.05
CG-DW17c_1	1.71	0.033	90	0.31	30	57	0.89
CG-DW17c_2	0.4	0.03	90	0.31	55	78	0.89

TABLE 13-1
DISTURBED WATERSHEDS - DRAINAGE CHARACTERISTICS
(Page 3 of 3)

Drainage[1]	Area (acres)[2]	Time of Concentration[3]	Curve Number[4]	Sedimentology			
				K factor	Average Length (ft)	Average Slope (%)	C factor
WC-DW18a	0.54	0.061	90	0.22	25	4	1.05
WC-DW18b	0.5	0.068	90	0.22	25	4	1.05
WC-DW18c	0.44	0.035	90	0.22	51	1.3	1.05
WC-DW18d	0.2	0.014	90	0.22	28	0.5	1.05
WC-DW19[8]	1.2	0.008	84	--	--	--	--

NOTES:

(1) WC represents Willow Creek area which are drainages of Willow Creek; CG represents Castle Gate area which are drainages of the Price River
(2) Areas measured directly from a 1" = 50' computer generated map
(3) Time of Concentration (T_c) calculated by SEDCAD3 computer model
(4) Curve numbers for disturbed drainage calculated as 90, unless noted otherwise
(5) Disturbed drainages DW-3a and DW-3b are the undisturbed steep slopes immediately above the mine face-up area
(6) Drainage DW-6b is run-of-mine stockpile
(7) Disturbed drainage DW-17a deleted; drainage combined with CG-UDW2b
(8) Disturbed drainage DW19 does not drain to a Sedimentation Pond, sediment control utilizes a silt fence structure.

TABLE 13-2
UNDISTURBED WATERSHEDS - DRAINAGE CHARACTERISTICS
(Page 1 of 2)

Watershed[1]	Area (acres)[2]	Time of Concentration (hours)[3]	Curve Number[4]
CGWS-U6[5]	52.11	0.181	78
CGWS-U7[5]	5.96	0.108	82
CG-UD2a	13.7	0.079	75
CG-UD2b	2.6	0.085	73
CG-UD2c	4.2		73
WC-UD3a_1	10.8	0.035	75
WC-UD3a_2	0.82	0.020	72
WC-UD3a_3	2.58	0.026	74
WC-UD3b	5.5	0.016	74
WC-UD4a_1	61.5	0.110	77
WC-UD4a_2	0.7	0.026	76
WC-UD4a_3	0.2	0.007	77
WC-UD4a_4	0.07	0.004	68
WC-UD4b_1	7.6	0.064	75
WC-UD4b_2	3.8	0.026	73
WC-UD5a	19.1	0.064	76
WC-UD5a_1	3.8	0.043	78
WC-UD5a_2	2.1	0.032	77
WC-UD5b_1a	5.5	0.037	77
WC-UD5b_1b	1.2	0.03	77
WC-UD5b_1c	0.74	0.029	78
WC-UD5b_2a	4.9	0.032	75
WC-UD5b_2b	0.44	0.010	75
WC-UD5b_2c	0.69	0.011	78
WC-UD5b_3a	0.30	0.021	76
WC-UD5b_3b	0.36	0.024	74
WC-UD5c_1	5.5	0.03	77
WC-UD5c_2	0.35	0.022	76
WC-UD5d	3.5	0.05	77
WC-UD5d_1	0.54	0.023	76

TABLE 13-2
UNDISTURBED WATERSHEDS - DRAINAGE CHARACTERISTICS
(Page 2 of 2)

Watershed[1]	Area (acres)[2]	Time of Concentration (hours)[3]	Curve Number[4]
WC-UD5d_2	0.35	0.012	77
WC-UD6a	127.6	0.204	76
WC-UD6a_1	2.42	0.046	73
WC-UD6b	17.0	0.092	74
WC-UD6c	2.03	0.028	74
WC-UD7	407.8	0.501	69
WC-UD7a	4.8	0.045	68
WC-UD7b	1.8	0.027	70
WC-UD7c	10.6	0.047	68

Notes:
(1) CG represents Castle Gate area which are drainages of the Price River; WC represents Willow Creek area which are drainages of Willow Creek
(2) Areas measured directly from computer generated maps
(3) Time of Concentration (T_c) calculated by SEDCAD3
(4) Curve numbers from Table EXDS-3, Willow Creek Area - Undisturbed Area Curve Numbers
(5) Source CGMC (1994)

The vegetation found in the area is typical of the inter-mountain plateau region. The north facing slopes of the Willow Creek permit area are primarily vegetated with mixed conifer stands interspersed with mountain brush. South-facing slopes are primarily vegetated with pinion-juniper, grass-sagebrush, and mixed mountain brush communities (Mariah, 1981; CPMC, 1995). Extensive areas of ledges and rock outcrops which typify the Book Cliffs result in many areas which lack any significant vegetation. In the area of the proposed mine surface facilities, previous surface disturbance resulted in an additional disturbed vegetation category being identified. The percentage of an undisturbed watershed covered by a particular vegetation community was determined by direct measurement from a 1 inch equals 2,000 feet scale computer generated map. The Regional Vegetation Map, (Map 5), shows the vegetation community matrices for the proposed mine area. Table 13-3, Willow Creek Area - Undisturbed Area Curve Numbers, summarizes the vegetative community composition for the undisturbed watersheds. Mariah and Associates (1981) established representative vegetation cover densities for the vegetation communities in the area. Table 13-4, Willow Creek Area Vegetative Cover, summarizes the average percent cover for the four primary communities found in the undisturbed area. A fifth community, disturbed vegetation, was identified on lands experiencing previous mining and reclamation activities. During the fall of 1994, CPMC, completed a vegetative survey that examined the cover condition of the previously disturbed areas. The location of the disturbed vegetation is displayed on The Facilities Area Vegetation Map, (Map 6). The disturbed vegetative community was identified as herbaceous, with total cover ranging from roughly 28 percent to 39 percent.

The mean annual precipitation for the Willow Creek area is approximately 14.84 inches. Average monthly precipitation ranges from 0.65 inches in June to 1.86 inches in September, with precipitation amounts spread uniformly over the year (Utah State University, 1994). Precipitation falling as rainfall, commonly high-intensity short-duration storms of limited aerial extent (Butler and Marsell, 1972), occurs during spring, summer and fall. Precipitation depths from a storm event of interest at the proposed Willow Creek Mine were determined by averaging the long-term estimated depth for the desired storm from three surrounding meteorological stations, Hiawatha, Price and Scofield Dam climatological stations (Richardson, 1971).

$$PPT_{WC} = PPT_{Hi} + PPT_{Pr} + PPT_{ScD}/3$$

where:
- PPT_{WC} = estimated precipitation at Willow Creek for the desired storm event
- PPT_{Hi} = estimated precipitation at Hiawatha for that storm event
- PPT_{Pr} = estimated precipitation at Price for that storm event
- PPT_{ScD} = estimated precipitation at Scofield Dam for that storm event

Precipitation amounts for the 10-year 6-hour, 25-year 6-hour, and 25-year 24-hour storm events were estimated to be 1.38, 1.66, and 2.44 inches, respectively. Table 13-5, Estimated Return Periods for Short-Duration Precipitation displays the precipitation data from the three regional climatological stations used to develop Willow Creek area estimated precipitation amounts.

According to the U.S. Soil Conservation Service (1972), the algebraic and hydrologic relations between storm rainfall, soil moisture storage, and runoff can be expressed by the equations:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

and

$$S = \frac{1000}{CN} - 10$$

where,
- Q = direct runoff volume (inches)
- S = watershed storage factor
- P = accumulated precipitation (inches)
- CN = runoff curve number (dimensionless)

TABLE 13-3
WILLOW CREEK AREA - UNDISTURBED DRAINAGE AREA CURVE NUMBERS
(Page 1 of 2)

Watershed	Area (acres)[1]	Percent Pinion-Juniper	Percent Grass-Sagebrush	Percent Mixed Brush	Percent Conifer	Percent Disturbed[1]	Area-Weight CN
CG-U2a	13.7	60	28	12	-	-	75
CG-U2b	2.6	40	38	22	-	-	73
CG-U2c	4.2	40	38	22	-	-	73
WC-U3a_1	10.8	65	25	10	-	-	75
WC-U3a_2	0.82	20	55	25	-	-	72
WC-U3a_3	2.58	50	36	14	-	-	74
WC-U3b	5.5	46	36	18	-	-	74
WC-U4a_1	61.5	48	8	7	22	15	77
WC-U4a_2	0.7	-	65	-	-	35	76
WC-U4a_3	0.2	-	55	-	-	45	77
WC-U4a_4	0.07	-	25	75	-	-	68
WC-U4b_1	7.6	65	26	9	-	-	75
WC-U4b_2	3.8	40	36	24	-	-	73
WC-U5a	19.1	70	15	12	-	3	76
WC-U5a_2	3.8	16	43	-	-	41	78
WC-U5a_3	2.1	-	62	-	-	38	77
WC-U5b_1a	5.5	75	25	-	-	-	77
WC-U5b_1b	1.2	77	18	-	-	5	77
WC-U5b_1c	0.74	-	50	-	-	50	78
WC-U5b_2	4.9	30	60	-	-	10	75
WC-U5b_2b	0.44	15	65	-	-	20	75
WC-U5b_3a	0.30	-	55	10	-	35	76
WC-U5b_3b	0.36	-	50	20	-	30	74
WC-U5b_2c	0.7	-	50	-	-	50	78
WC-U5c	5.5	65	30	-	-	5	77
WC-U5c_1	0.35	-	55	10	-	35	76
WC-U5d	3.5	71	21	-	-	8	77

TABLE 13-3
WILLOW CREEK AREA - UNDISTURBED DRAINAGE AREA
CURVE NUMBERS
(Page 2 of 2)

Watershed	Area (acres)[1]	Percent Pinion-Juniper	Percent Grass-Sagebrush	Percent Mixed Brush	Percent Conifer	Percent Disturbed[1]	Area-Weight CN
WC-U5d_1	0.54	-	55	10	-	35	76
WC-U5d_2	0.35	-	45	10	-	45	77
WC-U6a	127.6	72	16	12	-	-	76
WC-U6a_1	2.4	-	30	60	10	-	73
WC-U6b	17	51	25	24	-	-	74
WC-U6c	2.03	-	10	65	10	15	74
WC-U7	408	10	20	40	30	-	69
WC-U7a	4.8	-	30	50	20	-	68
WC-U7b	1.8	8	50	40	2	-	70
WC-U7c	10.6	-	30	50	20	-	68

(1) Areas directly measured from 1" = 50' and 1" = 2000' computer generated map
(2) Percentages of vegetative cover directly measured from 1" = 2000' computer generated map
(3) Areas identified as previously disturbed by prior land use activities; curve number of 84 used for previously disturbed drainage (based on herbaceous cover, poor condition; Haan, et al., 1994)

TABLE 13-4 WILLOW CREEK AREA VEGETATIVE COVER		
Vegetative Community	**Cover Condition**	**Percent Cover**
Grass-Sagebrush Reference Area	vegetation bareground/litter	40 27
Mixed Brush Reference Area	vegetation bareground/litter	41 24
Conifer Reference Area	vegetation bareground/litter	74 6
Pinion-Juniper Reference Area	vegetation bareground/litter	53 10
Table adapted from Mariah, 1981		

TABLE 13-5
ESTIMATED RETURN PERIODS FOR SHORT DURATION PRECIPITATION

Station: Price Elevation: 5680
Latitude: 39° 37′ Longitude: 110° 50′

Return Period (Years)	Duration									
	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
1	.08	.13	.17	.23	.29	.37	.44	.62	.78	.95
2	.12	.18	.23	.32	.40	.49	.58	.80	1.00	1.20
5	.16	.25	.32	.44	.56	.68	.79	1.07	1.32	1.58
10	.20	.31	.39	.54	.68	.81	.94	1.25	1.53	1.82
25	.24	.37	.47	.65	.82	.98	1.13	1.50	1.83	2.18
50	.28	.43	.54	.75	.95	1.12	1.29	1.71	2.08	2.47
100	.31	.49	.62	.85	1.08	1.27	1.45	1.91	2.32	2.74

Station: Hiawatha Elevation: 7230
Latitude: 39° 29′ Longitude: 111° 01′

Return Period (Years)	Duration									
	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
1	.03	.04	.05	.07	.09	.24	.39	.76	1.09	1.43
2	.07	.10	.13	.18	.23	.40	.55	.95	1.30	1.67
5	.13	.20	.25	.35	.44	.62	.79	1.22	1.60	2.00
10	.16	.25	.31	.43	.55	.75	.93	1.40	1.82	2.25
25	.23	.35	.44	.62	.78	.99	1.19	1.69	2.14	2.60
50	.26	.40	.50	.70	.88	1.11	1.33	1.89	2.38	2.90
100	.31	.48	.60	.84	1.06	1.30	1.54	2.12	2.64	3.18

Station: Scofield Dam Elevation: 7630
Latitude: 30° 47′ Longitude: 111° 07′

Return Period (Years)	Duration									
	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
1	.15	.23	.29	.40	.51	.58	.65	.81	.96	1.11
2	.17	.27	.34	.47	.60	.69	.78	1.00	1.20	1.40
5	.22	.34	.43	.60	.76	.88	1.00	1.29	1.55	1.82
10	.25	.39	.49	.68	.86	1.00	1.14	1.49	1.80	2.12
25	.31	.48	.60	.84	1.06	1.23	1.39	1.80	2.16	2.54
50	.33	.51	.64	.89	1.13	1.33	1.52	2.00	2.43	2.87
100	.36	.55	.70	.97	1.23	1.46	1.67	2.21	2.69	3.19

The curve number (CN) designates the runoff potential for a watershed and depends on: (1) Soil type, (2) Hydrologic Soil Group (HSG), (3) Vegetation type, condition, and hydrologic properties, and (4) Professional judgement. The CN for each undisturbed area was determined using an area-weighted average.

The assumptions and methodology used in determining the watershed area-weighted average curve number are described in detail in the following section.

Soils in the area are generally moderately deep to very deep, well drained, moderately permeable gravelly and bouldery sands (moderately course texture); however, runoff is generally rapid (USDA-SCS, 1988). The USDA-SCS (1972) defined soil characteristics associated with a Hydrologic Soil Group as: HSG Type B soils - *these soils have a moderate infiltration rate when thoroughly wet; are moderately deep, well-drained soils of moderately fine to course texture*; and, HSG Type C soils - *these soils have a slow infiltration rate when wet; are moderately deep, well-drained soils of moderately fine to moderately course texture.* Previously, soils in the area were identified as HSG Type C (CGMC Mining and Reclamation Permit, p.700-118). The soil map units identified within and adjacent to the proposed mine facility are typically moderately deep to deep, well drained soils of moderately fine to course texture (USDA-SCS, 1988). These soil characteristics suggest a Type B Hydrologic Soil Group. However, the considerable amount of rock outcrop and steep topography present in the area potentially reduces infiltration rates. Based on the soil characteristics, the topography, previous USDA-SCS and others soil investigations, and the current mapping information, an average of Hydrologic Soil Groups B and C was evaluated to determine an appropriate curve number for an undisturbed watershed. The average of hydrologic soil groups B and C appears to adequately describe the conditions of the Willow Creek area. However, due to the steepness of slopes and the occurrence of rock outcrops, CPMC choose a conservative approach and analyzed the undisturbed watershed runoff using a Type C hydrologic soil group for the runoff calculations.

The USDA-SCS also classifies vegetative covers by their hydrologic properties. A native arid and semiarid range/ pasture community, heavily grazed or having plant cover on less than 30 percent of the area is considered poor; while moderately grazed lands with 30 to 70 percent total cover are considered fair; and, total cover greater than 70 percent signifies good condition. Woodlands grazed, but not burned, with some litter cover are considered fair; while those protected from grazing with litter and brush adequately covering the soil are considered good (USDA-SCS, 1986). Table 13-4, Willow Creek Area Vegetative Cover, summarizes reference site percent cover for the four dominate area undisturbed vegetative communities. The vegetative cover in the area is generally about 50 percent (Mariah, 1981), and most landscapes are not suitable for grazing (USDA-SCS, 1988). Vegetative cover studies conducted by CPMC in 1994 suggest that total plant cover for the two dominate disturbed communities found in the proposed mine facilities area averaged roughly 33 percent. Based on the vegetative cover studies conducted by Mariah (1981) and CPMC (1994), an average hydrologic condition of poor/fair for the pinion-juniper, sage-grassland, and mixed brush communities in the Willow Creek area was used in the analysis of the hydrologic condition for determining an average watershed-specific curve number. The cover studies suggest that an average fair/good hydrologic condition describes the mixed conifer community. However, CPMC used a conservative approach, also calculating the conifer community hydrologic condition as an average of poor/fair. Table 13-6, Runoff Curve Numbers for Arid and Semiarid Rangelands displays typical curve number values for western inter-mountain rangelands based on the hydrologic condition and hydrologic soil group. Table 13-7, Willow Creek Area - Average Vegetative Community Curve Numbers shows the appropriate curve number for the Willow Creek Area vegetative communities based on the conservative estimates of hydrologic condition and hydrologic soil group. Table 13-3, Willow Creek Area - Undisturbed Area Curve Numbers summarizes the area-weighted curve numbers for the undisturbed watersheds. The watershed area-weighted average curve number is determined on the basis of the percentage of a vegetative community with the hydrologic soil group and hydrologic condition described found within the watershed. Curve numbers ranging from 68 to 78 were obtained for the various undisturbed watershed areas.

The curve number for disturbed areas was based on professional judgement and tabulated values presented by the USDA-SCS (1972). A value of 90 was used to determine runoff from areas heavily disturbed by mine area facility construction and grading. Several of the disturbed drainages incorporated area that was previously disturbed. These watersheds are primarily covered with herbaceous vegetation, of poor hydrologic condition with Type C hydrologic soil group soils. These previously disturbed areas were assigned a curve number value of 85. While portions of disturbed drainages may experience minimal disturbance, CGMC used the conservative value of 90 for disturbed area drainages, with three exceptions. The run-of-mine stock-pile was assigned a value of 70 and two undisturbed areas, immediately upslope of the portal area, (WC-DW3a and WC-DW3b), that drain to Sediment Pond 001 had a calculated curve number value of 78.

TABLE 13-6
RUNOFF CURVE NUMBERS FOR ARID AND SEMIARID RANGELANDS

Cover	Hydrologic Condition[1]	Hydrologic Soil Group			
		A[2]	B	C	D
Herbaceous[3]	Poor Fair		80 71	87 81	93 89
Oak-Aspen[4]	Poor Fair		66 48	74 57	79 63
Pinyon-Juniper[5]	Poor Fair		76 58	85 73	89 80
Sagebrush[6]	Poor Fair		67 51	80 63	85 70
Woods[7]	Poor Fair Good		66 60 55	77 73 70	83 79 77

Notes: Source Soil Conservation Service (1986)

(1) Poor: <30% ground cover (litter, grass, and brush overstory); Fair: 30 70% ground cover; Good: >70% ground cover.
(2) Curve numbers for Group A have not been developed for these vegetative communities in arid and semiarid rangelands.
(3) Mixture of grass, weeds, and low-growing brush overstory.
(4) Mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.
(5) With grass understory.
(6) With grass understory.
(7) Curve numbers for woods in a semiarid environment not developed, numbers presented from *Other Agricultural Lands*; Poor: forest litter, small trees, and brush destroyed by heavy grazing or regular burning; Fair: woods are grazed but not burned, and some forest litter covers the soil; Good: woods protected from grazing, and litter and brush adequately cover the soil.

TABLE 13-7
WILLOW CREEK AREA - VEGETATIVE COMMUNITY AVERAGE CURVE NUMBER[1]

Vegetation Community[2]											
Pinion-Juniper			**Sagebrush-Grass**			**Mixed Brush**			**Conifer**		
	Hydrologic Soil Group			**Hydrologic Soil Group**			**Hydrologic Soil Group**			**Hydrologic Soil Group**	
HC[3]	B	C	HC	B	C	HC	B	C	HC	B	C
Poor	75	83	Poor	67	80	Poor	66	74	Poor	66	77
Fair	58	73	Fair	51	63	Fair	48	57	Fair	60	73
Average CN[4] = 78			Average CN = 72			Average CN = 66			Average CN = 75		

Notes:
(1) Curve numbers taken from Table EXDS-6, Runoff Curve Numbers for Arid and Semiarid Rangelands.
(2) Undisturbed area vegetative communities identified by Mariah (1981) and CGMC (1995).
(3) HC is hydrologic condition.
(4) Average CN based on C hydrologic soil group for poor/fair hydrologic conditions for Pinion-Juniper, Sagebrush-grass, mixed brush, and conifer communities.

3.0 DESIGN METHODOLOGY AND ASSUMPTIONS

3.1 DESIGN OVERVIEW

This section presents the assumptions and methodology used to perform hydrologic and hydraulic calculations for drainage and sediment control within the proposed Willow Creek Mine area. The hydrologic calculations presented below consist of the determination of runoff volume, peak runoff discharges, watershed sediment erosion and sediment pond storage capacities. The hydraulic calculations presented for designing temporary diversions, permanent stream channels, and temporary spillways are discussed. Riprap design methods are also discussed.

All runoff and sedimentology calculations were performed utilizing the SEDCAD^{+}3 (SEDCAD) computer model designed by Civil Software Design. Drainage ditch sizing design utilized the FlowMaster I (FlowMaster) computer model developed by Haestad Methods, Inc.

SEDCAD is a hydrologic, hydraulic, and sediment calculation model designed for the use on a PC system. The SEDCAD hydrologic model calculates runoff volume and peak flow via a numerical modeling technique based on user inputs of a design storm event, (i.e., precipitation frequency data, selection of rainfall distribution, and convolution increment).

3.2 SEDCAD^{+} 3 HYDROLOGIC COMPUTER MODEL

Calculations for the watershed analysis were performed utilizing the SEDCAD Computer Model developed by Civil Software Design. SEDCAD modeling printouts are included in Appendices A and B for disturbed and undisturbed drainages, respectively.

SEDCAD is a hydrologic, hydraulic and sediment calculation model designed for use on computer systems. The SEDCAD hydrologic model calculates runoff volume, and peak flow via a numerical modeling technique based on user inputs of a design storm event, (i.e., precipitation frequency data, selection of rainfall distribution, and convolution increment). Hydrographs are developed on a subwatershed basis with the input of area, time of concentration, USDA-SCS Curve Number, and the selection of a hydrograph shape. Routing of hydrographs is accomplished by the Muskingum Method.

Inputs to the hydrology component of the SEDCAD Computer Model include:

- Precipitation Distribution
- Storm Duration
- Return Period/Precipitation
- Hydrograph Response Shape
- Drainage Basin Area
- Time of Concentration
- Muskingum Routing Parameters
- Curve Number

Input values used in this model, are shown on the SEDCAD printouts and are explained in the following text of this exhibit.

Precipitation Distribution

A precipitation distribution is input to model the run-off hydrograph. SEDCAD allows the user to choose between the USDA-SCS Type I and Type II and 6-hour storms. Type II storm distribution is designed for use in all areas of the western continental U.S. except for the coastal side of the Sierra Nevada and Cascade Mountains. The USDA-SCS Type II distribution was used for the 25-year 24-hour and 10-year 24-hour storms, and the USDA-SCS 6-hour distribution was used for the 25-year 6-hour and 10-year 6-hour storms.

Storm Duration

Storm durations of both 24 hours and 6 hours were used to model the watersheds for the proposed Willow Creek Mine.

Return Period/Precipitation

A precipitation amount is required for the appropriate return period. The following precipitation amounts were used for Willow Creek Mine area:

10-year, 6-hour event	1.38 inches
25-year, 6-hour event	1.66 inches
10-year, 24-hour event	2.06 inches
25-year, 24-hour event	2.44 inches

The precipitation amounts were obtained by averaging the estimated precipitation amount for the desired storm event from three regional climatological stations. Table 13-5, Estimated Return Periods for Short-Duration Precipitation displays the precipitation values for Hiawatha, Price, and Scofield Dam climatological stations (Richardson, 1971), the three regional stations used to develop the estimated precipitation amounts at Willow Creek for the design storms of interest.

Hydrograph Response Shape

A unit hydrograph is chosen for each drainage area or sub-area model to predict the run-off response. The hydrograph responses available in the SEDCAD model are slow, medium, and fast. A slow response corresponds to a forested area or an area with a number of obstructions. A fast response corresponds to an unvegetated or poorly protected area. Fast and medium hydrograph responses were chosen for disturbed and undisturbed areas, respectively.

The internal convolution increment is 0.05 hours and values are saved at the user specified interval of 0.1 hours or greater. A convolution increment of 0.1 was specified for the Willow Creek Mine. It should be noted that a time of concentration less than 0.125 hours bypasses the unit hydrograph technique and instantaneous run-off is assumed. As explained in the SEDCAD User's Manual (Schwab and Warner, 1987, page 113), the time of concentration restriction of 0.125 hours is somewhat mandated due to a combination of array size restrictions, minimum internal convolution interval, and the user specified time increment for saving convoluted values.

Drainage Basin Area

The watershed boundaries for the primary undisturbed drainages were determined by direct measurement from a 1" = 2000' scale computer-generated map. The undisturbed subwatershed boundaries were determined by direct measurement from a 1" = 50' scale map. The drainage areas for the disturbed areas were determined by direct measurement from a 1" = 50' scale map.

Time of Concentration, T_c

The time of concentration was calculated using the USDA-SCS upland method (a utility of SEDCAD). All hydraulic lengths, drainage heights and slopes were measured directly from 1" = 2000', 1" = 400' scale and 1" = 50' scale computer-generated maps. Table 13-1, Disturbed Drainage Characteristics, and Table 13-2, Undisturbed Drainage Characteristics, shows drainage T_c values. The hydraulic lengths and slopes used are included with the SEDCAD printouts in Appendices A and B, Disturbed and Undisturbed SEDCAD Modeling. The calculated T_c values for each structure are also shown on the SEDCAD printouts.

Muskingum Routing Parameters, K, X

The Muskingum Routing Parameters were calculated using the USDA-SCS upland method. All hydraulic lengths, drainage heights and slopes were measured directly from the 1" = 2000', 1" = 400' and 1" = 50' scale computer-generated maps. Values for hydraulic lengths, drainage heights, and slope are summarized in the SEDCAD printouts. The values calculated between each junction and/or subwatershed are also shown in the SEDCAD printouts.

Curve Number, CN

The USDA-SCS Curve Number designates the runoff potential of an area. Curve numbers were approximated based on hydrologic soil type, as well as type and amount of ground cover. Curve numbers were determined for the following conditions.

Soils identified within and adjacent to the proposed Willow Creek Area are generally moderately deep to deep, well-drained, moderately permeable gravelly and bouldery sands (moderately course texture), and runoff is moderately rapid to rapid (USDA-SCS, 1988). The USDA-SCS (1972) defined soil characteristics associated with a Hydrologic Soil Group as: HSG Type B soils - *these soils have a moderate infiltration rate when thoroughly wet; are moderately deep, well-drained soils of moderately fine to course texture*; and, HSG Type C soils - *these soils have a slow infiltration rate when wet; are moderately deep, well-drained soils of moderately fine to moderately course texture*. Previously, soils in the western reserves area were identified as HSG Type C (CGMC Permit, p.700-118). The physical characteristics of Willow Creek area soils (moderately deep, well-drained gravelly and bouldery sandy loams) suggest that they are hydrologic soil group Type B soils. Several area soils HSG were previously identified in the National Engineering Handbook, Hydrology, Section 4 (USDA-SCS, 1972). The USDA-SCS classified Curecanti and Winetti soils as Type B HSG soils and the Shupert soils as a Type A HSG soil. The Comodore was classified as a Type B soil and the Travessilla was classified as a Type D soil (USDA-SCS, 1986). Based on the soil characteristics, the topography, previous USDA-SCS and others soil investigations, and the current mapping information, an average of Hydrologic Soil Groups B and C was evaluated to determine an appropriate curve number for an undisturbed watershed. The studies and soils information suggest that the average of hydrologic soil types of B and C adequately describes hydrologic soil types of the Willow Creek area. However, the considerable amount rock outcrop and steep topography present in the area potentially reduces infiltration rates. To compensate for the steepness of slopes and the occurrence of rock outcrops, CPMC choose a conservative approach and analyzed the undisturbed watershed runoff using a Type C hydrologic soil group for the runoff calculations.

The hydrologic condition of a vegetative communities also were used in determining watershed curve numbers. The USDA-SCS classifies vegetative covers by their hydrologic properties. A native arid and semiarid range/pasture community, heavily grazed or having plant cover on less than 30 percent of the area is considered poor; while moderately grazed lands with 30 to 70 percent total cover are considered fair; and, total cover greater than 70 percent signifies good condition. Woodlands grazed, but not burned, with some litter cover are considered fair; while those protected from grazing with litter and brush adequately covering the soil are considered good (USDA-SCS, 1986). Table 13-4, Willow Creek Area Vegetative Cover, summarizes reference site percent cover for the four dominate area undisturbed vegetative communities. The vegetative cover in the area is generally about 50 percent (Mariah, 1981), and most landscapes are not suitable for grazing (USDA-SCS, 1988). Vegetative cover studies conducted by CPMC in 1994 suggest that total plant cover for the two dominate disturbed communities found in the proposed mine facilities area averaged roughly 33 percent. While vegetation sampling conducted by CPMC during 1994 suggests that the plant communities are successful in establishing native, productive stands, the semiarid short growing season potentially limits vegetative production. Based on the vegetative cover studies conducted by Mariah (1981) and CPMC (1994), an average hydrologic condition of poor/fair for the pinion-juniper, sage-grassland, and mixed brush communities in the Willow Creek area was used in the analysis of the hydrologic condition for determining an average watershed-specific curve number. The cover studies suggest that an average fair/good hydrologic condition describes the mixed conifer community. However, CPMC used a conservative approach, also basing the conifer community hydrologic condition as an average of poor/fair. Table 13-6, Runoff Curve Numbers for Arid and Semiarid Rangelands displays typical curve number values for western inter-mountain rangelands based on the hydrologic condition and hydrologic soil group.

Table 13-7, Willow Creek Area - Average Vegetative Community Curve Numbers shows the appropriate curve number for the Willow Creek Area vegetative communities based on the conservative estimates of hydrologic condition and hydrologic soil group. Table 13-3, Willow Creek Area - Undisturbed Area Curve Numbers summaries the area-weighted curve numbers for the undisturbed watersheds. Curve numbers as determined for the following vegetative communities are:

Vegetative Community	Soil Group	Ground Cover	Cover Condition	CN
Pinion-Juniper	C	53%	poor/fair	78
Grass-Sagebrush	C	40%	poor/fair	72
Mixed Brush	C	41%	poor/fair	66
Conifer	C	74%	poor/fair	75

The percentage of a drainage basin covered by a particular vegetation type was determined by direct measurement from a 1" = 2000' scale computer-generated map. The Regional Vegetation Map, (Map 5), shows vegetation cover for the Willow Creek area. The watershed area-weighted average curve number is determined on the basis of the percentage of a vegetative community with the hydrologic soil group and hydrologic condition described found within the watershed. Curve numbers ranging from 68 to 78 were calculated for the various undisturbed watershed areas.

The curve numbers for the disturbed areas were determined by using tabulated values presented by the USDA-SCS (1986) and professional judgement. Industrial areas (72% impervious) were assigned curve numbers of 88 and 91 for hydrologic soil groups B and C. Gravel roads were assigned curve numbers of 89 and 91 (Haan, et al., 1994). Based on this information, the curve number for heavily disturbed areas was calculated as 90. Several of the disturbed drainages incorporated areas that were previously disturbed, but has undergone subsequent reclamation. These areas are primarily covered with herbaceous vegetation, of poor hydrologic condition with Type C hydrologic soil group soils. Based on information provided by the USDA-SCS (1986), the curve number for these previously disturbed areas was calculated to be 85. While portions of disturbed drainages may experience minimal disturbance, and/or contain disturbed vegetation, CPMC used the conservative curve number value of 90 for all disturbed area drainages, with three exceptions. The run-of-mine stockpile was assigned a value of 70, while the curve number for two undisturbed areas, immediately upslope of the face-up area, whose runoff is being routed through sedimentation ponds were calculated as 78.

3.3 SEDCAD+ SEDIMENTATION COMPUTER MODEL

The calculations to determine the storm sediment yield were performed by the use of the SEDCAD Computer Model developed by Civil Software Design.

The sedimentation program was applied to develop a sedimentation graph using the Revised Universal Soil Loss Equation (RUSLE) and the following input parameters:

$$Y = 95 * (V * Q_p)^{0.56} * K * LS * CP$$

Where:

Y	=	Sediment yield (tons)
V	=	Run off volume (acre-feet)
Q_p	=	Peak discharge (cfs)
K	=	Soil erodibility factor
LS	=	Representative length-slope factor
CP	=	Control practice factor

The length-slope factor for the RUSLE subroutine is as follows:

$$LS = \frac{\lambda^m}{72.6} * (slope\ factor)$$

Where: λ = Representative slope length (ft)
m = 0.6 for slope > 10%
m = 0.5 for 4% < slope ≤ 10%
m = 0.4 for slope = 4%
m = 0.3 for slope < 4%

The slope factor is a piecewise linear relationship with the slope breakpoint at 8% as shown on figure 5.5, Slope Factor for the RUSLE, contained in the SEDCAD$^+$ Users Manual.

The sediment graph is then routed to a structure using an exponential decay procedure incorporating deposition of a particle size distribution.

Inputs for the sedimentology portion of the SEDCAD routine are:

- Particle size distribution
- Runoff volume
- Peak discharge
- Soil erodibility factor
- Representative slope length
- Average slope
- Control practice factor
- Sediment specific weight

Particle Size Distribution

The particle size distribution used for the sedimentation analysis was previously determined for the Castle Gate Preparation Plant area (CGMC-Castle Gate Coal Mine - Mining and Reclamation Plan, 1994). The soils found in the Willow Creek area and the Preparation Plant area exhibit numerous similarities and are of similar types. Previous studies in the Willow Creek Area undertaken by the Blackhawk Mining Company (ACZ, 1989) during the eastern reserve Final Closure Plan support the use of the Preparation Plant particle size distribution. A foundation-soils geotechnical study undertaken by CPMC in 1994 also supports the assumption that the size distribution in the Willow Creek area is similar to the Prep Plant area (TerraMatrix, 1995). However, the particle size analysis was conducted for soils at roughly 10 feet below ground surface, and was not analyzed for size distribution below 0.01 mm.

Runoff Volume, V

The runoff volume is calculated by the SEDCAD computer model during the hydrologic modeling routine.

Peak Discharge, Q_p

The peak discharge is calculated by the SEDCAD computer model during the hydrologic modelling routine.

Soil Erodibility Factor, K

The K factor for the site soils were provided by the regional USDA-SCS office. The average K value for Map Unit 72 is 0.32; for Map Unit 107 the average K value equals 0.31; and for Map Unit 121 the average K value is 0.35 (Leland Sasser, USDA-SCS Soil Scientist, personal communication, 1995). Mine area access roads will be gravelled. Native soils contain a high percentage of sandy loams and a K value of 0.22 (Haan, et al., 1994) was used for those disturbed drainages draining access roads.

Representative Slope Length, λ

The slope length is representative of the typical slope length for a subwatershed. It is the distance from the point of origin of overland flow to the point where the slope decreases such that significant deposition occurs or the flow enters a defined channel. The slope length was measured directly from a 1" = 50' computer generated map.

Average Slope

The average slope is entered as a percent and is the representative slope for overland flow for each subwatershed. The average slope was measured directly from a 1" = 50' computer generated map.

Control Practice Factor, CP

The control practice factor is defined as the ratio of sediment loss from an area with a given cover and conservation practice to that of a field in continuous fallow. The following values (Haan, et al., 1994) were utilized:

Area	Condition	CP
Disturbed	Rough, irregular, tracked in all directions	0.89
Disturbed	Compacted, smooth, gravel surface	1.05
Undisturbed	No appreciable canopy, 30% grass	0.15

Annual sediment yield, V_{annual}

Sediment yields calculated by SEDCAD⁺ for single storm events can be converted to annual yields by the following equation:

$$V_{annual} = \frac{R_{annual}}{R_{storm}} * Y * \frac{1}{SW} * \frac{2000\ lbs/ton}{43.560\ ft^2/acre}$$

Where:
- V_{annual} = Annual sediment volume (acre-feet/year)
- R_{annual} = Annual rainfall factor
- R_{storm} = Single storm rainfall factor
- Y = Settlement yield for 25 year, 24 hour storm event (tons)
- SW = Sediment specific weight (lbs/ft^3)

For a USDA-SCS Type II Storm:

$$R_{annual} = 27 * (P_{2,6})^{2.2}$$

Where: $P_{2,6}$ = 2 year, 6 hour precipitation in inches
= 0.92 inches

$$R_{storm} = \frac{19.25}{D^{0.4672}} * P_{10,24}^{2.2}$$

Where: $P_{25,24}$ = 25 year, 24 hour precipitation in inches
= 2.44 inches
D = Storm Duration = 24 hours

Sediment Specific Weight, SW

The sediment specific weight of a sandy loam is approximately 77.8 lbs/ft_3.

3.4 CHANNEL MODEL

The surface water diversions were sized using Manning's Equation for open channel flow. Side slopes for the channels were generally set at 3H:1V. The slope of the bed was determined from a 1" = 50' computer-generated map.

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Where:
- Q = Peak discharge from storm event (cfs)
- n = Mannings roughness coefficient
- A = Cross sectional area of flow (ft²)
- R = Hydraulic radius (ft)
- S = Channel slope (ft/ft)

A Manning's Roughness Coefficient of 0.035 was used which represents an earthen lined channel with some stones (Haan et. al. 1994). In steep channels with flow velocities greater than 5.0 fps, a Manning's Roughness Coefficient can be approximated (Abt, 1988) based on an average D_{50} :

$$n = 0.0456(D_{50}S)^{0.159}$$

Where:			
	n	=	Manning's roughness coefficient
	D_{50}	=	the riprap diameter in inches such that 50 percent of the stones have a diameter smaller than D_{50}, and 50 percent larger
	S	=	the slope in feet per foot

Rock riprap requirements were determined using the channel utility in the SEDCAD model and the nomographs presented in the Surface Mining Water Diversion Design Manual (OSM, 1982). For moderate slopes (generally less than 10 percent), SEDCAD uses the Simons/OSM method. Simons/OSM bases riprap size on discharge, channel slope, depth of flow and channel geometry. The basic design procedures balances the gravitational and overturning forces of a D_{50} rock riprap particle. However, this method may not be applicable for both very shallow flow and/or steep slopes. The SEDCAD model uses the Pader method (Stover, 1990) for steep channel riprap sizing. Pader sizing is based on the permissible velocity concept and not directly on channel slope. Manning's equation is used and Manning's n is a function of D_{50} and depth of flow. The solution procedure is iterative. The depth of flow, D_{50}, and channel velocity are determined from a combination of a Manning's n - depth of flow equation, the Manning's equation, and the continuity equation of Q=VA.

However, the Pader method appears to be limited on very steep slopes, i.e., greater than 25 percent, especially with shallow flows. For channel slopes greater than about 20 percent and/or low flow rates, the OSM steep slope nomographs were used to determine D_{50} particle size.

3.5 ALTERNATIVE SEDIMENT CONTROL

A series of silt fences and hay bales will be used as alternative sediment control structures to prevent sediment generated by mining-activities that do not discharge into a sedimentation structure from mixing with surrounding undisturbed water without first being treated to remove any excess sediment load. The alternative sediment control structures are designed to safely pass the peak discharge from a 10-year 24-hour storm event.

Given the peak discharge and permissivity of sediment fence, the amount of sediment fence surface area required to safely pass the 10-year 24-hour event peak discharge can be determined as follows:

Sediment Fence Permissivity: 0.033 cfs/ft² or 15 gal/min/ft²
(manufacturer's specification)

Required Surface Area: design storm cfs / 0.033 cfs/ft² = ft²

The required length of fence will be calculated assuming a flow depth of one foot. Actual fence installed should be a minimum of 1.5 feet to allow freeboard and a factor of safety on permissivity.

The sediment fence will be installed in accordance with the manufacturer's recommendations. Once the fences are installed, CMPC will conduct regular inspections and maintenance to insure that they are operating properly.

SUPERSEDED
EFFECTIVE:
NOV 06 1996
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INCORPORATED
EFFECTIVE:
AUG 26 1996
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4.0 STRUCTURE DESIGN

4.1 DRAINAGE AND DIVERSION STRUCTURES

Diversion structures within the proposed Willow Creek surface facilities area include drainage ditches and culverts to convey storm runoff from disturbed and undisturbed drainage areas, and berms to contain disturbed-area drainage. The location of the diversion structures are shown on the Drainage and Sediment Control Plan (Maps 23A through 23F).

The 10-year 6-hour storm is the required storm event for the design of temporary intermittent and perennial diversions (R645-301-742.323). The 25-year 6-hour storm is now the required storm for the design of non-MSHA pond spillways, inflow and outflow structures (R645-301-742.223). To insure an appropriate factor of safety and minimize the risk of design failure, CPMC designed the Willow Creek Area drainage structures to carry the 25-year 24-hour event peak flows. A permanent diversion, UD-28, located in undisturbed drainage WC-UDW7, is designed to carry the 100 year-6 hour storm event. A comparison of peak flow discharge for the 25-year 6-hour event and the 25-year 24-hour event was performed to insure that culverts and ditches were adequately sized.

The typical design criteria used in developing carrying capacity for ditches relies on flow surface area verses ditch depth or width so that even with some sedimentation, the ability of a ditch to convey the design flows is not compromised. The carrying capacity of the diversion ditches and culverts was determined using the FlowMaster and SEDCAD computer models for ditch and culvert designs, respectively.

Ditch Design and Riprap

The drainage ditch cross sections approximate either a trapezoidal or triangular shape. Figure 13-1, Typical Drainage Structure Configuration displays the typical cross sectional shape for earthen diversion ditches. Calculations supporting the design of the ditches were performed using the FlowMaster Computer Model (Haestad Methods, 1990). The 25-year 24-hour storm event was used to design all diversion ditches with one exception. Ditch UD-28 is a permanent diversion in the vicinity of the mine and fire water tank and the 100-year 6-hour event was used to design this ditch. FlowMaster calculates the maximum flow velocities based on the maximum ditch slope. Table 13-8, Disturbed Drainage - Diversion Ditches and Table 13-9, Undisturbed Drainage - Diversion Ditches present summaries of the minimum ditch geometries for disturbed and undisturbed drainage ditches, respectively. Ditch design computer modeling calculations are included in Appendices C and E for disturbed drainage and undisturbed drainage ditches, respectively. Unlined ditches will have a minimum of 0.3 feet of freeboard, while lined (riprapped) ditches will have a minimum of 0.5 feet of freeboard. The freeboard is necessary to prevent overtopping due to sedimentation, additional depth due to a higher roughness coefficient than used in the design, or wave action. Also, certain ditch reaches require design problem considerations to prevent overtopping due to super-elevation. A change in flow direction at ditch bends results in centrifugal forces and a higher water surface elevation on the concave bank. CPMC plans on lining ditch curves and ditch junctions with riprap to reduce the erosive forces of the turbulent flow. Figure 13-3, Typical Channel Bank Riprap Protection displays situations were CPMC will install localized riprap in earthen-lined ditches to prevent ditch instability. Additionally, ditch freeboard will increase from 0.5 feet to 1.0 feet to prevent flow overtopping the ditch.

For diversion ditches with velocities greater than five feet per second (5 fps) the channel will be lined with riprap to protect channel banks from erosion. Figure 13-2, Typical Riprap-lined Drainage Structure Configuration shows the typical cross-sectional shape for riprapped ditches. Applications of riprap include: embankments, channels, energy dissipation structures, and sediment control structures. The primary elements of riprap design are rock durability, rock sizing, riprap gradation, and riprap placement (Fiske, et al., 1994). Channel riprap D_{50} requirements were determined using either the SEDCAD Channel Utility Simons/OSM method or the OSM Steep Slope Riprap Design nomographs. The nomographs are included in Appendix G. The SEDCAD Simons/OSM method provides a conservative estimate of riprap size. The method is applicable for mild slopes (less than 10 percent). Riprap sizing for steeper channels was calculated by either the Pader method (SEDCAD) or with the OSM nomographs. Simons/OSM method riprap calculations are included at the

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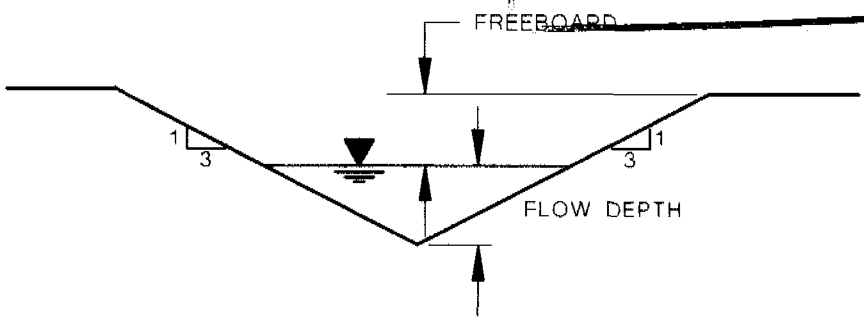
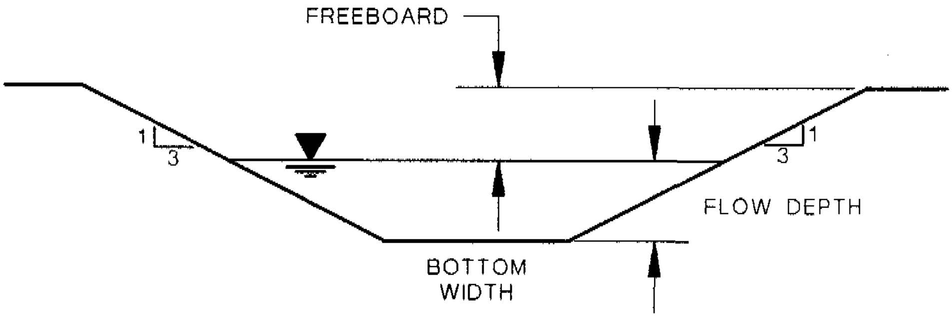


TYPICAL TRIANGULAR CHANNEL SECTION
Not to Scale



TYPICAL TRAPEZOIDAL CHANNEL SECTION
Not to Scale

Project No.: 866-2200	Design By: J. WEINMAN	Scale: AS SHOWN
File: DR-STRUC.DWG	Drawn By: M. MATHISEN	Date: April 1995

TerraMatrix
Engineering & Environmental Services
1475 Pine Grove Road, P.O. Box 774018
Steamboat Springs, Colorado 80477

Figure 13-1

CYPRUS Plateau Mining

TYPICAL EARTHEN DRAINAGE STRUCTURE CONFIGURATION

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DISTURBED DRAINAGE - DIVERSION DITCHES
25-YEAR 24-HOUR STORM EVENT

(Page 1 of 3)

Diversion Ditch	25yr-6hr Ditch Flow (cfs)[1]	25yr-24hr Design Flow (cfs)[1]	Ditch Geometry	Side Slope H:V	Ditch Length (ft)[2]	Ditch Slope (%)	Manning's n	Flow Depth (ft)[3]	Velocity (ft)[3]	Minimum Ditch Depth (ft)[4]	Ditch Top Width (ft)	Minimum Flow Area (sf)[3]	Riprap D_{50} (inches)[5]
DD-1	1.16	2.19	Triangular	3:1	200	0.6	0.035	0.68	1.58	0.98	6	1.58	n/a
DD-1a	1.16	2.19	Triangular	3:1	315	0.4	0.035	0.75	1.34	1.05	6.3	1.64	n/a
DD-2	1.16	2.19	Triangular	3:1	142	6.7	0.035	0.44	3.84	0.74	4.5	0.57	n/a
DD-2a	1.16	2.19	Tirangular	3:1	125	7.8	0.035	0.42	4.07	0.72	4.3	0.54	n/a
DD-3a	0.58	1.09	Triangular	3:1	228	0.33	0.035	0.59	1.04	0.89	5.4	1.04	n/a
DD-3b	0.58	1.09	Triangular	3:1	119	6.3	0.035	0.34	3.15	0.64	3.9	0.35	n/a
DD-4a	0.29	0.54	Triangular	3:1	201	0.37	0.035	0.44	0.91	0.74	4.5	0.59	n/a
DD-4b	0.29	0.54	Triangular	3:1	178	11	0.035	0.24	3.26	0.54	3.3	0.17	n/a
DD-5	1.74	4.37	Triangular	3:1	173	9.8	0.04	0.55	4.77	1.05	6.3	0.92	18
DD-6a	4.05	7.77	Triangular	3:1	198	1	0.035	1	2.59	1.3	7.8	3	n/a
DD-6b	4.05	7.77	Triangular	3:1	336	7.6	0.04	0.72	5	1.22	7.3	1.55	18
DD-7[6]													
DD-8a[6]													
DD-8b	4.05	7.77	Triangular	3:1	618	6.2	0.039	0.74	4.72	1.24	7.4	1.65	12
DD-9a	1.49	2.81	Triangular	3:1	275	0.7	0.035	0.73	1.75	1.03	6.2	1.6	n/a
DD-9b	1.78	3.36	Triangular	3:1	70	1	0.035	0.73	2.1	1.03	6.2	1.6	n/a
DD-10	5.69	11.58	Triangular	3:1	629	0.5	0.035	1.33	2.17	1.63	9.8	5.34	n/a
DD-11	0.76	1.44	Triangular	3:1	704	0.5	0.035	0.62	1.27	0.98	5.9	1.14	n/a
DD-12	1.95	4.79	Triangular	3:1	10	0.5	0.035	0.95	1.77	1.25	7.5	2.71	n/a
DD-12a	1.95	2.34	Triangular	3:1	168	9.5	0.035	0.42	4.46	0.72	4.4	0.53	n/a
DD-12b	1.95	4.79	Triangular	3:1	257	9.5	0.04	0.58	4.82	1.08	6.5	0.99	18
DD-12c	1.95	4.79	Triangular	3:1	328	4.7	0.035	0.63	4.07	0.93	5.6	1.18	n/a
DD-12d	3.08	6.94	Triangular	3:1	514	8.6	0.04	0.67	5.09	1.17	7	1.36	18
DD-12e	3.08	6.94	Triangular	3:1	10	2.5	0.035	0.81	3.54	1.01	6.1	1.96	n/a
DD-13a	0.59	1.12	Triangular	3:1	245	0.4	0.035	0.57	1.14	0.87	5.2	0.98	n/a
DD-13b	0.59	1.12	Triangular	3:1	202	3.7	0.035	0.38	2.6	0.68	4.1	0.43	n/a
DD-13c	0.59	1.12	Triangular	3:1	170	3.5	0.035	0.38	2.55	0.68	4.1	0.44	n/a
DD-14a	10.63	22.04	Triangular	3:1	375	1.4	0.038	1.43	3.58	1.93	11.6	6.16	12
DD-14b	11.25	23.2	Triangular	3:1	393	9.4	0.044	1.08	6.63	1.58	9.5	3.5	30

TA[illegible]3-8
DISTURBED DRAINAGE - DIVERSION DITCHES
25-YEAR 24-HOUR STORM EVENT
(Page 2 of 3)

Diversion Ditch	25yr-6hr Ditch Flow (cfs)[1]	25yr-24hr Design Flow (cfs)[1]	Ditch Geometry	Side Slope H:V	Ditch Length (ft)[2]	Ditch Slope (%)	Manning's n	Flow Depth (ft)[3]	Velocity (ft)[3]	Minimum Ditch Depth (ft)[4]	Ditch Top Width (ft)	Minimum Flow Area (sf)[3]	Riprap D_{50} (inches)[5]
DD-14c	0.45	0.95	Triangular	3:1	380	9.4	0.035	0.30	3.51	0.60	3.6	0.26	n/a
DD-15a	0.48	0.9	Triangular	3:1	317	3.2	0.035	0.36	2.32	0.66	4	0.39	n/a
DD-15b	1.69	3.2	Triangular	3:1	229	2.6	0.035	0.6	2.97	0.9	5.4	1.08	n/a
DD-15c	1.69	3.2	Triangular	3:1	497	5.8	0.035	0.52	4.01	0.82	5	0.8	n/a
DD-16	13.44	27.34	Triangular	3:1	398	6.4	0.043	1.22	6.08	1.72	10.3	4.49	24
DD-17a	0.14	0.27	Triangular	31	190	7.4	0.035	0.2	2.36	0.5	3	0.11	n/a
DD-17b	13.66	27.75	Triangular	3:1	139	2.9	0.042	1.42	4.62	1.92	11.5	6.01	18
DD-17c	13.66	29.52	Trapezoidal 6 ft bottom	3:1	117	16.2	0.038	0.47	8.41	0.97	11.8	3.51	12
DD-18	0.53	1	Triangular	3:1	430	2.8	0.035	0.38	2.27	0.68	4.1	0.44	n/a
DD-19a	0.57	0.53	Triangular	3:1	130	11	0.035	0.23	3.24	0.53	3.2	0.16	n/a
DD-19a_1	0.57	1.08	Triangular	3:1		10.5	0.035	0.31	3.8	0.61	3.7	0.28	n/a
DD-19b	1.45	2.74	Triangular	3:1	300	0.3	0.035	0.83	1.31	1.13	6.8	2.09	n/a
DD-19c	1.45	2.74	Triangular	3:1	160	3	0.035	0.55	3	0.85	5.1	0.91	n/a
DD-19d	1.7	3.21	Triangular	3:1	120	12.9	0.039	0.46	4.98	0.96	5.8	0.64	12
DD-20a	0.44	0.89	Triangular	31	205	2.6	0.035	0.37	2.14	0.67	4	0.42	n/a
DD-20b	0.44	0.89	Triangular	3:1	79	5.1	0.035	0.33	2.76	0.63	3.8	0.32	n/a
DD-21	0.47	0.88	Triangular	3:1	667	10.3	0.035	0.29	3.6	0.59	3.5	0.24	n/a
DD-22	0.47	0.88	Trapezoidal 6 ft bottom	3:1	33	33.3	0.038	0.05	2.95	0.55	9.3	0.3	6
DD-23	0.31	0.59	Triangular	3:1	179	1.7	0.035	0.35	1.65	0.65	3.9	0.36	n/a
DD-23a	1.33	2.52	Triangular	3:1	375	2	0.035	0.58	2.53	0.88	5.3	1	n/a
DD-24	1.64	3.11	Triangular	3:1	212	6.6	0.035	0.5	4.17	0.8	4.8	0.75	n/a
DD-25a	1.41	2.62	Triangular	3:1	1150	3.4	0.035	0.53	3.11	0.83	5	0.84	n/a
DD-25b	1.41	2.62	Triangular	3:1	152	2	0.035	0.59	2.54	0.89	5.3	1.03	n/a
DD-26a	1.41	2.62	Triangular	3:1	948	4.4	0.035	0.51	3.42	0.81	4.9	0.77	n/a
DD-26b	1.41	2.62	Triangular	3:1	119	2.3	0.035	0.57	2.7	0.87	5.2	0.97	n/a
DD-26c_1	1.41	2.62	Triangular	3:1	108	0.5	0.035	0.77	1.47	1.07	6.4	1.78	n/a
DD-26c_2	1.41	2.62	Triangular	3:1	121	0.4	0.035	0.79	1.41	1.09	6.5	1.86	n/a

TABLE 13-8
DISTURBED DRAINAGE - DIVERSION DITCHES
25-YEAR 24-HOUR STORM EVENT
(Page 3 of 3)

Diversion Ditch	25yr-6hr Ditch Flow (cfs)[1]	25yr-24hr Design Flow (cfs)[1]	Ditch Geometry	Side Slope H:V	Ditch Length (ft)[2]	Ditch Slope (%)	Manning's n	Flow Depth (ft)[3]	Velocity (ft)[3]	Minimum Ditch Depth (ft)[4]	Ditch Top Width (ft)	Minimum Flow Area (sf)[3]	Riprap D_{50} (inches)[5]
DD-27	1.41	2.62	Trapezoidal 4 ft bottom	3:1	23	48	0.04	0.11	5.55	0.61	7.7	0.47	6[7]
DD-28	0.60	1.14	Triangular	3:1	360	8.8	0.035	0.32	3.62	0.62	3.8	0.32	n/a
DD-28a	0.60	1.14	Triangular	3:1	40	35	0.051	0.29	4.57	0.79	4.7	0.25	6[7]
DD-29	0.64	1.66	Triangular	3:1	340	9.6	0.035	0.34	3.86	0.64	3.8	0.34	n/a

Notes: Ditch designs based on the 25-year 24-hour storm event peak discharge

(1) Ditch Flow calculated using SEDCAD3 computer model
(2) Ditch length determined by direct measurement from a computer generated map
(3) Calculated using Flowmaster 1 computer model
(4) Minimum ditch depth equals flow depth + 0.3 feet of freeboard; riprapped ditches have 0.5 feet of freeboard
(5) Riprap D_{50} calcualted using SEDCAD3 Riprap Utility OSM method, unless noted otherwise
(6) Ditch deleted
(7) Riprap D_{50} calcualted using OSM Steep Slope Riprap nomographs
n/a riprap sizing not applicable when flow velociaty is less than 5.0 feet per second (fps)

TABLE 13-9
UNDISTURBED DRAINAGE - DIVERSION DITCHES
25-YEAR 24-HOUR STORM EVENT
(Page 1 of 3)

Diversion Ditch	25yr-6hr Ditch Flow (cfs)[1]	25yr-24hr Design Flow (cfs)[1]	Ditch Geometry	Side Slope (H:V)	Ditch Length (ft)[2]	Ditch Slope (%)	Manning's n	Flow Depth (ft)[3]	Velocity (fps)[3]	Minimum Ditch Depth (ft)[4]	Ditch Top Width (ft)	Minimum Flow Area (sf)[3]	Riprap D_{50} (inches)[5]
UD-1	2.53	10.9	Triangular	3:1	444	2.3	0.035	0.97	3.84	1.27	7.6	2.84	n/a
UD-2	2.19	11.35	Triangular	3:1	423	2.4	0.035	0.98	3.95	1.28	7.6	2.88	n/a
UD-3	16.43	70.92	Triangular	3:1	627	9.9	0.050	1.71	8.12	2.21	13.3	8.73	18[8]
UD-4a	0.50	1.64	Triangular	3:1	235	2.6	0.035	0.47	2.51	0.77	4.6	0.65	n/a
UD-4	5.61	18.79	Triangular	3:1	235	10.6	0.044	0.98	6.58	1.48	8.9	2.86	6[8]
UD-5	5.69	19.46	Triangular	3:1	230	9.6	0.044	1.01	5.62	1.51	9.1	3.41	24
UD-6	0.84	2.73	Triangular	3:1	505	15.0	0.045	0.45	4.55	0.95	5.7	0.60	n/a
UD-7	2.15	7.02	Trapezoidal 4.0 bottom	3:1	206	34.0	0.057	0.26	5.58	0.76	8.6	1.26	12[8]
UD-8	7.91	26.74	Triangular	3:1	181	8.3	0.044	1.17	6.56	1.67	10.0	4.08	24
UD-9a	0.20	0.61	Triangular	3:1	256	2.0	0.035	0.34	1.77	0.64	3.8	0.34	n/a
UD-9b	1.51	4.91	Triangular	3:1	285	4.2	0.035	0.64	3.95	0.94	5.6	1.24	n/a
UD-9c		32.58	Triangular	3:1	25	3.5	0.043	1.46	5.07	2.00	12.0	6.43	21
UD-10[6]													
UD-11	1.06	3.94	Trapezoidal 4.0 bottom	3:1	73	15.0	0.047	0.19	4.41	0.69	8.[illegible]	0.89	6[8]
UD-12	1.06	3.94	Triangular	3:1	338	3.9	0.035	0.60	3.63	0.90	5.[illegible]	1.08	n/a
UD-13a	1.14	4.25	Triangular	3:1	248	1.0	0.035	0.80	2.22	1.10	6.[illegible]	1.91	n/a
UD-13b	0.19	0.23	Triangular	3:1	310	10.0	0.035	0.23	2.54	0.53	3.[illegible]	0.[illegible]	n/a
UD-14[6]													

TABLE 13-9
UNDISTURBED DRAINAGE - DIVERSION DITCHES
25-YEAR 24-HOUR STORM EVENT

(Page 2 of 3)

Diversion Ditch	25yr-6hr Ditch Flow (cfs)[1]	25yr-24hr Design Flow (cfs)[1]	Ditch Geometry	Side Slope (H:V)	Ditch Length (ft)[2]	Ditch Slope (%)	Manning's n	Flow Depth (ft)[3]	Velocity (fps)[3]	Minimum Ditch Depth (ft)[4]	Ditch Top Width (ft)	Minimum Flow Area (sf)[3]	Riprap D_{50} (inches)[5]
UD-15	14.68	47.99	Trapezoidal 10.0 bottom	2:1	57	49.1	0.068	0.49	8.89	1.49	16.0	5.40	30[8]
UD-16	1.40	5.21	Trapezoidal 8.0 bottom	8:1	470	6.2	0.035	0.18	3.06	0.48	15.7	1.70	n/a
UD-17	0.05	0.16	Trapezoidal 8.0 bottom	8:1	123	13.0	0.035	0.02	1.06	0.32	13.0	0.15	n/a
UD-18	16.13	53.39	Trapezoidal 6.0 bottom	2:1	83	8.4	0.044	0.89	7.68	1.89	13.6	6.95	12
UD-19	1.81	7.49	Trapezoidal 8.0 bottom	8:1	519	3.1	0.035	0.27	2.74	0.57	17.1	2.74	n/a
UD-20	1.81	7.49	Triangular	3:1	114	22	0.043	0.60	6.99	1.10	6.6	1.07	24
UD-21	1.81	7.49	Triangular	3:1	41	4.9	0.039	0.76	4.28	1.26	7.6	1.75	12
UD-22a	0.38	1.65	Trapezoidal 8.0 bottom	8:1	191	8.4	0.035	0.08	2.25	0.38	14.1	0.73	n/a
UD-22b	0.38	1.65	Trapezoidal 8.0 bottom	8:1	75	12.7	0.035	0.07	2.57	0.37	14.0	0.64	n/a
UD-22c	1.99	7.87	Trapezoidal 8.0 bottom	8:1	100	6.0	0.035	0.23	3.48	0.53	16.5	[illegible].26	n/a
UD-23a	1.99	7.87	Triangular	3:1	43	37.2	0.058	0.62	6.89	1.12	6.7	1.14	12[8]
UD-23b	0.38	1.65	Triangular	3:1	176	7.4	0.035	0.38	3.92	0.68	4.1	0.44	n/a
UD-23c	2.38	9.522	Triangular	3:1	195	15.9	0.043	0.69	6.57	1.19	7.1	1.45	24
UD-24	1.01	1.58	Triangular	31	457	4.6	0.035	0.41	3.08	0.71	4.3	0.51	n/a
UD-25[6]													

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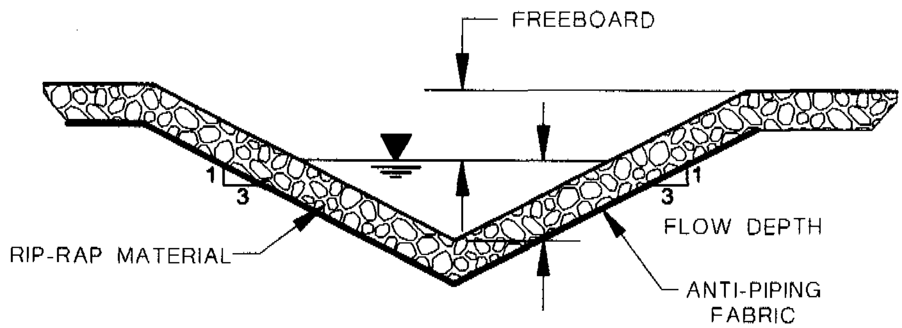
TABLE 13-9
UNDISTURBED DRAINAGE - DIVERSION DITCHES
25-YEAR 24-HOUR STORM EVENT

Diversion Ditch	25yr-6hr Ditch Flow (cfs)[1]	25yr-24hr Design Flow (cfs)[1]	Ditch Geometry	Side Slope (H:V)	Ditch Length (ft)[2]	Ditch Slope (%)	Manning's n	Flow Depth (ft)[3]	Velocity (fps)[3]	Minimum Ditch Depth (ft)[4]	Ditch Top Width (ft)	Minimum Flow Area (sf)[3]	Riprap D_{50} (inches)[5]
UD-26[6]													
UD-27	0.68	1.87	Triangular	3:1	194	1.0	0.035	0.59	1.81	0.89	5.3	1.03	n/a
UD-28[7]	31.19[9]	66.26	Trapezoidal 10.0 bottom	3:1	685	8.5	0.036	0.67	8.23	1.67	20.0	8.05	12
CGD-10[10]	9.91	33.52	Triangular	2:1	640	6.3	0.043	1.57	6.84	2.07	8.3	4.90	24

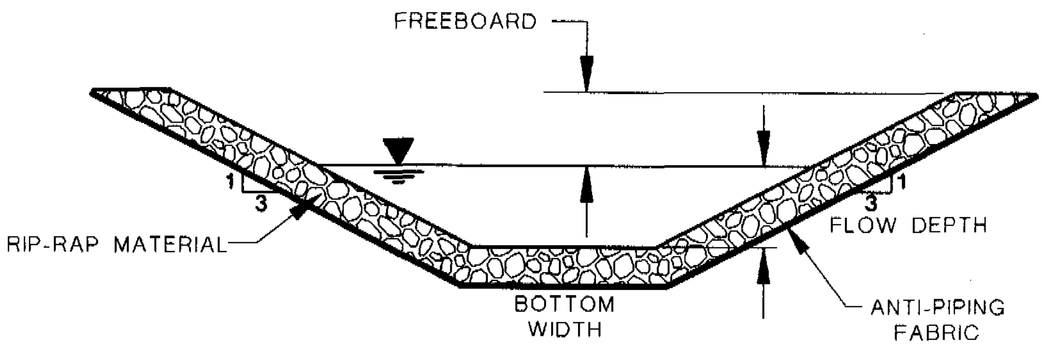
Notes:

- (1) Ditch flow calculated using SEDCAD3 computer model
- (2) Ditch length determined by direct measurement from a computer generated map
- (3) Calculated using Flowmaster I computer model
- (4) Minimum ditch depth = flow depth + 0.3 feet of freeboard; riprapped ditches have 0.5 feet of freeboard
- (5) Riprap sizing calculated with SEDCAD3 Riprap Utility OSM Method unless noted otherwise
- (6) Ditch deleted
- (7) Diversion ditch UD-28 sized for the 25-year, 24-hour storm event, which has greater peak flow than regulation specified 100 year-6 hour event
- (8) Riprap sizing calculated with OSM Steep Slope Riprap Nomographs
- (9) 31.18 is peak flow for 100-year, 6 hour storm event
- (10) CGD-10 Existing Castle Gate Mine Company ditch relocated due to conveyor corridor.
- n/a riprap sizing not applicable when flow velocities less than 5.0 fps



TYPICAL TRIANGULAR CHANNEL SECTION

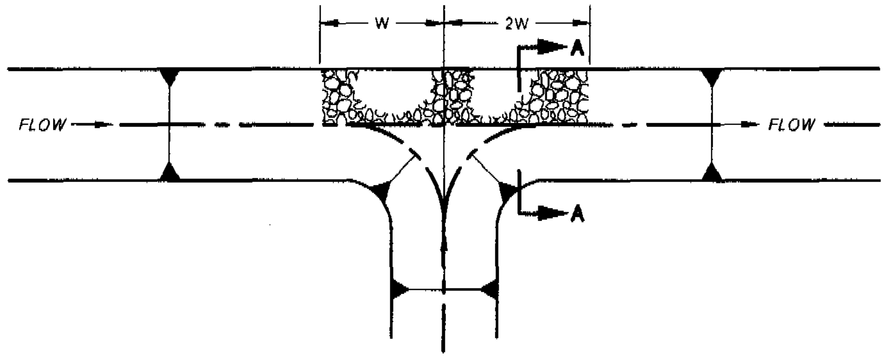
Not to Scale



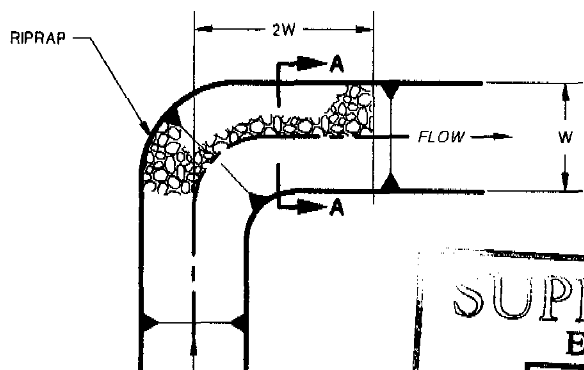
TYPICAL TRAPEZOIDAL CHANNEL SECTION

Not to Scale

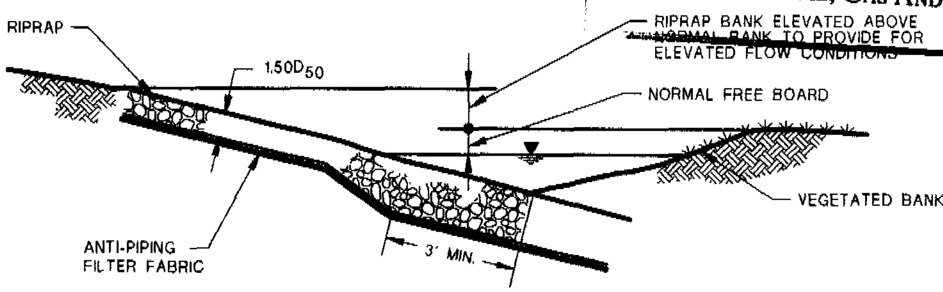
Project No.: 866-2200	Design By: J. WEINMAN	Scale: AS SHOWN	CYPRUS Plateau Mining
File: DR-RRAP.DWG	Drawn By: M. MATHISEN	Date: April 1995	
TerraMatrix Engineering & Environmental Services 1475 Pine Grove Road, P.O. Box 774018 Steamboat Springs, Colorado 80477	Figure 13-2		TYPICAL EARTHEN DRAINAGE WITH RIP-RAP STRUCTURE CONFIGURATION



PLAN AT "TEE" JUNCTION



PLAN AT BEND



SECTION A-A

Project No.: 866-2200	Design By: John Weinman	Scale: Not To Scale	CYPRUS Plateau Mining
File: WILLCBRP.DWG	Drawn By: Eric Simonsen	Date: April 1995	
TerraMatrix Engineering & Environmental Services 1475 Pine Grove Road, P.O. Box 774018 Steamboat Springs, Colorado 80477		Figure 13-3	TYPICAL CHANNEL BANK RIPRAP PROTECTION

end of Appendices C and E, Disturbed Ditch Design Modeling and Undisturbed Ditch Design Modeling, respectively. Riprap sizing for those ditches with flow velocities greater than 5.0 fps is included in Tables 13-8 and 13-9, for disturbed and undisturbed ditches respectively.

It is essential for a riprap layer to be composed of rock having a gradation such that the voids between the larger particles are filled with smaller particles to reduce interstitial flows and provide overall stability to the system (Fiske, et al., 1994). Table 13-10, Riprap Gradation Particle Sizes displays an appropriate particle size gradation for use in riprapping structures. Proper placement of the rock course is necessary to fully realize the erosion mitigation potential of a riprap design. The thickness of a riprap is typically a function of the rock size and is expressed in terms of the riprap D_{50}. The riprap layer design will follow these general guidelines:

- The thickness of a riprap layer will be at least 1.5 to 2 times the D_{50}
- Riprap layers will be at least 12 inches in thickness
- Where the D_{50} is greater than 8 inches, the placement procedures will include a certain amount of individual placement (using specialized equipment or hand labor) to ensure that the proper thickness and cover is achieved.

A filter blanket will be placed beneath any riprap course to stabilize the riprap layer and prevent erosion in the in-situ base material underlying the riprap. The mechanism of base material erosion is the interstitial flow of water between the openings of individual rocks which can be strong enough to initiate erosion of the base material, and subsequently undermine the riprap course.

The filter blanket will consist of granular material placed to a depth of 0.5 the riprap D_{50} or a maximum of six inches, which ever is less. The following criteria have been established for sizing the filter, based on the size distribution of the riprap and the base material (Haan, et al., 1994):

(1) $\frac{D_{50}\text{ (filter)}}{D_{50}\text{ (base)}} < 40$ also $\frac{D_{50}\text{ (riprap)}}{D_{50}\text{ (filter)}} < 40$

(2) $5 < \frac{D_{15}\text{ (filter)}}{D_{15}\text{ (base)}} < 40$ also $5 < \frac{D_{15}\text{ (riprap)}}{D_{15}\text{ (filter)}} < 40$

(3) $\frac{D_{15}\text{ (filter)}}{D_{85}\text{ (base)}} < 5$ also $\frac{D_{15}\text{ (riprap)}}{D_{85}\text{ (filter)}} < 5$

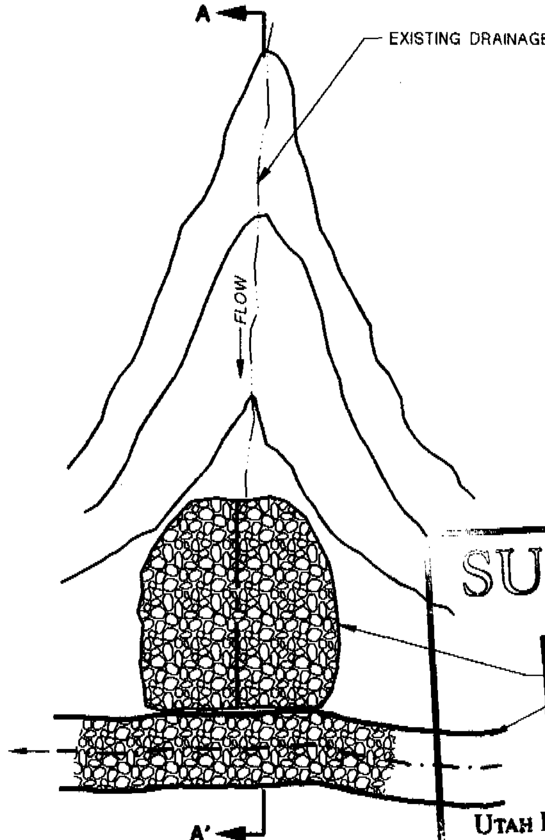
The filter blanket used in the Willow Creek area will consist of gravel road base material with a D_{max} of 1.5 inches. For those ditches lined with a riprap D_{50} greater than 24 inches, multiple filter layers will be placed prior to the riprap revetment.

Under certain situations, CPMC may substitute a geotextile fabric blanket, with a minimum specification of 12 ounces per square yard, in place of the granular blanket.

The erosive forces generated by the flow of water increase in areas of flow concentration. To lessen the problems associated with concentrated flow, energy dissipators will be used in highly turbulent zones including channel junctions, culvert outlets, and spillway outslope toes. The location of energy dissipators are shown on Map 23, Drainage and Sediment Control Plan - Sheet A through Sheet F. A typical energy dissipator design is shown in Figure 13-4, Typical Energy Dissipator Structure Design. An energy dissipator is an over-excavated channel or pit lined with riprap sizes larger than the D_{50} calculated using the permissible velocity concept. Riprap sizing for energy dissipators is based on the localized bottom velocity flow (Abt, et al., 1988). This method is suited in areas where hydraulic jumps occur. A general design application of 2.0 times the D_{50}, placed to a depth of 3.0 D_{50} will provide the stability required to protect against the increased erosive forces of the concentrated flow. Energy dissipation structures will also be lined with a non-piping filter blanket.

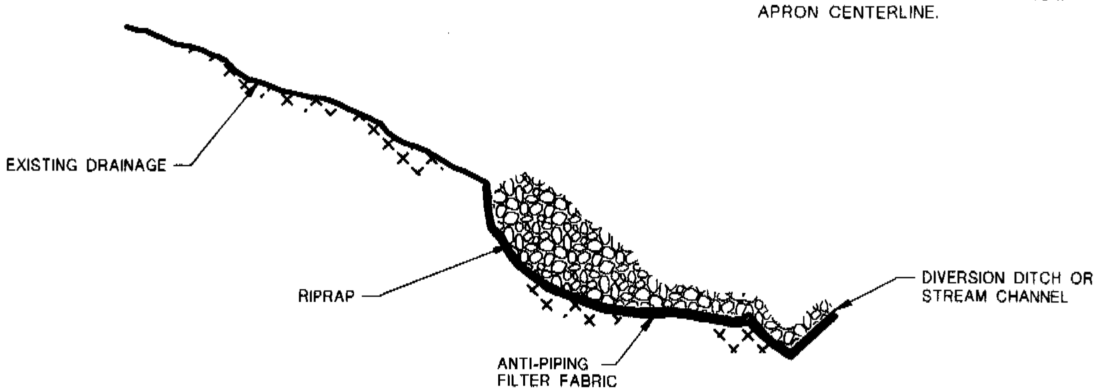
Berms will also be used to contain disturbed drainage flows. Typically, they will be used in conjunction with a drainage ditch. A typical berm design is displayed in Figure 13-5, Typical Earthen Berm Detail. The location of berms is shown on the Drainage and Sediment Control Plan, (Maps 23A through 23F).

TABLE 13-10 RIPRAP GRADATION PARTICLE SIZES	
Percent Finer	**Particle Size**
0	0.25 D_{50}
10	0.35 D_{50}
20	0.50 D_{50}
30	0.65 D_{50}
40	0.80 D_{50}
50	1.0 D_{50}
60	1.2 D_{50}
70	1.4 D_{50}
80	1.6 D_{50}
90	1.8 D_{50}
100	2.0 D_{50}
Source: Fiske, et al., 1994	



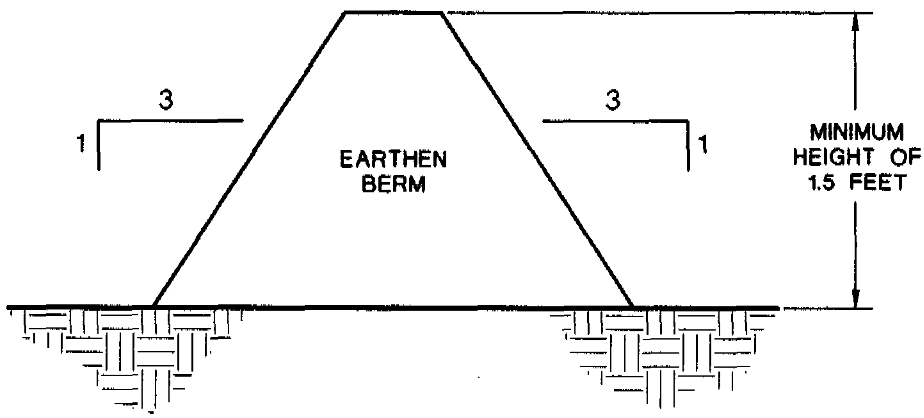
PLAN VIEW DETAIL
Not To Scale

NOTE:
FOR UNLINED DITCHES RIPRAP APRON WILL EXTEND INTO CHANNEL. APRON WILL EXTEND UPSTREAM & DOWNSTREAM 1 x APRON WIDTH FROM APRON CENTERLINE.



CROSS-SECTION DETAIL
Not To Scale

Project No.: 866-2200	Design By: John Weinman	Scale: Not To Scale	CYPRUS Plateau Mining
File: WILLTEDD.DWG	Drawn By: Eric Simonsen	Date: April 1995	
TerraMatrix Engineering & Environmental Services 1475 Pine Grove Road, P.O. Box 774018 Steamboat Springs, Colorado 80477	Figure 13-4		TYPICAL ENERGY DISSIPATOR DETAIL



DISTURBED DRAIN BERM DETAIL

Not To Scale

NOTE: Earthen Berm Shall Consist of On-Site Native Soils. Berms Shall Be Regularly Maintained.

Project No.: 866-2200	Design By: John Weinman	Scale: Not To Scale	CYPRUS Plateau Mining
File: WIL-BERM.DWG	Drawn By: Janet Bever	Date: April 1995	
TerraMatrix Engineering & Environmental Services 1475 Pine Grove Road, P.O. Box 774018 Steamboat Springs, Colorado 80477	Figure 13-5		TYPICAL EARTHEN BERM DETAIL

Culvert Design

Eighteen culverts were designed to convey disturbed drainage runoff within the proposed Willow Creek Mine surface facilities area boundary. The culverts route runoff between drainage ditches, under access roads and surface-area storage facilities. Ten culverts were designed to divert storm runoff from the undisturbed watersheds around and/or through the disturbed area. Culvert locations are shown on the Drainage and Sediment Control Plan, (Maps 23A through 23F).

Culvert construction includes embankment headwall and outlet erosion protection using riprap. Typical culvert erosion protection is displayed in Figure 13-6 and Figure 13-7, Typical Riprap Headwall Protection Detail, and Typical Culvert Outlet Erosion Protection, respectively. Additionally, all culverts installed to carry undisturbed drainage will have a trash rack, constructed of re-bar fastened to the culvert inlet bell. Figure 13-8, Typical Culvert Trash Rack displays the culvert trash rack design. Due to their excessive lengths, culverts DC-5c, DC-18, UC-1a/1b, UC-3b, UC-10, and DC-13 will have clean-out boxes to allow access for sedimentation and/or debris removal. A typical clean-out box design is displayed on Figure 13-9, Typical Culvert Clean-out Box Detail. The location of the culverts and their clean-out boxes is shown on the Drainage and Sediment Control Plan, (Maps 23A through 23F).

The ability of the proposed culverts to carry the design flow discharge generated from the 25yr-24hr event was calculated using the Culvert Utility in the SEDCAD computer model. A summary of culvert sizing calculations is presented in Table 13-11, Disturbed Drainage - Culvert Sizing, and Table 13-12, Undisturbed Drainage - Culvert Sizing, for disturbed and undisturbed drainage, respectively. The recommended culvert design size calculated was increased to insure that the culverts can adequately carry peak flows and reduce the risk of overtopping and culvert. Culvert sizing modeling computations are presented in Appendix D, SEDCAD Modeling for Disturbed Drainage Culvert Sizing and Appendix F, SEDCAD Modeling for Undisturbed Drainage Culvert Sizing.

Due to design changes subsequent to the original submittal, one disturbed drainage culvert and one undisturbed drainage culvert have been replaced with flexible elongated tubing (FET). The design specifications for the FETs are provided in Table 13-11 and 13-12 for the disturbed and undisturbed drainage FETs, respectively. FET design specifications for the FETs are provided in Appendix D.

Undisturbed drainages will also have a debris catcher installed across the channel were the channel emerges from the upslope topography and intersects the proposed surface mine facilities area. Figure 13-10, Typical Debris Catcher Detail, displays what a debris catcher will look like. Roofing bolts will be driven into the ground on two-foot centers and re-bar welded horizontally to the bolts. The debris catchers will serve as an interceptor for woody debris and rocks that may move down an undisturbed channel during a storm event and potentially clog or impede flow in the diversion ditches. The location of the debris catchers are shown on the Drainage and Sediment Control Plan, (Maps 23A through 23F).

4.2 SEDIMENT PONDS

Sedimentation Ponds 001 and 002 are located in the Willow Creek area, while Pond 003 is an existing depression in the vicinity of the truck scale in the Castle Gate Preparation Plant area. The ponds will control the storm runoff from the disturbed drainage areas at the proposed Willow Creek Mine facility. The Facilities Area Hydrology Map, (Map 16), shows the location of Sediment Ponds 001, 002, and 003. The design topography and cross sections for Ponds 001, 002, and 003 are shown on the Sedimentation Pond - Design Maps, (Maps 24, 25, and 26) respectively. In accordance with R645-310-742.220, the 10-year 24-hour event was used to calculate capacity adequacy. Non-MSHA sedimentation ponds are required to have a principal and emergency spillway that will safely discharge a 25-year 6-hour or greater storm event (R645-301-742.223). CPMC used the 25-year 24-hour event to calculated the adequacy of the principal and emergency spillways.

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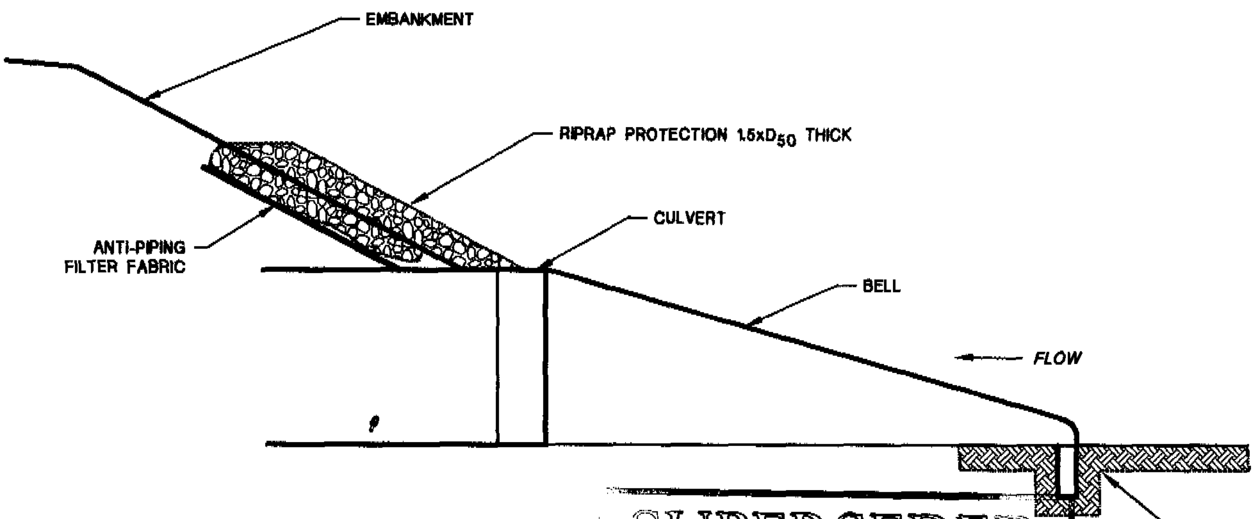
A comparison of the 25-year 6-hour event was performed against the 25-year 24-hour event to insure that the 25-year 24-hour event was the larger of the storms. Sediment removal from the sedimentation ponds will be preformed when the sediment reaches the 60 percent clean-out level. Prior to sediment removal, the sediment will be tested to determine if it contains any acid and/or toxic forming compounds. The sediment will then be transported to the Refuse Pile and deposited. Permanent pool water will be used for mine area access road dust abatement.



PROFILE VIEW

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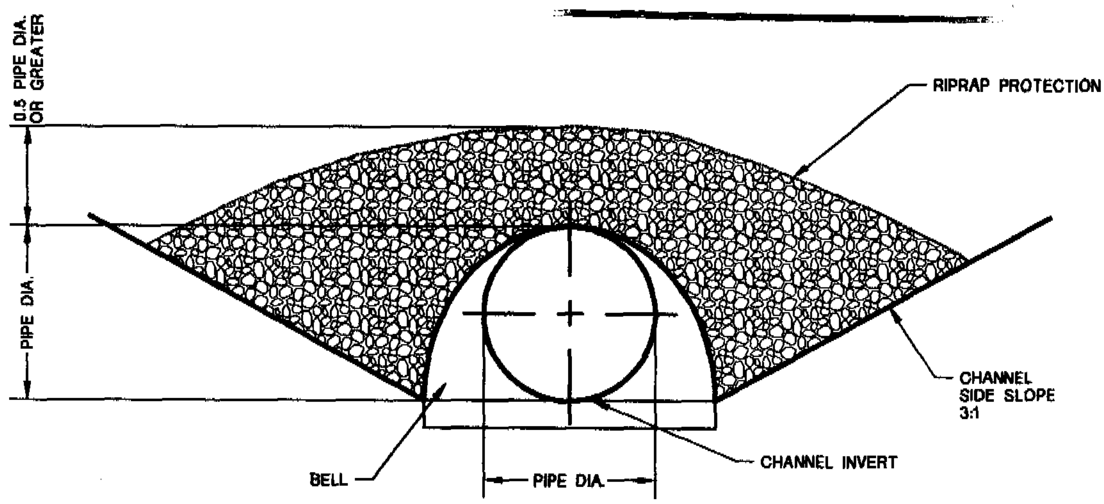
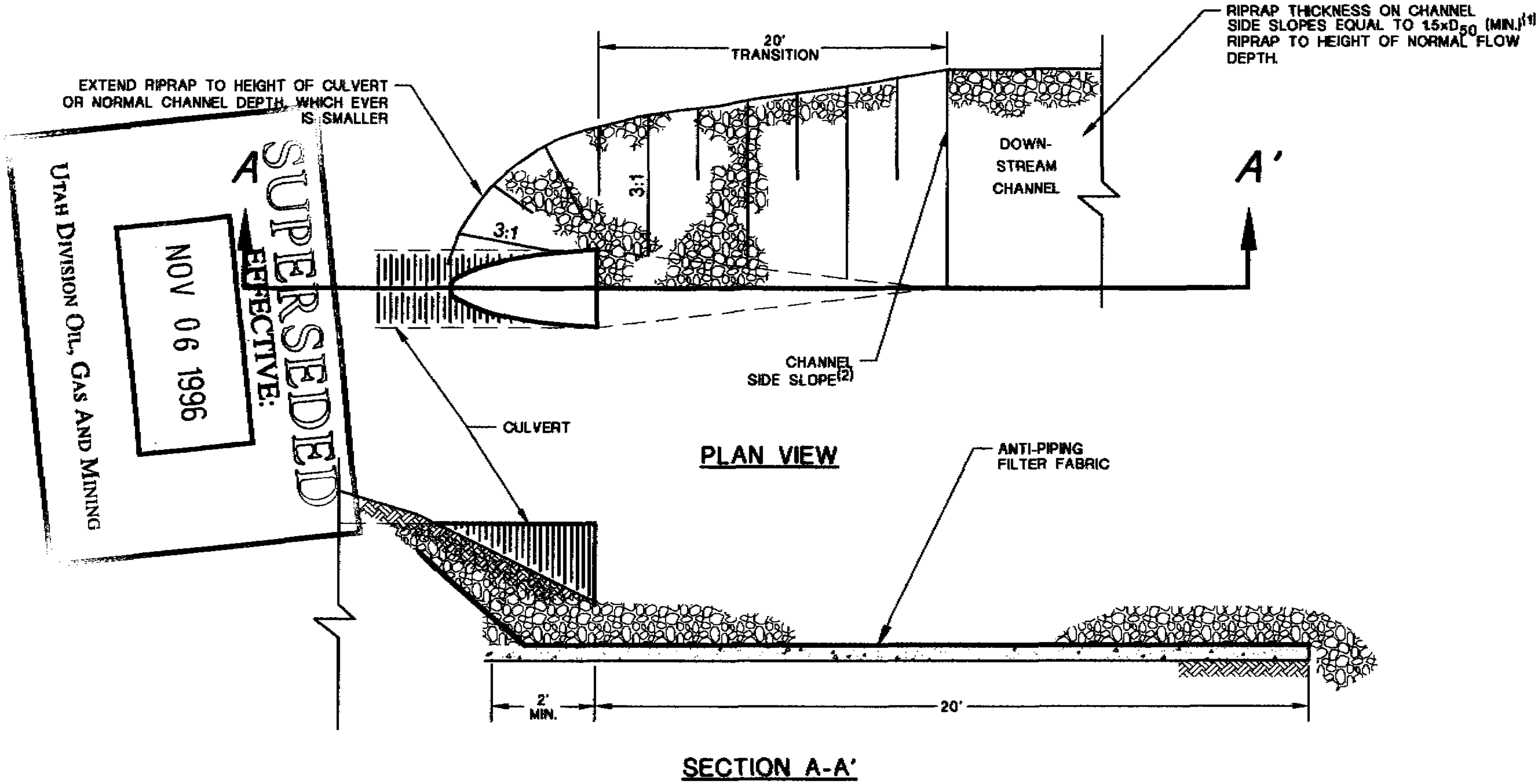


FRONT VIEW

Not to Scale

Project No.: 866-2200	Design By: John Weinman	Scale: Not To Scale	CYPRUS Plateau Mining
File: WILLRHWP.DWG	Drawn By: Eric Simonsen	Date: April 1995	
TerraMatrix Engineering & Environmental Services 1475 Pine Grove Road, P.O. Box 774018 Steamboat Springs, Colorado 80477	Figure 13-6		TYPICAL RIPRAP HEAD WALL PROTECTION DETAIL



NOTES:

1. RIPRAP THICKNESS ON DOWNSTREAM CHANNEL ONLY APPLICABLE FOR LINED CHANNELS.
2. CHANNEL SIDE SLOPES TYPICALLY 3:1.

Project No.: 866-2200	Design By: Jerry Nettleton	Scale: Not To Scale
File: WILLCOEP.DWG	Drawn By: Eric Simonsen	Date: April 1995

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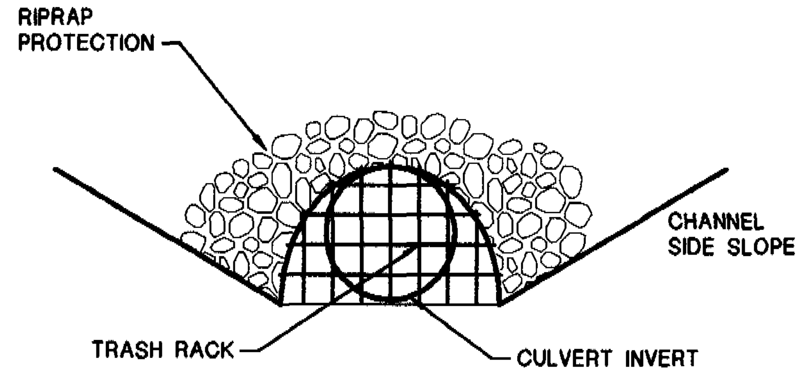
Steamboat Springs, Colorado 80477

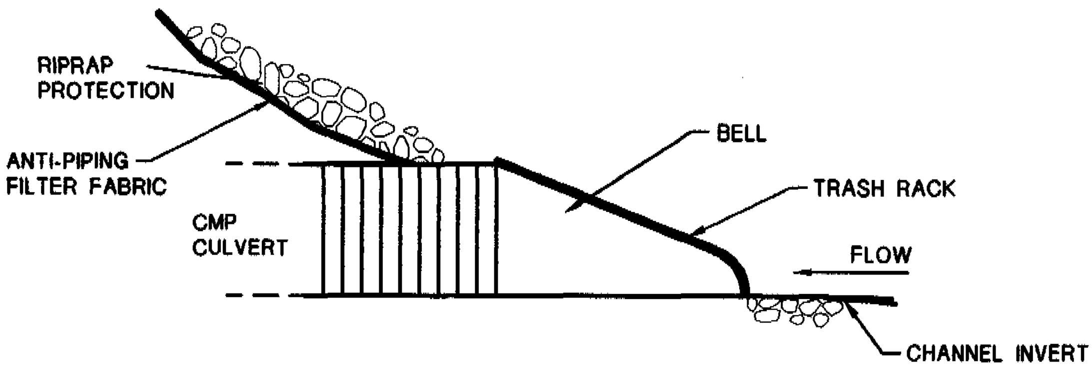
Figure 13-7

CYPRUS Plateau Mining

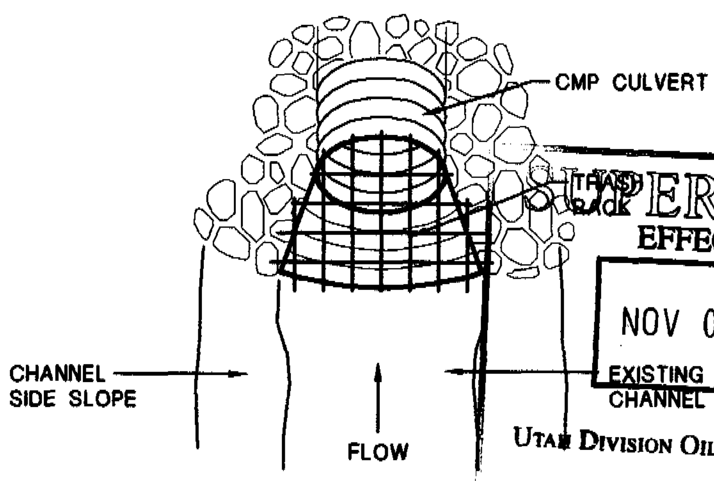
TYPICAL CULVERT OUTLET EROSION PROTECTION



FRONT VIEW DETAIL
Not To Scale



SIDE VIEW DETAIL
Not To Scale



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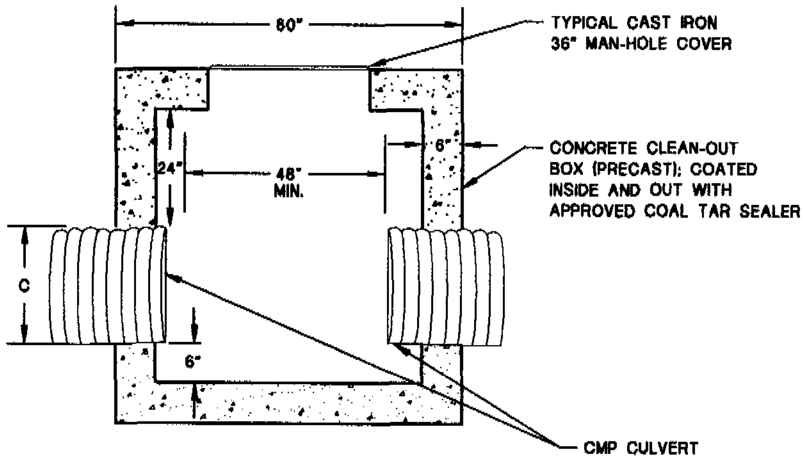
PLAN VIEW DETAIL
Not To Scale

Project No.: 866-2200	Design By: John Weinman	Scale: Not To Scale	CYPRUS Plateau Mining
File: WILLCTRK.DWG	Drawn By: Janet Bever	Date: April 1995	
TerraMatrix Engineering & Environmental Services 1475 Pine Grove Road, P.O. Box 774018 Steamboat Springs, Colorado 80477	Figure 13-8		TYPICAL CULVERT TRASH RACK



CROSS-SECTION DETAIL

Not To Scale

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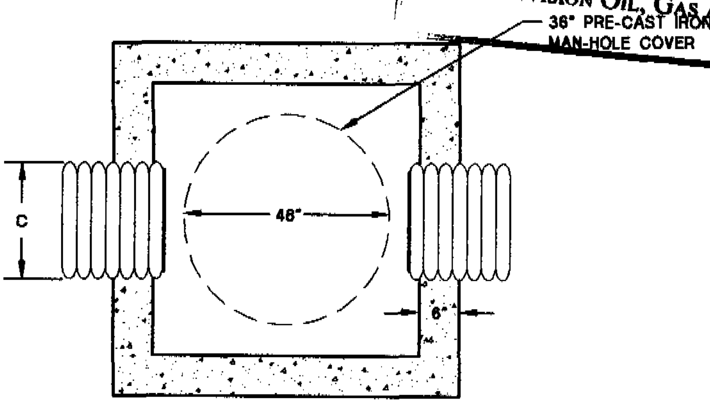


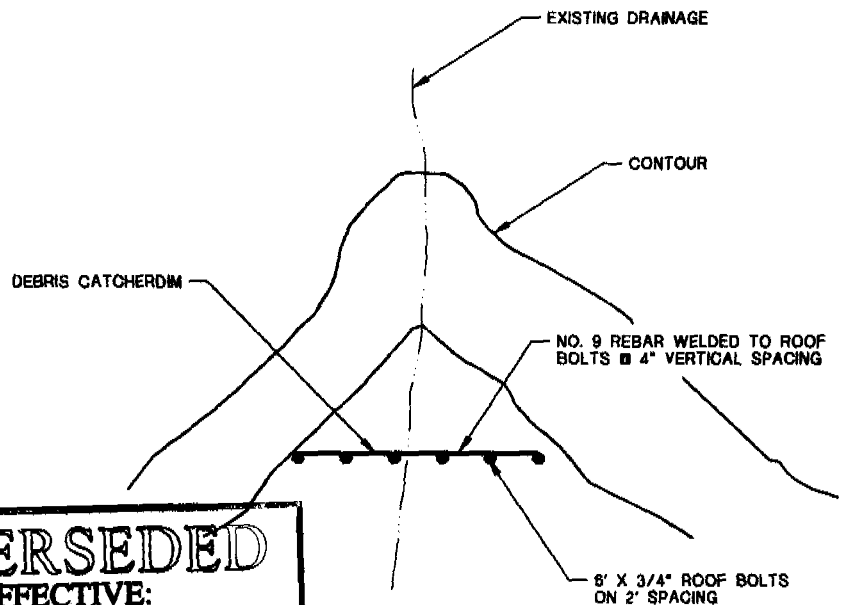
PLAN VIEW DETAIL

Not To Scale

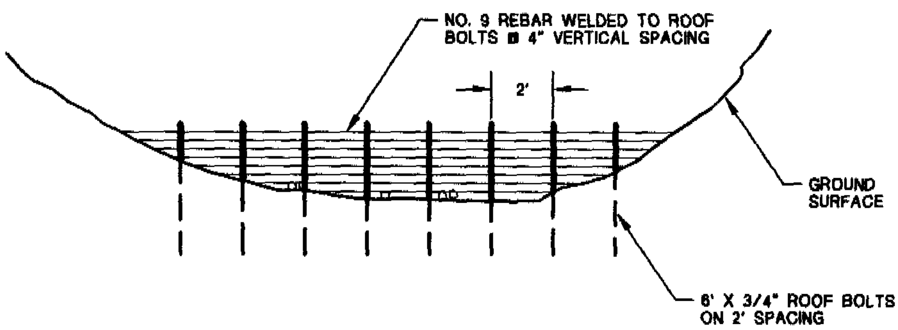
NOTES:

1.) "C" REPRESENTS CULVERT DIAMETER, VARIES WITH LOCATION.
2.) PRE-CAST CONCRETE MAN-HOLE EITHER SQUARE OR CIRCULAR CONSTRUCTION.
3.) CULVERT FLUSH WITH CONCRETE & GROUTED.

Project No.: 866-2200	Design By: John Weinman	Scale: Not To Scale	CYPRUS Plateau Mining
File: WILLCCOB.DWG	Drawn By: Eric Simonsen	Date: April 1995	
TerraMatrix Engineering & Environmental Services 1475 Pine Grove Road, P.O. Box 774018 Steamboat Springs, Colorado 80477	Figure 13-9		TYPICAL CULVERT CLEAN-OUT BOX DETAIL



PLAN VIEW DETAIL



TYPICAL DEBRIS CATCHER

Project No.: 866-2200	Design By: John Weinman	Scale: Not To Scale	CYPRUS Plateau Mining
File: WILL-TDC.DWG	Drawn By: Eric Simonsen	Date: April 1995	
TerraMatrix Engineering & Environmental Services 1475 Pine Grove Road, P.O. Box 774018 Steamboat Springs, Colorado 80477	Figure 13-10		TYPICAL DEBRIS CATCHER

TABLE 13-11
DISTURBED DRAINAGE - CULVERTS[1]

Culvert	Design Discharge (cfs)[2]	Entrance Loss Coefficient	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Maximum Headwater (ft)[3]	Minimum Pipe Diameter (inches)	Recommended Pipe Diameter (inches)
DC-1	3.28	0.9	30	1.7	0.015	1.5	12	24
DC-2	1.08	0.9	60	9.2	0.015	1	8	24
DC-3[4]								
DC-4	4.79	0.9	55	3.6	0.015	2	15	24
DC-5	8.05	0.9	120	1.5	0.015	2	18	24
DC-5a	6.94	0.9	25	2	0.015	2	18	24
DC-5b[4]								
DC-5c_1	1.12	0.9	35	20	0.015	1	8	24
DC-5c_2	1.12	0.9	85	1.2	0.015	1	8	24
DC-6a	3.2	0.9	10	5.9	0.015	1.5	12	24
DC-6b	3.2	0.9	45	42	0.015	1.5	12	24
DC-7	27.34	0.9	90	2.8	0.015	3	36	48
DC-8	27.75	0.9	115	3.5	0.015	3	36	48
DC-9	1	0.9	153	23.5	0.015	1	8	24
DC-10	0.88	0.9	65	4.6	0.015	1	8	24
DC-11	3.11	0.9	45	4.44	0.015	1	18	24

TABLE 13-11
DISTURBED DRAINAGE - CULVERTS[1]

Culvert	Design Discharge (cfs)[2]	Entrance Loss Coefficient	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Maximum Headwater (ft)[3]	Minimum Pipe Diameter (inches)	Recommended Pipe Diameter (inches)
DC-12	2.62	0.9	45	0.6	0.015	1.5	12	24
DC-13	7.77	0.9	170	1.8	0.015	2	18	24
DC-14	2.34	0.9	27	37	0.015	1.5	12	24
DC-15	2.62	0.9	45	0.6	0.015	1.5	12	24
DC-16	1.08	0.9	35	0.7	0.015	1	8	24
DC-17	3.36	0.9	162	1.0	0.015	1.5	15	24
DC-18	4.79	0.90	215	0.5	0.02	1.5	18	24.00
FET-1	3.2	NA	40	58	0.025	0.26[5]	NA	24

Notes:
(1) Culverts sized with SEDCAD3 computer model
(2) Design discharge based on 25year-24hour storm event peak flows
(3) Headwater Depth in Diameters (H:D)
(4) Culvert deleted
(5) Flow depth in tubing
NA = not applicable

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Revised: April 1996

TABLE 13-12
UNDISTURBED DRAINAGE - CULVERTS[1]

Culvert	Design Discharge (cfs)[2]	Entrance Loss Coefficient	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Maximum Headwater (ft)[3]	Minimum Pipe Diameter (inches)	Recommended Pipe Diameter (inches)
UC-1a	18.79	0.9	90	10.0	0.015	2.5	30	48
UC-1b	18.79	0.9	173	11.6	0.015	2.5	30	48
UC-2	19.18	0.9	64	9.4	0.015	2.5	30	48
UC-3a	32.58	0.9	78	6.4	0.015	3.0	36	48
UC-3b	32.58	0.9	230	5.5	0.015	3.0	36	48
UC-4[4]								
UC-5	53.39	0.9	120	4.2	0.015	4.0	42	60
UC-6a	7.49	0.9	65	6.4	0.015	2.0	18	30
UC-6b[5]								
UC-6c	7.49	0.9	55	1.9	0.015	2.0	18	30
UC-7	1.65	0.9	55	1.8	0.015	1.0	12	24
UC-8	7.87	0.9	55	2.7	0.015	2.0	18	30
UC-9[6]	66.26	0.9	125	7.2	0.015	4.0	48	60
UC-10	4.7	0.9	150	6.8	0.015	1.5	15	24
UC-11[4]								
UC-12[7]								
FET-2	4.7	NA	70	43	0.025	0.33[8]	NA	24

Notes:
(1) Culverts sized with SEDCAD3 computer model
(2) Design discharge based on 25year-24hour storm event peak flows, unless otherwise noted.
(3) Headwater depth in diameters (H:D)
(4) Culvert deleted
(5) Culvert replaced with diversion ditch UDD-20
(6) Design discharge used for culvert sizing is the 100 year-6-hour storm event
(7) Culvert UC-12 design has changed as a result of subsequent design revisions since the submittal of the initial applicaton. See Exhibit 14, Willow Creek Realignment Plans for specific culvert dimensions and capacity.
(8) Flow depth in tubing
NA = not applicable

4.2.1 Sediment Pond 001

Pond 001 is designed to fully contain runoff volumes from any storm event less than or equal to the 10-year 24-hour event (R645-301-742.221.33). Any storm event greater than the 10-year 24-hour event, i.e., the 25-year 24-hour event will be discharged through both the principal and emergency spillways. The principal spillway is a 18-inch diameter CMP riser with three 2-inch diameter gooseneck decants. The Sedimentation Pond 001-Design, (Map 24), shows the proposed layout of Sediment Pond 001. Both plan and cross-sectional views are provided. Additional information presented on Map 24 includes the Stage-Storage Curve, the Storage Capacity Table, and both Principal and Emergency Spillway design detail. The computation of the runoff volume assumed a total drainage area of 25.9 acres and a curve number of 90 for the disturbed area draining to Pond 001. An undisturbed area of approximately 2.8 acres with a curve number of 78 is included within the disturbed area category. This undisturbed area is immediately upslope of the proposed mine face-up area, the slopes are extremely steep and the construction of a clean-water ditch to intercept runoff from the area appears impractical.

Pond 001 has a total storage capacity of 6.88 acre-feet. The top of the pond embankment is 6,171.0 feet above mean sea-level. The elevation of the emergency spillway invert and the top of the principal spillway is 6,168.5 feet above mean sea-level (MSL). The elevation of the three decant orifices on the principal spillway are at 6,165.5 feet above MSL. The three year sediment dead-storage volume of 0.33 acre-feet is at 6,158.65 feet above MSL. The design storm runoff volume from the 10-year 24-hour and the 25-year 24-hour events are 2.28 acre-feet and 2.97 acre-feet, respectively. The dead-storage requirement and runoff volumes were calculated using the Sedimentology portion of the SEDCAD3 computer model. SEDCAD3 modeling for Pond 001 is presented in Appendix A-1.

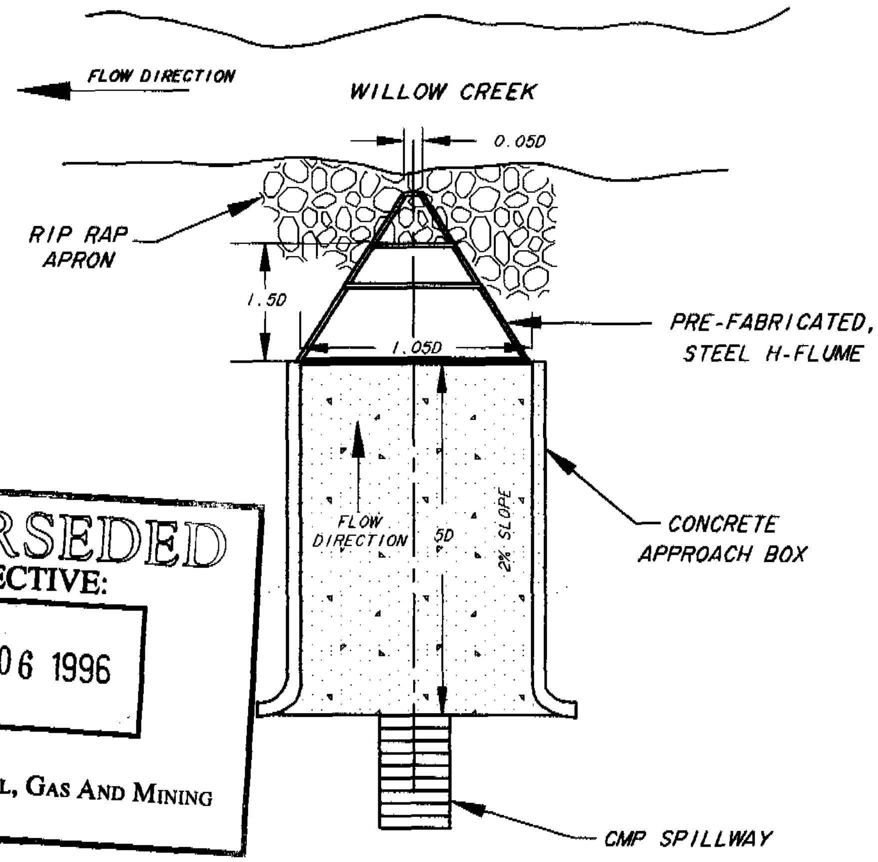
In setting the decant orifices at 6,165.5 MSL, the pond calculations are based on the premise that the pond contains a total of 4.39 acre-feet of water and sediment at the onset of the design storm. To assure that the pond has adequate storage capacity at all times, the pond must be dewatered and/or cleaned of sediment once the stored water/sediment elevation exceeds 6,164.5 feet MSL. The conservative pond design assures that not only is there adequate storage capacity to treat the design storm, but that in the event of the occurrence of mine-water discharge, the pond capacity is adequate to treat any mine-water inflows. Normally any accumulated water will be used for dust control. If dewatering is necessary, prior to dewatering the pond the water will be tested to assure that it meets applicable effluent limitations per R645-301-751.

The 10-year 24-hour storm was routed through the principal spillway to determine the maximum stage and flow rate. Computations were conducted assuming that the pond contained the maximum allowable sediment dead-storage volume of 0.33 ac-ft (3 years), and that the pond was full of water up to the spillway decant elevation prior to the start of the design storm runoff event. This results in a conservative estimation of maximum stage since, in general, the pond can be assumed to be empty at the beginning of a storm event. From the stage-storage curve for the pond structure shown on the Sedimentation Pond 001 - Design (Map 24), the allowable storage at the invert of the emergency spillway is approximately 6.88 ac-ft. Therefore, the pond will fully contain the runoff from the 10-year 24-hour storm event, as required by R645-301-742.221.33, and allow for sediment storage.

Discharge from the principal spillway will be measured using a pre-fabricated steel H-flume. Peak discharge from Pond 001, as a result of the 10-year, 24-hour design event was calculated as 0.49 cfs. CPMC proposes to install a 1.0 foot deep H-flume at the culvert outflow with a concrete approach box. Figure 13-11, Typical Flume Design, displays the typical design.

From the analysis of the 10-year 24-hour event, the maximum inflow rate to the pond structure is 27.45 cfs and the maximum outflow rate is 0.49 cfs. The corresponding high water elevation is 6,167.92, 0.58 feet below the invert of the emergency spillway and 2.08 feet below the minimum embankment elevation of 6,170.0 feet MSL. The estimated dewatering time from peak surface water elevation to decant elevation is 3.4 days. The principal spillway riser design detail is shown on the Sedimentation Pond 001 - Design (Map 24). Thus, Pond 001 will adequately treat the 10-year 24-hour peak flow.

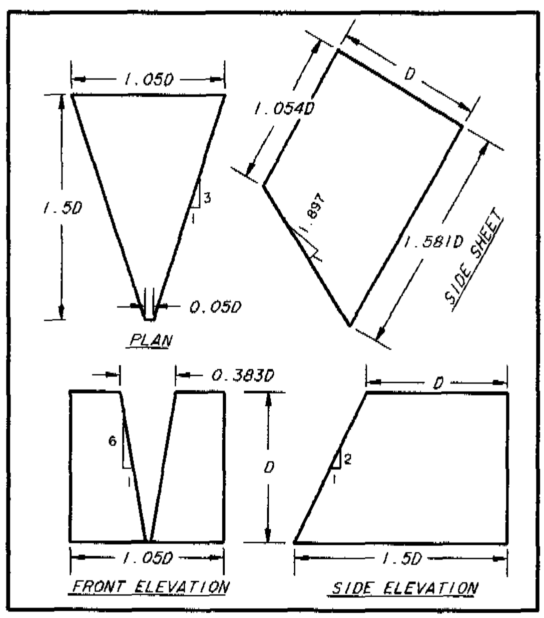
Both the 25-year, 6-hour, and the 25-year, 24-hour storm were routed through the emergency spillway to evaluate the design of the spillway crest and outslope. Computations were conducted assuming that the pond contained the maximum allowable sediment dead-storage volume of 0.33 acre-feet (3 years), and that the pond water surface elevation was 6,168.5 feet MSL (emergency spillway invert elevation). A stage-discharge curve



PLAN VIEW DETAIL

Not to Scale

H-FLUME TABLE			
	PRINCIPAL SPILLWAY PEAK DISCHARGE (Cfs)	HEAD (Ft)	RECOMMENDED FLUME SIZE DEPTH (D) (Ft)
POND 001	0.49	0.49	1.0
POND 002	0.09	0.23	0.6



FLUME SPECIFICATIONS

Project No.: 866-2200	Design By: J.WEINMAN	Scale: NOT TO SCALE
File: FLUME-D.DWG	Drawn By: K.CONRATH	Date: SEPTEMBER 1995

TerraMatrix
Engineering & Environmental Services
1475 Pine Grove Road, P.O. Box 774018
Steamboat Springs, Colorado 80477

FIGURE 13-11

CYPRUS Plateau Mining

TYPICAL
H-FLUME DESIGN

was calculated by SEDCAD3 for the emergency spillway. The SEDCAD modeling for Pond 001 (emergency spillway only) is contained in Appendix A-1. From the emergency spillway only analysis of the 25-year 24-hour event, the maximum inflow rate to the pond structure is 35.15 cfs and the maximum outflow rate is 24.21 cfs. The corresponding high water elevation is 6,169.13 feet. The outlet of the emergency spillway was evaluated to determine the necessity of riprap on the spillway crest and outslope. The spillway crest will be constructed of concrete 20 feet wide with side slopes of 8:1 (H:V). Based on a slope of 0.0083 ft/ft, a Manning's roughness coefficient of 0.035, and a maximum discharge rate of 24.21 during the 25-year 24-hour event, the exit velocity across the spillway crest was calculated to be 2.13 feet per second (fps). Based on this exit velocity, riprap is not required on the spillway crest. The spillway outslope was analyzed with a slope of 0.375 ft/ft, a Manning's roughness coefficient of 0.035 and a maximum discharge rate of 24.21 cfs. The exit velocity was calculated to be 7.27 feet per second (fps). To prevent outslope channel erosion riprap is required. Due to model limitations for extreme slopes SEDCAD3 is not used to size outslope riprap. The median riprap size (D_{50}) needed to prevent erosion of 18 inches was determined using the OSM Steep Slope Riprap Nomographs. The riprap sizing is based on an extrapolation of the 40% slope curve for a fourteen foot wide trapezoidal channel. Appendix G, OSM Steep Slope Riprap Nomographs contains the OSM Surface Mining Water Diversion Design Manual steep slope riprap sizing nomographs. Emergency Spillway Design calculations are presented on the Sedimentation Pond 001 - Design (Map 24).

SEDCAD3 modeling for Sediment Pond 001 inflow and outflow runoff volumes and discharge rates, stage-discharge and stage-storage curves, and emergency spillway calculations are found in Appendix A-1 SEDCAD3 Modeling for Sediment Pond 001.

4.2.2 Sediment Pond 002

Pond 002 is designed to fully contain runoff volumes from any storm event less than or equal to the 10-year 24-hour event as required under R645-301-742.221.33. Any storm event greater than the 10-year 24-hour event, i.e., the 25-year 24-hour event will be discharged through both the principal and emergency spillways. The principal spillway is a 12-inch diameter CMP riser with a single 1 1/2 inch diameter gooseneck decant. Sedimentation Pond 002 - Design, (Map 25), shows the proposed layout of Sediment Pond 002. Both plan and cross-sectional views are provided. Additional information included on Map 25 includes the Stage-Storage Curve, the Storage Capacity Table, and both Principal and Emergency Spillway design detail. The computation of the runoff volume assumed a total drainage area of 1.8 acres and a curve number of 90 for the disturbed area draining to Pond 002. No undisturbed areas contributed drainage to the pond.

The top of the pond embankment is 6,158.0 feet above MSL. The elevation of the emergency spillway invert and the top of the principal spillway is 6,156.5 feet above MSL. The elevation of the decant orifice on the principal spillway is at 6,153.0 feet above MSL. Pond 002 has a total storage capacity of 0.27 acre-feet.The three year sediment dead-storage volume of 0 acre-feet is at 6,148 feet above MSL. The design storm runoff volume from the 10-year 24-hour event is 0.17 acre-feet. From the stage-storage curve for the pond structure shown on the Sedimentation Pond 002 - Design (Map 25), the allowable storage at the invert of the emergency spillway is approximately 0.27 ac-ft. The dead-storage requirement and runoff volumes were calculated using the Sedimentology portion of the SEDCAD3 computer model. SEDCAD3 modeling for Pond 002 is presented in Appendix A-2.

In setting the decant orifices at 6,153.0 MSL, the pond calculations are based on the premise that the pond has a 0.09 acre-foot permanent pool of water and sediment at the onset of the design storm. To assure that the pond has adequate storage capacity at all times, the pond must be pumped of water and/or cleaned of sediment once the stored water/sediment elevation exceeds 6,152.5 feet MSL. CPMC proposes to use any permanent pool water for mine area access road dust abatement. Prior to dewatering, the pond water will be tested to assure that it meets applicable effluent limitations per R645-301-751.

Both the 25-year, 6-hour, and 25-year, 24-hour, storm events were routed through the emergency spillway to determine the maximum stage and flow rate. Computations were conducted assuming that the pond contained the maximum allowable sediment dead-storage volume of 0 ac-ft (3 years), and that the pond was full of water up to the spillway decant elevation prior to the start of the design storm runoff event. This results in a conservative estimation of maximum stage since, in general, the pond can be assumed to be empty at the beginning of a storm event.

From the analysis of the 10-year 24-hour event, the maximum inflow rate to the pond structure is 2.09 cfs and the maximum outflow rate is 0.09 cfs. The corresponding high water elevation is 6,155.41, 0.91 feet below the invert of the emergency spillway and 2.59 feet below the minimum embankment elevation of 6,158.0 feet MSL. The estimated dewatering time from peak surface water elevation to the decant elevation is 1.0 days. The principal spillway riser design detail is shown on the Sediment Pond 002 - Design (Map 25). Based on the design storm calculations and modeled output Pond 002 will adequately treat the 10-year 24-hour peak flow.

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Discharge from the principal spillway will be measured using a pre-fabricated, steel H-flume. Peak discharge from Pond 002, as a result of the 10-year, 24-hour design event was calculated using SEDCAD as 0.09 cfs. CPMC proposes to install a 0.6 foot deep H-flume at the culvert outflow with a concrete approach box. Figure 13-11, Typical H-Flume Design, displays the typical design.

The 25-year 24-hour storm was routed through the emergency spillway to evaluate the design of the spillway crest and outslope. Computations were conducted assuming that the pond contained the maximum allowable three year sediment storage, and that the pond water surface elevation was 6,156.5 feet MSL (emergency spillway invert elevation). A stage-discharge curve was calculated by SEDCAD3 for the emergency spillway. The SEDCAD modeling for Pond 002 (emergency spillway only) is contained in Appendix A-2. From the emergency spillway only analysis of the 25-year 24-hour event, the maximum inflow rate to the pond structure is 2.62 cfs and the maximum outflow rate is 2.55 cfs. The corresponding high water elevation is 6,156.58 feet. The outlet of the emergency spillway was evaluated to determine the necessity of riprap on the spillway crest and outslope. The spillway crest will be of earthen construction, four feet wide with side slopes of 3:1 (H:V). Based on a slope of 0.0167 ft/ft, a Manning's roughness coefficient of 0.035, and a maximum discharge rate of 2.55 during the 25-year 24-hour event, the exit velocity was calculated to be 2.02 feet per second (fps). Riprap is not required on the spillway crest. The spillway outslope was analyzed with slope of 0.427 ft/ft, a Manning's roughness coefficient of 0.035 and a maximum discharge rate of 2.55 cfs. The exit velocity was calculated to be 5.78 feet per second (fps). To prevent outslope channel erosion riprap is required. Due to model limitations for extreme slopes SEDCAD3 is not used to size outslope riprap. The median riprap size (D_{50}) needed to prevent erosion of 12 inches was determined using the OSM Steep Slope Riprap Nomographs. The riprap sizing is based on an extrapolation of the 50% slope curve for a six foot wide trapezoidal channel and is a conservative estimate. While this is a conservation estimation of required riprap size, CPMC uses a conservation approach to minimize the risk of design failure. Appendix G, OSM Steep Slope Riprap Nomographs contains the OSM Surface Mining Water Diversion Design Manual steep slope riprap sizing nomographs. Emergency Spillway Design calculations are presented on the Sedimentation Pond 002 - Design (Map 25).

SEDCAD3 modeling for Sediment Pond 002 inflow and outflow runoff volumes and discharge rates, stage-discharge and stage-storage curves, and emergency spillway calculations are found in Appendix A-2: SEDCAD3 Modeling for Sediment Pond 002.

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4.2.3 Sediment Pond 003

Pond 003 is designed to fully contain runoff volumes from any storm event less than or equal to the 25-year 24-hour event. This is a total containment pond. UDOGM regulation R645-301-743.224 allows for the design of a total containment structure when it is demonstrated that the sedimentation pond will safely control the design precipitation event. To insure that Pond 003 will safely control runoff, the capacity of the pond was analyzed using the 25-year 24-hour storm event. The Sedimentation Pond 003- Design (Map 26) shows the proposed layout of Sediment Pond 003. Both plan and cross-sectional views are provided. Additional information included on Map 26 includes the Stage-Storage Curve and the Storage Capacity Table. The computation of the runoff volume assumed a total drainage area of 3.0 acres and a curve number of 90 for the disturbed area draining to Pond 003. No undisturbed areas contributed drainage to the pond. This pond is located in the vicinity of the truck scale in the Preparation Plant area. Currently, this pond has a total storage capacity of approximately 0.31 acre-feet. Presently the top of the pond embankment is roughly 6,088.0 feet above MSL.

The design storm runoff volume from the 10-year 24-hour and the 25-year 24-hour events are 0.33 acre-feet and 0.41 acre-feet, respectively. The three year sediment dead-storage volume is approximately 0.02 acre-feet. The dead-storage requirement and runoff volumes were calculated using the Sedimentology portion of the SEDCAD3 computer model. SEDCAD3 modeling for Pond 003 is presented in Appendix A-3.

Based on the design storm analyses, Pond 003 as currently configured will not totally contain runoff volumes from the contributing drainage. Therefore, CPMC will need to reconstruct the pond to totally contain runoff volumes from storm events equal to and less than the 25-year 24-hour event. Due to the existence of water and sewer mains in the area, the pond embankment will be increased to a minimum elevation of 6,090.0 feet above MSL verses increasing the pond depth.

The reconstructed pond, with a minimum top of embankment elevation of 6,090.0 feet, will have a total sediment storage capacity of 1.03 acre-feet. The pond is being designed to allow a permanent pool of 0.52 acre-feet. The peak pool surface elevation is 6,087.0 feet. When the combined sediment volume and permanent pool elevation exceeds 6,087.0 feet, then the pond will need to be dewatered and/or cleaned of sediment. Designing the pond with the excess capacity results in a conservative estimation of maximum stage since, in general, the pond can be assumed to be empty at the beginning of a storm event. From the stage-storage curve for the pond structure shown on the Sedimentation Pond 003 - Design (Map 26), the allowable storage at the peak permanent pool elevation is 0.52 acre-feet. With a permanent pool elevation at 6,087.0 feet, the peak elevation for the 25 year-24 hour event is 6,088.2 feet. With a top of embankment elevation of 6,090.0 ft., Sediment Pond 003 can safely contain storm event runoff from a 25 year-24 hour event.

According to R645-301-742.221.34, sedimentation ponds require a non-clogging dewatering device. As proposed, this pond will be a non-discharging structure. Therefore, the pond will be dewatered using a portable pump system. The inlet structure to the pump will float on the surface of the water. The pump system will include an oil skimmer to prevent floating matter from being discharged from the pond during dewatering. The pond will be dewatered to a maximum elevation of 6,084.32, the maximum sediment storage elevation. Normally any accumulated water will be used for dust control. If dewatering is necessary, prior to dewatering the impounded water will be sampled and tested to insure that it meets UPDES discharge requirements as required under R645-301-751.

4.2.4 Portal Collection Sump

The portal area collection sump is designed to intercept and route runoff volumes from any storm event less than or equal to the 10-year 24-hour event. UDOGM regulation R645-301-743.224 allows for the design of a total containment structure when it is demonstrated that the structure will safely control the design precipitation event.

This collection sump is located in the vicinity of the proposed Willow Creek mine face-up area. The drainage areas contributing to this sump are disturbed subwatersheds that, because of the mine face-up configuration, will not drain to Sedimentation Pond 001. Flows collected by the sump will ultimately will be routed through the system of disturbed drainage ditches and culverts to Sedimentation Pond 001. The location of the sump is shown on the Facilities Area Hydrology Map, (Map 16). The computation of the runoff volume assumed a total drainage area of 6.44 acres and a curve number of 90 for the disturbed area drainage to the sump. An undisturbed area of approximately 2.1 acres with a curve number of 78 is included within the disturbed area category. This undisturbed area is immediately upslope of the proposed mine face-up area, the slopes are extremely steep and the construction of a clean-water ditch to intercept runoff from the area would result in possible greater environmental damage than allowing the runoff to mix with disturbed runoff.

The collection sump has a total storage capacity of 0.39 acre-feet, and the maximum elevation in 6,266.6 feet. The design storm runoff volume from the 10-year 24-hour event is 0.50 acre-feet. Computations were conducted assuming that the sump contained the maximum allowable sediment dead-storage volume of 0.04 ac-ft (1 year of sediment storage), and was without a permanent pool at the onset of the design storm. The elevation of the sediment dead-storage is 6,261.38. The dead-storage requirement and runoff volumes were calculated using the Sedimentology portion of the SEDCAD3 computer model. SEDCAD3 modeling for the portal collection sump (designated as Pond 004) is presented in Appendix A-4.

Runoff from the 10-year 24-hour event reaches a maximum elevation of 6,265.6 feet. This design analysis assumes that the dewatering pump will be activated once the surface water elevation in the sump reaches 6,261.5 feet. This sump is designed with a float actuated suction pump dewatering device as the principal means to dewater the structure in accordance with R645-301-742.221. The pump inlet pipe will extend to the design sediment level. The pump system will include an oil skimmer to prevent floating matter from being discharged from the pond during dewatering. The pond will be dewatered to a maximum elevation of 6,258.56, the maximum sediment storage elevation. The water will be pumped through a 3-inch PVC pipe to the clean-out box in Culvert DC-13. From there the water will be carried in diversion ditches to Sedimentation Pond 001 where the water will be treated. The Portal Collection Sump - Design, (Map 27), shows the sump layout. In routing the water collected in Pond 004 to Pond 001, treatment requirements stated under R645-301-742.221 shall be met.

4.3 POND CONSTRUCTION SPECIFICATIONS

All pond designs for the Willow Creek Mine area have been developed under the supervision of a qualified Registered Professional Engineer (R645-301-512). A qualified Registered Professional Engineer will supervise construction and inspection of the pond structures to insure consistency with design specifications (R-645-301-514.300). Upon completion of construction, the engineer will certify the ponds and forward certification documents to the UDOGM.

4.3.1 Pond Construction

Pond construction will follow the regulatory guidelines as outlined in R645-301-533. The initial step in embankment construction is the removal of all organic materials from the foundation area. This will occur in conjunction with topsoil recovery operations as described in Section 4.5, Engineering Design and Operation Plans. Foundation areas will be graded to achieve maximum 1:1 slopes.

On-site borrow materials will be utilized for fill for the construction of pond embankments. Fill material shall be selectively handled to exclude organic material, frozen soils, and other unsuitable materials. Coal processing wastes may be used as embankment fill material.

Fill materials for pond embankment construction will be placed in horizontally continuous lifts beginning at the base of the structure. In using fine-grained soils, lift thickness should not exceed 12 inches (McCulloch, 1992). Material should be compacted to at least 95 percent of the maximum dry density as defined by the standard Protor test, with the placement of water content not exceeding the range of -2 to +3 percent of optimum (McCulloch, 1992).

At a minimum, the top width of each pond will not be less than 20 percent of the sum of the height, in feet, of the embankment measured at the upstream toe plus 10 feet. The embankment cross-sections are shown on the Sedimentation Pond- Designs (Maps 24, 25, and 26), for Ponds 001, 002, and 003, respectively.

Design specifications for embankment height provide for a minimum of 1.0 foot freeboard between the top of the embankment and the emergency spillway flow level, and an additional five (5) percent factor of safety to offset any settling which might occur. The five (5) percent settling factor is conservative (high), because construction plans specify compaction of the horizontally continuous lift embankment fills. The compaction should all but eliminate settling. In addition, ponds will be constructed primarily with clay, which, because of its high density, will also decrease the potential for settling.

Tests need to be performed during the construction of pond embankments to determine compliance with moisture-density specifications. At a minimum, one field test for every 2,000 cubic yards of compacted structural fill, with at least one test per lift; one field test for every 200 cubic yards of compacted backfill in trenches or around structures, with at least one test per lift (in situations were small diameter pipes are used, more frequent tests will be preformed); supplementary laboratory compaction curves for at least every 20 field density tests.

Maps 24, 25, and 25 show that the combined upstream and downstream slopes of the settled embankments will not be less than 1V:5H, with neither slope steeper than 1V:2H. All pond embankments will be designed and constructed to insure stability and minimize erosion. Upon completion of fill placement, all embankments and surrounding disturbance areas will be final graded and stabilized by seeding with the seed mix discussed in Section 5.3, Habitat Restoration Plans.

4.4 ALTERNATIVE SEDIMENT CONTROL PRACTICES

There are three operational areas within the proposed surface mine facilities area boundary which do not drain to the sedimentation ponds. The Drainage and Sediment Control Plan, (Maps 23A through 23F), identifies those operational areas where CPMC will implement alternative control practices to minimize any possible adverse impacts to the hydrologic resource as a result of mining activities. By definition, areas which do not drain to a sedimentation structure are referred to as alternative sediment control areas (ASC). Silt fences and/or straw bales and sediment traps will be used as alternative control structures to prevent sediment generated by mining activities from mixing with undisturbed water without first being treated to remove any excess sediment load. Figure EXDS-12, Typical Sediment Control Practices, shows the design of silt fences and hay bale structures used in controlling sediment yields.

The three areas where alternative sediment control measures will be utilized include:

- ASC-1: the access road area at the upgradient entrance to the "Long-Tunnel"
- ASC-2: the access road to the Mine and Fire Water Tank area
- ASC-3: the Topsoil stockpile area

The contributing drainage area to ASC-1 is 0.67 acres. The volume of runoff from 25-year 24-hour event is 0.08 ac-ft, with a corresponding peak discharge of 0.99 cfs. Rainfall runoff from ASC-1 will be routed through collection depression lined with course riprap material, then routed through a silt fence structure at the depression outfall and the treated water discharged into diversion ditch UDD-23a.

ASC-2 is subdivided into three areas and has a total contributing drainage area of 1.02 acres. The water tank pad is approximately 0.26 acres in size. The runoff volume associated with the 25-year 24-hour design storm is 0.03 ac-ft. The pad area is completely surrounded with a berm and the pad surface will be a gravel bed that will allow for infiltration of any rain-on precipitation. The berm and gravel will totally contain any precipitation in the tank pad area. The upgradient portion of the access road is approximately 0.14 acres. The road surface will be graded to insure that the 25-year 24-hour runoff volume of 0.02 ac-ft flows into diversion ditch DD-28. The outfall will be to a small collection depression lined with course riprap material and from there the runoff will be routed through a silt fence structure. A berm (approximately 6 inches high) will be constructed across the road to divide the upgradient and downgradient areas. The downgradient portion of the road is approximately 0.17 acres and the road will be graded so that runoff of 0.02 ac-ft is collected in diversion ditch DD-29. The ditch outfall will be into an existing natural drainage containing a silt fence structure that runs along State Highway 191.

ASC-3 has a contributing drainage area of approximately 1.5 acres. The runoff volume from the 25-year 24-hour storm event is 0.13 ac-ft. A berm, 2.0 feet high will be constructed around the downgradient side of the stockpile. This will be a total containment structure. A silt fence structure will be installed along the toe of the berm. The topsoil pile will be graded and stabilized by seeding with the seed mix discussed in Section 5.3, Habitat Restoration Plans.

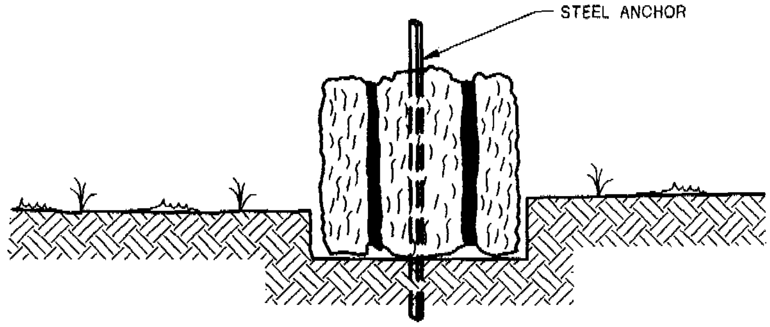
In addition to the two identified areas requiring alternative sediment control measures, alternative controls will be utilized in conjunction with the following specific activities:

- Initial construction areas
- Construction areas in or adjacent to Willow Creek (including the two relocated segments)
- Road fill and embankment outslopes adjacent to the Willow Creek stream buffer zone

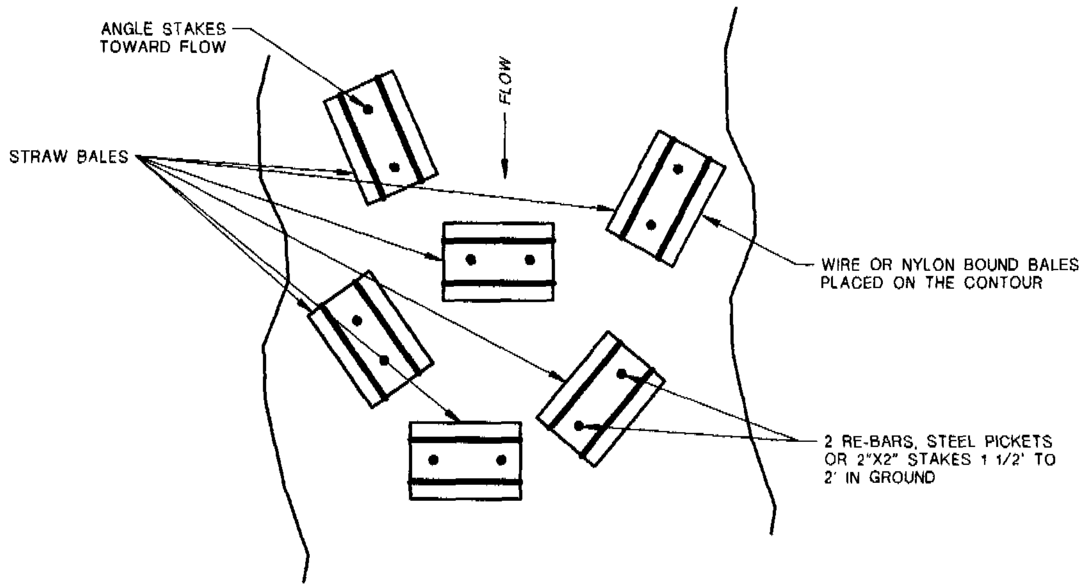
The alternative sediment controls associated with these areas are interim control measures until temporary vegetative cover is established. Sediment control measures which will be used during the construction of the two realigned channel segments are discussed in Exhibit 14, Willow Creek Realignment Plans.

4.4.1 Hydrology Designs

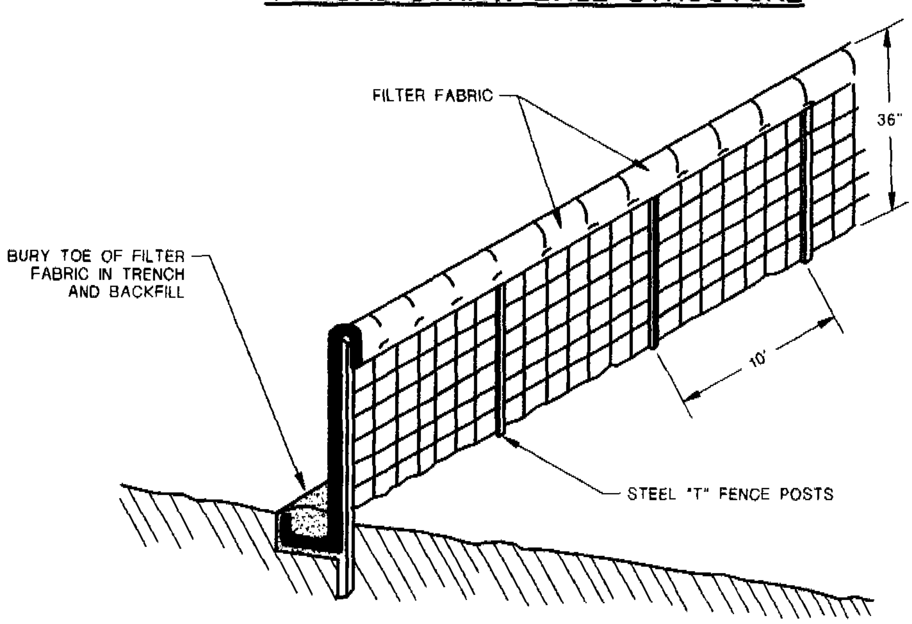
Runoff peak discharge calculations were performed utilizing the SEDCAD computer model, consistent with the methodology discussed in the preceding section. The curve number for ASC-1 and ASC-2 was determined based on the following conditions (Haan, et al., 1994):



EMBEDDING DETAIL



TYPICAL STRAW BALE STRUCTURE



TYPICAL SILT FENCE

Not to Scale

Project No.: 866-2200	Design By: John Weinman	Scale: NOt To Scale	CYPRUS Plateau Mining
File: SEDCTRL.DWG	Drawn By: Karen Conrath	Date: April 1995	
TerraMatrix Engineering & Environmental Services 1475 Pine Grove Road, P.O. Box 774018 Steamboat Springs, Colorado 80477	Figure 13-12		TYPICAL SEDIMENT CONTROL MEASURES

Disturbed

Soil Type: C

Industrial area (72% impervious)

Gravel road

CN: 90

For ASC-3, the curve number was determined based on the following conditions:

Disturbed

Soil Type: C

Ground Cover: Poor

Cover Type: Herbaceous

CN: 84

Calculated peak discharges for the 25-year 24-hour event for the three areas are:

- ASC-1 0.99 cfs
- ASC-2 0.84 cfs
- ASC-3 1.71 cfs

4.4.2 Sediment Fence Requirements

Given the peak discharge and permissivity of sediment fence, the amount of sediment fence surface area required to safely pass the peak discharge from a 25-year 24-hour event was determined using the following calculation:

Sediment Fence Permissivity: 0.033 cfs/ft^2 or 15 gal/min/ft^2 (manufacturer's specification)

Required Surface Area:

ASC-1:	0.99 cfs/0.033 cfs/ft^2 = 30 ft^2
ASC-2:	0.84 cfs/0.033 cfs/ft^2 = 25 ft^2
ASC-3:	1.37 cfs/0.033 cfs/ft^2 = 52 ft^2

The required length of fence will be calculated assuming a flow depth of one foot. Actual fence installed should be a minimum of 1.5 feet to allow freeboard and a factor of safety on permissivity.

The sediment fence will be installed in accordance with the manufacturer's recommendations and the fences will undergo regular inspections and maintenance to insure proper operational capabilities.

4.4.3 SAE Request

No underground mining occurs in the immediate vicinity of the three areas proposed for alternative sediment control practices. There is no evidence of groundwater discharge from mine workings and/or springs or seeps to the surface in the vicinity of the three areas and none is anticipated. Given the absence of groundwater discharge, there will be no mixing of surface drainage and mine discharge.

In order to preclude any significant adverse impacts on downstream water quality, CPMC designed an alternative sediment control method of berms and/or small catchment sumps in conjunction with sediment fences to intercept any sediment generated from the areas. CPMC plans an ongoing maintenance program on the berms, collection sumps, and sediment fences during the period of active operations, including inspection and repair of any significant damage and periodic sediment removal.

The sediment fences, berms, and collection sumps are designed to safely pass the runoff from the 10-year 24-hour storm event for the contributing drainage area. The location of the alternative sediment control areas are shown on the Drainage and Sediment Control Plan, Maps 23D, 23F, and 23C for ASC-1, ASC-2, and ASC-3, respectively.

As previously discussed, the disturbed areas for ASC-1, ASC-2, and ASC-3 are 0.67 acres, 1.02 acres, and 1.5 acres, respectively. Given the limited sized of ASC-1, the isolated nature of ASC-2 and ASC-3, and the sediment control measures previously discussed which will effectively prevent significant adverse downstream water quality impacts, CPMC respectively requests UDOGM approval of ASC-1 (the downgradient entrance area to the "Long-Tunnel"), ASC-2 (the Mine and Water Tank area), and ASC-3 (the Topsoil Stockpile area) as small area exemptions.

4.5 POSTMINE DRAINAGE DESIGN

Reclamation will be an integral part of the Willow Creek mining and related activities, however, because the mine will be an underground mine and the surface facilities and related surface disturbance areas will remain in place until the end of the mine, mining and reclamation will not occur concurrently or, in the case of progressive mining activities, sequentially. Reclamation of surface disturbance areas will generally occur following the cessation of mining operations to complete the mining and reclamation cycle although CPMC will implement temporary stabilization measures in certain areas following initial construction or during ongoing operations.

An integral part of the Willow Creek Mine reclamation plan is the postmine drainage configuration. Objectives of the planned reclamation activities involve stabilizing surface disturbance areas, minimizing erosion, restoring the natural drainage pattern, and limiting potential adverse surface water impacts.

The postmine drainage configuration will be compatible with the natural drainage pattern of the surrounding terrain. Additionally, it will effectively route natural drainage from undisturbed upgradient areas through the reclaimed surface facilities area with minimal erosion or increases in sediment loading. This section describes the postmine reclamation drainage configuration and plan for the proposed Willow Creek Mine.

4.5.1 Reclamation

The proposed operational life of the Willow Creek Mine is roughly 15 to 20 years. The mine surface facilities and associated disturbance areas will disturb approximately 38 acres. Roughly 34 acres is located within the Willow Creek drainage and the remaining four acres is located adjacent to the Castle Gate Preparation Plant area. The postmining reclamation topography for both the Willow Creek area and the operational area which drains to Sediment Pond 003 which is adjacent to the Castle Gate Preparation Plant is shown on Map 21A, Mine Surface Facilities Area - Postmining Topography. The proposed reclamation plan for the existing Castle Gate Preparation Plant area was developed and approved separately from this mining and reclamation plan and is discussed in Exhibit 19, Castle Gate Information. The Willow Creek Mine reclamation plan is further described in Section 5.0, Reclamation Plans.

Site reclamation and the reestablishment of postmine drainage will be sub-divided into three phases: Phase I, Site Reclamation, which includes the removal and reclamation of mine related structures and facilities; Phase II, Final Reclamation, which includes the removal of any temporary drainage and sediment control and associated structures; and, Phase III, Bond-Release Reclamation, which includes water and vegetation monitoring during the extended liability period.

4.5.1.1 Phase I Reclamation

The first stage in reestablishing site drainage will occur in conjunction with Phase I Reclamation. During Phase I reclamation, reclamation activities will include:

- Removal of all mine related structures and facilities
- Disposal of waste materials
- Removal of roads not needed for access during the extended liability period
- Backfilling and grading of disturbed areas
- Soil replacement
- Revegetation of disturbed areas

All existing mine structures which lie within the disturbed area boundary will be removed, including the mine warehouse and shop buildings, the conveyor structures, mine office, mine fire water tank and other mine surface facilities. The majority of the roads and storage areas will also be removed during this initial phase of reclamation.

Required grading work will be completed in order to establish a stable postmining configuration which blends with the surrounding terrain, provides for effective overland flow drainage patterns, and is consistent with the postmining land use of wildlife habitat. Existing conditions in the Willow Creek mine-surface facilities area reflect previous mine-related disturbance. Since the pre-mining configuration represents a disturbed landform, CPMC may slightly modify the surface configuration during reclamation in order to establish an effective drainage pattern and blend the mine surface facilities area into the adjacent, undisturbed topography. Map 21A, Mine Surface Facilities Area - Postmining Topography, displays the proposed postmining topography for the Willow Creek areas. The land configuration in the mine surface facilities area adjacent to the Castle Gate Preparation Plant is very steep and was disturbed by previous activities. CPMC will blend the disturbed area into the existing adjacent topography and create a landform which resembles the surrounding topography. The postmining topography for the Willow Creek Mine surface facilities area which is adjacent to the Castle Gate Preparation Plant is also shown on Map 21A, Mine Surface Facilities Area -Postmining Topography.

During the backfilling and regrading operations, the following work will be performed:

- Elimination of berms and temporary diversions, except where noted
- Grading to establish overland flow drainage where possible
- Construction of permanent drainage channels
- Removal of existing culverts, except where noted
- Removal of Sedimentation Ponds 002 and 003
- Selective application of alternative sediment control methods
- Installation of silt fences
- Soil replacement, seeding, fertilizing, and mulching

The diversion ditches which collect storm event runoff from undisturbed areas and route the flow around and through the mine surface facilities will be eliminated during Phase I reclamation. ~~However, four permanent~~ drainage features, or postmine drainage channels (PMCs) will be established in the Willow Creek mine surface facilities area to carry runoff from most upgradient, undisturbed areas though the reclaimed mine surface facilities area. The location of the four PMCs are shown on Map 21A, Mine Surface Facilities Area - Postmining Topography. The design summary for these channels is provided in Section 4.5.3.1.

Sedimentation Pond 001 will be the primary means of treating runoff and sediment generated from reclaimed watersheds corresponding to the mine surface facilities area reclamation watersheds during and following Phase I reclamation. The reclaimed watersheds are shown on Map 21B. Runoff from those undisturbed areas which will not be routed through the permanent drainage channels may potentially contribute runoff and sediment to Sedimentation Pond 001 during Phase I reclamation. Map 21B also shows those undisturbed areas which may contribute runoff and sedimentation to the reclaimed mine surface facilities area and ultimately Pond 001. To limit runoff and sediment contributions to Pond 001, however, CPMC proposes to use alternative sediment control measures (ASCM's) to supplement the designed drainage features . The proposed alternative control method technologies are described in Section 4.5.2.

Siltation fences will be installed during Phase I reclamation as alternative sediment control measures to limit sediment delivery to the PMCs, the stream buffer zone, and ultimately Willow Creek. The siltation fences will be installed parallel to the regraded postmining contour, which correlates to an angle of approximately 45 degrees to the channel centerline. CPMC proposes to use 50 foot segments with 10 feet of overlap. Appendix H-4 contains calculations which show the proposed spacing of the siltation fence segments. In addition, on an as needed temporary basis, CPMC may install a second sequence of siltation fences parallel to the stream buffer zone and/or PMC(s).

Several operational berms and diversion ditches which collect and route overland flow from the disturbed surface facilities area to Sedimentation Pond 001 will be retained during Phase I of reclamation. The reclamation collection and diversion ditch (RCDD) which will remain in place during Phase I reclamation is displayed on Map 21B, Mine Surface Facilities Area - Interim Drainage Control. Two culverts will be installed to convey reclamation diversion ditch flows across two of the permanent drainage features. The location of the two reclamation culverts (RC) are also shown on Map 21B. The design summary for the reclamation collection and diversion ditch is included in Section 4.5.3.1, while Section 4.5.3.2 summarizes design information for the two culverts. As noted previously, Sedimentation Pond 001 will be retained as primary sediment control for the Willow Creek mine surface facilities area during and following Phase I reclamation. Because of the space limitations and its proximity to Willow Creek, Pond 001 was designed so that it would not require modification during reclamation, thereby limiting the amount of disturbance in the Willow Creek buffer zone. Section 4.5.3.3 provides the Phase I reclamation design summary for Pond 001. CPMC proposes to retain the reclamation collection and diversion ditch, the two culverts, and Pond 001 for a minimum of three years and up to ten years, during the time required for the reestablishment of an adequate vegetation community to control erosion.

Sedimentation Ponds 002 and 003 will not be retained for sediment control subsequent to Phase I reclamation. Incorporation of the two sediment ponds and associated diversion ditches for reclamation sediment control would result in redisturbance of these areas following vegetative re-establishment. Both of these areas are relatively small, with contributing drainage areas of 1.8 and 3.1 acres for Ponds 002 and 003, respectively. Based on the small contributing drainage area and the consequences of redisturbing established vegetation, CPMC proposes to use alternative sediment control measures to limit and control sediment and runoff during reclamation from those operational areas which drain to Ponds 002 and 003. Disturbed areas currently proposed as Alternative Sediment Control Areas, the Long Tunnel portal entrance (ASC-1) and the mine fire water tank area (ASC-2) will also use ASCM's to limit sediment and runoff from reclaimed areas during the reclamation phase. Additionally, CPMC proposes to use ASCM's in the mine ventilation fan area to control erosion and limit sediment during reclamation. The location of the reclamation alternative sediment control areas (RASCAs) are shown on Map 21B, Mine Surface Facilities Area - Interim Drainage Control. The proposed alternative control methods are described in Section 4.5.2.

CPMC will continue its comprehensive hydrologic monitoring program during Phase I reclamation. Activities specified for the reclamation phase hydrologic monitoring program, including the monitoring network and the parameter compliance list are presented in Exhibit 12, Hydrologic Monitoring Plan.

4.5.1.2 Phase II Reclamation

Phase II reclamation will commence once CPMC has demonstrated that the proposed postmining plant community has successfully reestablished a viable, self-sustaining vegetative community based on the habitat restoration plans presented in Section 5.3, Habitat Restoration Plans, of the Mining and Reclamation Permit Application, and UDOGM has given approval for the removal of the interim drainage and sediment control structures. The operations which will be performed during this phase of reclamation include:

- Backfilling of Pond 001
- Elimination of the remaining berms and temporary diversion channels
- Removal of the temporary culverts
- Removal of silt fences and straw bales

The temporary reclamation diversion and berm, which were left to control runoff during and following Phase I reclamation will be removed. The two reclamation culverts will also be removed. Additionally, silt fences and straw bales which were installed as part of the interim drainage and sediment control plan will be removed. Any significant sediment accumulations behind silt fences will be deposited in Pond 001. Where the removal of silt fence fabric may substantially disrupt the established vegetation adjacent to the fence, the fabric may be cut at ground level and the buried fabric abandoned in place. Pond 001 will be backfilled. Grading will be completed to establish the final design configuration in the Pond 001 area. The areas disturbed during Phase II of reclamation will be seeded and mulched in accordance with Section 5.3 Habitat Restoration Plans.

During reclamation of the Phase I drainage and sediment control structures, CPMC will use temporary alterative sediment control measures such as silt fences or straw bales to control sediment contributions to the downgradient receiving waters. CPMC proposes to install siltation fences or straw ales parallel to the reclaimed contour in 50 foot segments, with a minimum 10 foot overlap and spaced approximately 55 feet apart. These temporary features be installed prior to Phase II reclamation activities and prevent sediment from the reclamation areas from reaching the Willow Creek buffer zone and/or stream channel. The temporary alternative sediment controls will remain in place during backfill/regrading operations, the placement of soil or substitute materials, reseeding, and the reestablishment of vegetation.

CPMC will continue its comprehensive hydrologic monitoring program during Phase II reclamation. Activities specified for the reclamation phase hydrologic monitoring program, including the monitoring network and the parameter compliance list are presented in Exhibit 12, Hydrologic Monitoring Plan.

4.5.1.3 Phase III Reclamation

Phase III reclamation will consist of water and vegetation monitoring until bond release. Vegetation monitoring will occur in accordance with Section 5.3.2.8, Revegetation Success - Criteria and Evaluation Methods. CPMC will continue its hydrologic monitoring program during Phase III reclamation.

The Willow Creek surface facilities area primary access road (PR-1) and the Willow Creek culvert will be removed and the disturbed area reclaimed following a determination by UDOGM that Phase II reclamation and revegetation is successful. CPMC proposes that the removal and reclamation activities will occur during low flow conditions to minimize the reclamation impacts to Willow Creek. The access road will be ripped and surface material disposed of in an approved on-site disposal area. Subsurface materials will be excavated and the terrain regraded to conform with existing the channel bank configuration. In conjunction with the excavation and regrading activities, the culvert will be pulled and the channel bed restored to a condition similar to the immediate upgradient and downgradient reaches. CPMC will line Willow Creek with siltation fences and straw bales to trap erosion generated during the excavation and regrading of subsurface materials. The silt fences and hay bales will remain until the approved postmining vegetation community has been successfully reestablished. In addition, a series of rock check dams will be installed in Willow Creek downgradient of the culvert to trap any sediment generated during the removal of the culvert and the reestablishment of a stable channel bed.

CPMC proposes a modified monitoring network and parameter compliance list during the limited liability period through bond release. At the time that CPMC moves into Phase III reclamation, hydrologic monitoring will occur on Willow Creek and the Price River upstream and downstream of the former mine surface facilities area to demonstrate the success of CPMC's reclamation plan.

The proposed Phase III reclamation hydrologic monitoring parameter compliance list will include:

- pH
- Temperature
- Specific conductance (corrected to 25 °C)
- Total Dissolved Solids
- Total Suspended Solids
- Total iron
- Total manganese
- Flow

4.5.2 Alternative Sediment Control Measures

The proposed mine surface facilities area is primarily located within a narrow strip of land along the north bank of Willow Creek. Three additional areas, however, all relatively small in size will be disturbed by mine surface facilities construction. One area, the mine fire and water tank area is located across from the primary surface facilities area on the south side of Willow Creek. The second area, the existing office trailer area and proposed Willow Creek topsoil stockpile area, is located along the south side of Willow Creek, between State Highway 191 and Willow Creek. The third area, the west portal of the long tunnel and associated access road is located along the east bank of the Price River south of and adjacent to the Castle Gate Preparation Plant area.

The use of sediment ponds as primary sediment control could potentially lengthen the time necessary to establish permanent vegetation in all mine disturbance areas. The incorporation of sediment ponds and associated diversion ditches for all operational areas during the reclamation process may result in redisturbance of significant areas of established vegetation. CPMC proposes that alternative sediment control measures (ASCM's) be utilized as the primary means to control erosion and sediment yields from the disturbance areas associated with the water tank, the office trailer/soil stockpile area, and west portal installations identified above. In addition, in order to effectively control erosion in other areas, CPMC may also selectively utilize ASCM's as appropriate. Map 21B, Mine Surface Facilities Area - Interim Drainage Control, displays the mine surface facilities areas where CPMC proposed to incorporate ASCM's as the primary sediment control measures during the reclamation phase. It is important to note that ASCM's will also utilized for portions of the mine surface facilities area which will use Pond 001 as the primary sediment control measure during the reclamation phase.

The following alternative control methods, utilized individually or in combination, are proposed to limit and control erosion and sediment runoff:

- Pitting
- Surface ripping
- Contour furrowing
- Silt fences and straw bales
- Seeding, fertilizing, and mulching

These methods are considered the best available control technology for mine reclamation applications (OSM, 1982). In addition to these alternative sediment control measures, rock armoring may be used in selected locations where steep fill slopes increase the potential for erosion.

The proposed alternative sediment control measures can be classified into four categories: mechanical treatments, surface protection measures, filtering structures, and vegetation. Mechanical treatments increase surface roughness thereby reducing overland flow velocity, and minimizing sediment transport capacity. Reduction of runoff also increases soil moisture for plant germination. Surface protection measures include mulch, mulch binders, netting, seeding, and rock armoring. These measures are the most effective controls since they minimize the amount of soil exposed, reducing soil detachment by raindrop impact, and thus limit soil loss at the source. Surface protection measures also increase surface roughness and increase water infiltration. Filtering structures inhibit runoff and sediment transport capacity by reducing flow velocity. They also physically trap sediment in the filter openings while allowing water to pass through. Vegetative sediment filters reduce overland flow velocities, remove fine sediment from overland flow, and control erosion on the disturbed areas.

Mechanical treatment of slopes less than 20% will be performed by ripping the soil to a depth of 12" to 18". Steeper slopes will be scarified using the tines of a backhoe bucket. Ripping will loosen the soil and allow root penetration and increase moisture storage. This will allow re-establishment, which will reduce erosion. In addition to ripping the soil, contour furrows may established on slope areas. Contour furrows trap sediment dislodged by raindrop impact and overland flow. They also reduce the length of potential flow paths and limit flow velocities, thereby reducing the sediment carrying capacity of the runoff. Pitting is similar to ripping in that many small pockets or depressions are created which trap runoff and reduce overland flow. The pits also encourage water infiltration providing for increased soil moisture storage. Pitting will involve the use of a backhoe or a basin blade mounted on a crawler tractor to create numerous small depressions on reclaimed slopes.

Mulching can significantly reduce the amount of sediment yield from an area (Simons, et al., 1983). Mulching also helps retain moisture to allow for seed germination. Mulching is particularly valuable in protecting seeded areas from the high intensity, short duration storms (USDA- USFS, 1979). The rainfall intensity factor for the 10-year, 6-hour storm event in the Willow Creek area is 0.61 inches per hour (Earthfax, 1995) . A minimum mulch application rate of 0.9 tons per acre will be required to prevent mulch loss from rainfall with a rainfall intensity factor of 0.61 inches per hour (Simons, et al., 1983). To assure that the mulch will remain in place, it will be applied at the rate of one tons per acre and crimped in place.

Permanent plant growth is the best method of controlling erosion from slopes (Simons, et al., 1983). Upon completion of the grading and mechanical treatment of the soil, reclaimed areas will be seeded with proposed permanent seed mixtures which include woody species, grasses, and forbs and selected areas will also be planted with woody species transplants. The seedbed preparation and seeding activities, including the proposed seed mixtures are discussed in Section 5.3.2.2, Revegetation Practices, and Section 5.3.2.3, Revegetation Species and Amounts. Seeding will be conducted at the appropriate time of the year in consideration of available moisture for germination. Areas where seed does not germinate will be reseeded.

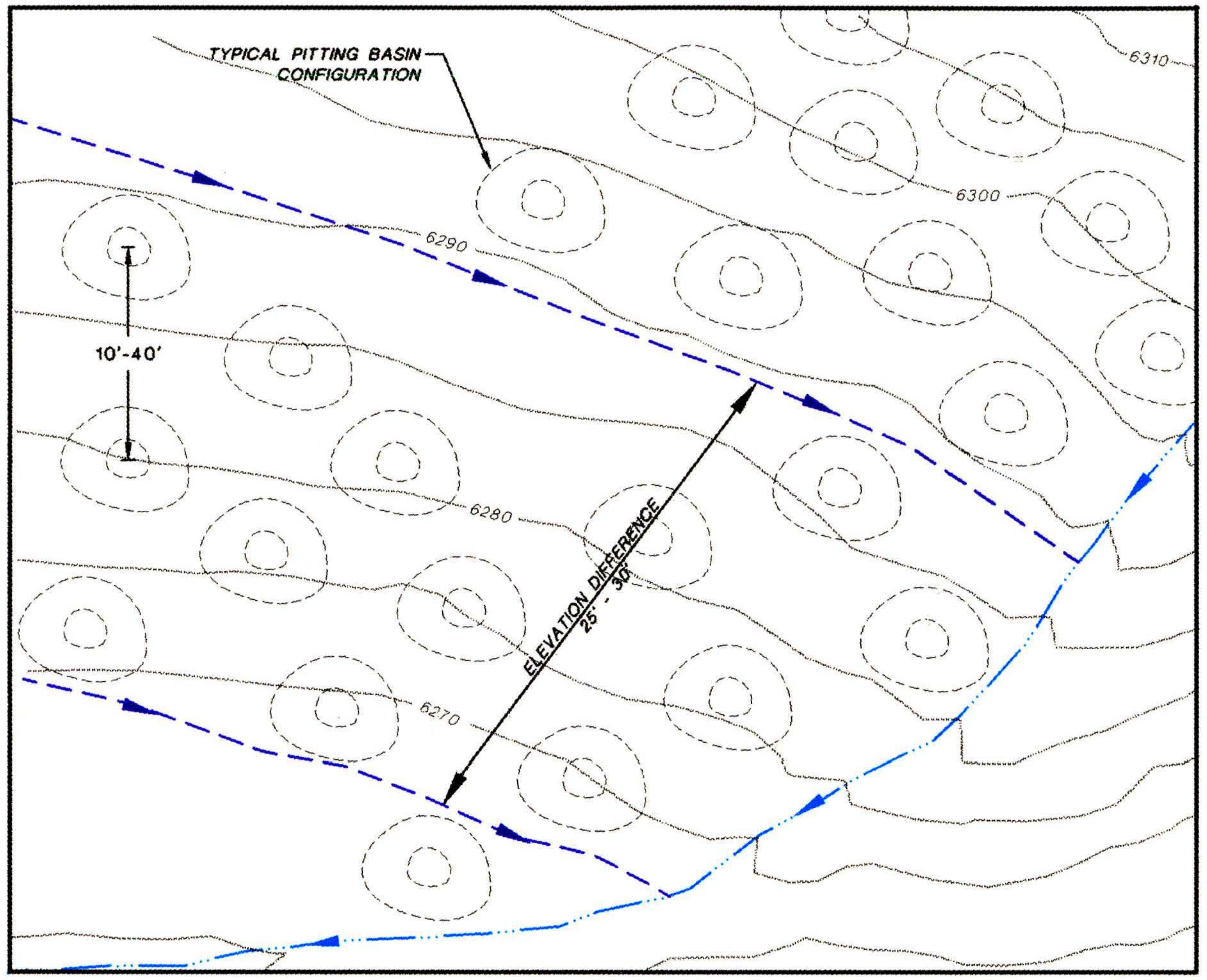
Filtering structures will be used in conjunction with the other alternative sediment control measures to protect the constructed permanent drainage channels and Willow Creek. The silt fences will be installed parallel to the contours with the ends of the fences turned up perpendicular to the contours to contain the sediment. Where the permanent drainage features cross the reclaimed facilities area, silt fences and/or hay bales will be placed at 45 degree angles to the channel centerline to intercept sediment. Silt fences and hay bales will typically be installed in accordance with Figure 13-12. CPMC proposes to use 50 foot segments, with 10 foot overlaps, that will be spaced approximately 55 feet apart. To prevent sediment from passing under the fence, the fabric will be secured by burying the bottom edge in a small trench along the length of the fence. Appendix H-4 presents the calculations that verify that a single tier system of 36" high silt fences will be adequate to capture sediment during a 10-year, 6-hour storm event without failing, assuming they are properly maintained.

Calculations which support the use of alternative sediment control measures for controlling erosion and sediment production can be found in Appendix H-4. Figure 13-13, Typical Reclamation Alternative Sediment Control Design displays the typical configuration of contour furrows and pitting basins which will be used to control runoff and erosion on the reclaimed facilities surface area.

The alternative ASCM's constructed during Phase I reclamation will be inspected quarterly or after every major storm event. Observations made during these inspections, as well as corrective actions taken, will be recorded. Any necessary modifications to the sediment control plan indicated by those inspections will be implemented in a timely manner to prevent future sediment runoff into the PMCs and/or Willow Creek. Corrective action will be taken when sediment builds up on either side of a silt fence to half it's height, when the sediment fence is listing more than 20 degrees for the vertical, when straw bales become 50 percent saturated with silt, or when a gully greater than six inches in depth is created due to the lack of vegetative establishment. Corrective action will consist of repairing/replacing or adding filter fabric fences and/or straw bales as necessary, regrading of the ground surface only as necessary to fill in six inch gullies caused by erosion, and reseeding and mulching to reestablish vegetation. Soil material trapped by sediment control measures that is not used in repairing the site will be removed and disposed of within the Willow Creek Mine permit boundary.

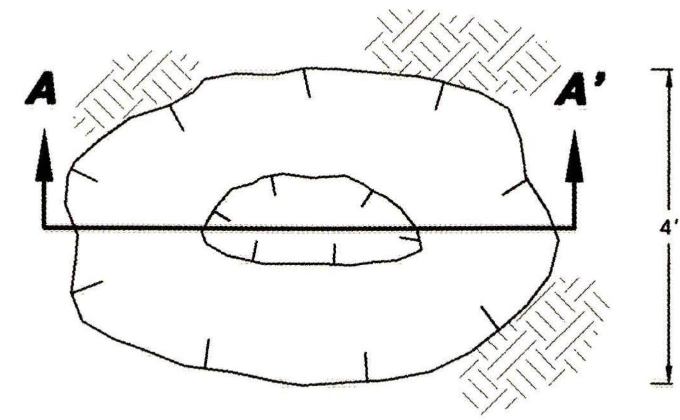
4.5.3 Reclamation Hydrology

The postmine drainage configuration will be compatible with the existing natural drainage patterns. The drainage pattern will effectively route natural drainage from undisturbed areas through the reclaimed area with minimal erosion or sediment loads. Map 21A, Mine Surface Facilities Area - Postmining Topography, shows the postmine drainage configuration and the permanent drainage features.



REGRADED FACILITIES SURFACE AREA

Not to Scale

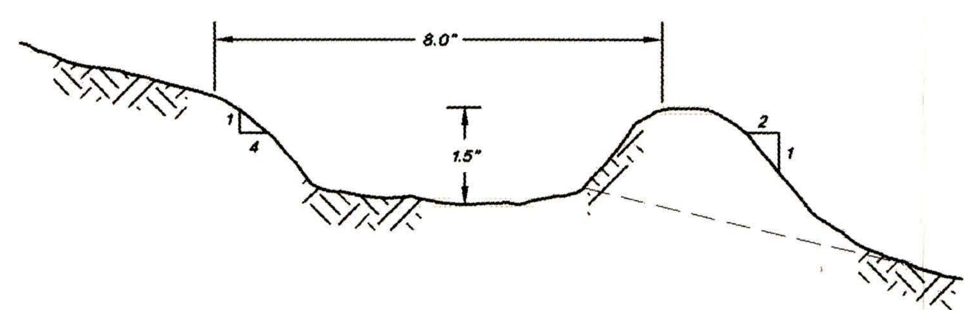


TYPICAL PITTING BASIN DESIGN PLAN VIEW

Not to Scale

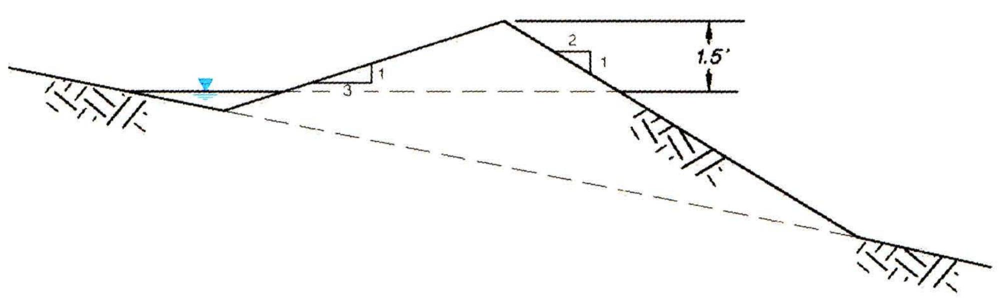
LEGEND

- POST-MINING TOPOGRAPHY
- RECLAMATION COLLECTION AND DIVERSION DITCH
- TYPICAL CONTOUR FURROW DITCH
- TYPICAL PITTING BASIN



CROSS-SECTION A-A'

Not to Scale



TYPICAL CONTOUR FURROW DITCH

Not to Scale

NOTES:
1. PITTING BASIN DESIGN DIMESIONS ARE MAXIMUM DIMENSIONS.
2. DISTANCES BETWEEN PITTING BASINS WILL RANGE FROM 10-40 FT.
3. PITTING BASIN AND CONTOUR FURROW DESIGN WILL BE BASED ON SITE SPECIFIC CONDITIONS.
4. CONTOUR FURROW DITCHES WILL BE CONSTRUCTED AT A MAXIMUM SLOPE OF 2%.

Project No.:	Design By:	Scale:
866-4300	J.WEINMAN	Not To Scale
File: ALT-SCD.DWG	Drawn By: K.CONRATH	Date: APRIL 1996

TerraMatrix
Engineering & Environmental Services
1475 Pine Grove Road, P.O. Box 774018
Steamboat Springs, Colorado 80477

FIGURE 13-13

CYPRUS Plateau Mining

TYPICAL RECLAMATION ALTERNATIVE SEDIMENT CONTROL PLAN

4.5.3.1 Reclamation Channel Design

Several operational disturbed diversion ditches along Willow Creek will be retained during Phase I reclamation. These diversion ditches will be redesignated as the reclamation collection and diversion ditch (RCDD). The ditch has been subdivided into sub-reaches for purposes of riprap design. Map 21B, Mine Surface Facilities Area - Interim Drainage Control shows the location of the RCDD. This ditch will collect and route overland flow from the reclaimed operational face-up area and the majority of the mine support facilities area along Willow Creek to Pond 001. This ditch will be retained during Phase I reclamation. The RCDD will consist of operational disturbed diversion ditches DD-6a, DD-8b, DD-10, DD-14a, DD-14b, DD-16, DD-17b, and DD-17c. Current UDOGM regulations require that temporary diversions channels are sized so they adequately convey storm runoff from the 10-year, 6-hour event (R645-301-742.323). Due to the close proximity of the mine surface facilities area boundary to Willow Creek, CPMC designed the operational diversion ditches for the 25-year, 24-hour storm event. Table 13-8 provides the operational design schedule for the disturbed area diversion ditches.

FlowMaster 1 (Haestad Methods, 1990) was utilized to size the reclamation channel. FlowMaster incorporates Manning's and continuity equations and solves for open channel flow. The channel bottom width, side slopes, an assumed Manning's roughness coefficient, and peak discharge are inputs for each channel. Flow depth and velocity are model outputs. For reaches of the RCDD where flow velocity exceeded 5 fps, channel design included riprap sizing. The average D_{50} material was determined using the Simons/OSM Method in the SEDCAD channel utility. The OSM steep slope nomographs were used as a design check. Once the riprap D_{50} was calculated, then Abt's equation (Abt, et al., 1988) was used to verify that a reasonable Manning's n was incorporated into the ditch design.

As described in Section 4.5.1, during backfill and regrading operations the life-of-mine undisturbed drainage diversion ditches will be removed. Removal of the ditches will result in an increase of drainage area contributing runoff to Sediment Pond 001. Table 13-13, Reclamation Watersheds, summarizes those undisturbed drainages which will contribute runoff to Pond 001 during the reclamation phase. Map 21 B, Mine Surface Facilities Area - Interim Drainage Control shows the undisturbed watersheds which will drain to Pond 001 during Phase I reclamation. Peak flow calculations were performed to assure that the RCDD will have adequate capacity to convey the additional runoff contributed by the undisturbed areas for the 10-year, 6-hour storm event.

Table 13-14, Reclamation Hydrology Channel Design, summarizes the RCDD design schedule and provides a comparison of discharges for the 10-year, 6-hour design event under worst-case reclamation conditions, and the 25-year, 24-hour storm event under operational conditions. Additionally, Table 13-14, shows the calculated flow conditions and the design necessary to convey the 25-year, 24-hour storm event under the best case scenario. The worst-case reclamation scenario would occur immediately following backfill and regrading operations, when the land surface would be barren, and prior to any mulching, vegetation cover establishment, or other ASCM's. The best-case scenario would occur following seedbed preparation (pitting, ripping, and furrowing), mulching, and the successful establishment of a vegetative cover.

While the possibility exists that a 25-year, 24-hour storm (or larger) may occur during Phase I reclamation, the probability that an event of this magnitude will occur during the one year it will take to complete the ASCM's and allow for an emergent ground cover is only 4 percent. The probability of the 10-year, 6-hour event occurring under the worst-case reclamation scenario is 10 percent (Dunne and Leopold, 1978; Equation 2.5). CPMC feels that the possibility of the 25-year, 24-hour storm occurring under the worst-case reclamation scenario is an acceptably small probability and has designed the RCDD for the 25-year, 24-hour storm event under the best-case reclamation scenario, i.e., ASCM's are in place with an emergent vegetative cover.

CPMC expects to complete the ASCM's within the first reclamation construction season, which in conjunction with successful vegetation establishment, will greatly reduce the time-period that the reclaimed surfaces will be most susceptible to erosion and sediment. With the ASCM's in place, runoff and sediment from the 25-year, 24-hour event are comparable to the worst-case scenario for the 10-year, 6-hour storm event. Table 13-14 shows the calculated peak discharge and velocities for the seven reaches of the RCDD for the 10-year, 6-hour and 25-year, 24-hour storm events. The 25-year, 24-hour storm event discharge and flow velocities are slightly higher then the 10-year, 6-hour event.

APPENDIX A-3

REPLACES SEDIMENT POND 003 CALCULATIONS

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

WILLOW CREEK MINE: SEDIMENT POND 003 TOTAL CONTAINMENT

by

Name: jcw

Company Name: ACZ, INC.
File Name: C:\SEDCAD3\WC\POND3

Date: 04-26-1995

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND3 User: jcw
Date: 04-26-1995 Time: 15:55:19
Willow Creek Mine: Sediment Pond 003 Total Containment
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Specific Gravity: 2.50
Submerged Bulk Specific Gravity: 1.25

Particle Size Distribution(s):

Size (mm)	psd-1 % Finer
0.2500	100.00
0.1000	50.00
0.0500	35.00
0.0100	19.00
0.0050	15.00
0.0010	6.00
0.0001	0.00

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
1	1	2	1	8	45.04	4.44	6.32	0.00	0.001	0.394
1	1	3	1	8	200.36	6.00	7.35	0.01	0.007	0.406
1	2	2	1	8	65.07	4.62	6.45	0.00	0.002	0.395
2	1	1	1	8	34.79	33.33	17.32	0.00	0.000	0.455

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Civil Software Design -- SEDCAD+ Version 3.1

Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND3 User: jcw
Date: 04-26-1995 Time: 15:55:19
Willow Creek Mine: Sediment Pond 003 Total Containment
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	0.40*	90	F	0.030	0.000	0.000	0.0	0.05	0.59
		Type: Null		Label: at DD-23 outflow						
111	Structure	0.40							0.05	
111	Total IN/OUT	0.40							0.05	0.59
112	1	1.71*	90	F	0.048	0.000	0.000	0.0	0.21	2.52
		Type: Null		Label: at DC-11 outflow						
112	Structure	1.71							0.26	
112	Total IN/OUT	2.11							0.26	3.11
111 to 112 Routing						0.001	0.394			
113	1	0.00	0	M	0.000	0.000	0.000	0.0	0.00	0.00
		Type: Null		Label: at Pond 003 (dummy)						
113	Structure	0.00							0.26	
113	Total IN/OUT	2.11							0.26	3.11
112 to 113 Routing						0.007	0.406			
121	1	0.60*	90	F	0.025	0.000	0.000	0.0	0.07	0.88
		Type: Null		Label: at DC-10 outflow						
121	Structure	0.60							0.07	
121	Total IN/OUT	0.60							0.07	0.88
122	1	0.00	0	M	0.000	0.000	0.000	0.0	0.00	0.00
		Type: Null		Label: at Pond 003 (dummy)						
122	Structure	0.00							0.07	
122	Total IN/OUT	0.60							0.07	0.88
121 to 122 Routing						0.002	0.395			
211	1	0.41	99	F	0.000	0.000	0.000	0.0	0.08	0.76
		Type: Pond		Label: Pond 003						
211	Structure	0.41							0.41	

211 Total IN	3.12	0.41	4.75
211 Total OUT		0.00	0.00

3 to 211 Routing 0.000 0.455

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Sedimentology-

SED: Sediment
SCp: Peak Sediment Concentration
SSp: Peak Settleable Concentration
24VW: Volume Weighted Average Settleable Concentration - Peak 24 hours
24AA: Arithmetic Average Settleable Concentration - Peak 24 hours

	JBS	SWS	K	L (ft)	S (%)	CP	Tt (hrs)	PS #	SED (tons)	SCp (mg/l)	SSp (ml/l)	24VW (ml/l)	24AA (ml/l)
R	111	1	0.31	55.0	78.0	0.890	0.000	1	30.7				
					Type: Null		Label: at DD-23 outflow						
	111 Structure								30.7				
	111 Total IN/OUT								30.7	630031	399.99	237.37	60.94
R	112	1	0.31	32.0	4.1	0.890	0.000	1	5.3				
					Type: Null		Label: at DC-11 outflow						
	112 Structure								36.0				
	112 Total IN/OUT								36.0	174304	110.66	61.68	14.77
	111 to 112 Routing						0.001						
R	113	1	0.00	0.0	0.0	0.000	0.000	0	0.0				
					Type: Null		Label: at Pond 003 (dummy)						
	113 Structure								36.0				
	113 Total IN/OUT								36.0	174292	110.65	61.68	14.77
	112 to 113 Routing						0.007						
R	121	1	0.22	25.0	2.0	1.050	0.000	1	0.8				
					Type: Null		Label: at DC-10 outflow						
	121 Structure								0.8				
	121 Total IN/OUT								0.8	14263	9.06	5.00	1.18
R	122	1	0.00	0.0	0.0	0.000	0.000	0	0.0				
					Type: Null		Label: at Pond 003 (dummy)						
	122 Structure								0.8				
	122 Total IN/OUT								0.8	14263	9.06	5.00	1.18
	121 to 122 Routing						0.002						
R	211	1	0.31	10.0	2.0	0.890	0.000	1	0.7				
					Type: Pond		Label: Pond 003						
	211 Structure								37.4				

211 Total IN		37.4	120869	76.74	41.23	10.22
211 Total OUT		0.0	10451	0.00	0.00	0.00
113 to 211 Routing	0.000					

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Civil Software Design -- SEDCAD+ Version 3.1

Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND3 User: jcw
Date: 04-26-1995 Time: 15:55:19
Willow Creek Mine: Sediment Pond 003 Total Containment
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

DETAILED SUBWATERSHED INPUT/OUTPUT TABLE

J	B	S	SWS	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Time Conc. (hr)	Muskingum K (hr)	Muskingum X
1	1	2	1	-a	5	70.00	57.14	7.56	0.00			
				-b	5	229.00	7.86	2.80	0.02			
				-c	8	320.00	1.56	3.75	0.02	0.048		

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND3 User: jcw
Date: 04-26-1995 Time: 15:55:19
Willow Creek Mine: Sediment Pond 003 Total Containment
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

CAUTION: THE STAGE OF YOUR PRINCIPLE SPILLWAY MAY CAUSE BED SCOUR.
YOUR OBSERVED EFFLUENT MAY NOT MEET THE DESIRED EFFLUENT STANDARD.
INCREASE THE STAGE OF YOUR PRINCIPAL SPILLWAY.

J2, B1, S1
Pond 003

Drainage Area from J2, B1, S1, SWS(s)1: 0.4 acres
Total Contributing Drainage Area: 3.1 acres

DISCHARGE OPTIONS:

	Perf. Riser
Riser Diameter (in)	3.0
Riser Height (ft)	5.00
Barrel Diameter (in)	3.0
Barrel Length (ft)	25.00
Barrel Slope (%)	0.10
Manning's n of Pipe	0.015
Spillway Elevation	6089.0
Lowest Elevation of Holes	6086.5
# of Holes/Elevation	3
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	----
Crest Length (ft)	----
Z:1 (Left and Right)	-- --
Bottom Width (ft)	----

POND RESULTS:

Sediment Storage* (ac-ft)	Permanent Pool (ac-ft)	Dead Space (%)	Sediment Algorithm
0.02	0.08	20.00	CSTRS

*Sediment Capacity based on Average Annual R of 11.0 for 3.0 year(s)

	Runoff Volume (ac-ft)	Peak Discharge (cfs)	Sediment (tons)	Peak Sediment Concentration (mg/l)	Peak Settleable Concentration (ml/l)	24VW (ml/l)	24AA (ml/l)
IN	0.41	4.75	37.4	120869	76.74	41.23	10.22
OUT	0.00	0.00	0.0	10451	0.00	0.00	0.00

Peak Elevation	Trap Efficiency (%)	Hydrograph Detention Time (hrs)
6088.2	100.00	17.63

Dewatering Time (Max. Perf. Riser Elev to Lowest Orifice):%11771.3 days

****

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND3 User: jcw
Date: 04-26-1995 Time: 15:55:19
Willow Creek Mine: Sediment Pond 003 Total Containment
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-DISCHARGE TABLE

J2, B1, S1
Pond 003

Drainage Area from J2, B1, S1, SWS(s)1: 0.4 acres
Total Contributing Drainage Area: 3.1 acres

Elevation	Perf. Riser (cfs)	Total Discharge (cfs)
6086.11	0.0	0.0
6086.50	0.0>0.02	0.0
6087.00	0.0	0.0
6087.50	0.0	0.0
6088.00	0.0	0.0
6088.50	0.0	0.0
6089.00	0.0	0.0
6089.50	0.2	0.2
6090.00	0.2	0.2

****

Civil Software Design -- SEDCAD+ Version 3.1

Company Name: ACZ, INC.
Filename: C:\SEDCAD3\WC\POND3 User: jcw
Date: 04-26-1995 Time: 15:55:19
Willow Creek Mine: Sediment Pond 003 Total Containment
Storm: 2.44 inches, 25 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J2, B1, S1
Pond 003

Drainage Area from J2, B1, S1, SWS(s)1: 0.4 acres
Total Contributing Drainage Area: 3.1 acres

SW#1: Perforated Riser

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6086.00	0.00	0.19	0.00		
6086.00	0.00	0.19	0.00		
6086.11	0.00	0.19	0.02	0.00	Top of Sediment Storage (0 Stage)
6086.50	0.39	0.21	0.08	0.00	Low Orifice of SW#1
[illegible]87.00	0.89	0.23	0.19	0.00	
[illegible]87.50	1.39	0.24	0.30	0.00	
6088.00	1.89	0.26	0.43	0.00	
6088.20	2.09	0.27	0.49	0.00	Peak Stage
6088.50	2.39	0.28	0.57	0.00	
6089.00	2.89	0.30	0.71	0.00	Stage of SW#1
6089.50	3.39	0.31	0.86	0.17	
6090.00	3.89	0.33	1.03	0.24	

****

LIST OF MAPS

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05/02/95 5:40pm WP51/nn

LIST OF MAPS

LIST OF MAPS

LIST OF MAPS

Peak discharge from the 10-year, 6-hour design event for the worst-case scenario (reclaimed areas are barren and the ASCM's are not in place) and the 25-year, 24-hour event under the best-case scenario (ASCM's are in place, and the reclaimed areas are mulched with emerging vegetation) were compared with the operational design for the 25-year, 24-hour storm event to determine if existing operational channel design will be adequate for the reclamation phase. Table 13-13, Reclamation Watersheds summarizes the sub-basin physical characteristics. Curve numbers for the undisturbed drainage areas were taken from Table 13-2, Undisturbed Watersheds - Drainage Characteristics. The curve number for the reclaimed area was assumed to be 91 (SCS, 1986) for the worst-case scenario and 80 for best-case conditions. The comparison of runoff from the 10-year, 6-hour design event under worst-case conditions and the 25-year, 24-hour storm under best-case conditions with the 25-year, 24-hour design event under operational conditions suggests that slight modifications would be needed in the following sub-reaches of the RCDD to accommodate the increased flow under reclamation activities: 1) RCDD-3 would require an increase in ditch depth from 1.35 feet to a minimum of 1.85 feet (the specified operational D_{50} riprap sizing remains adequate, however, additional rock material will be needed to cover the increase in channel bank base material); 2) RCDD-4 would require an increase in ditch depth from 1.9 feet to a minimum depth of 2.1 feet (riprap sizing is adequate, however, additional rock material will be needed to cover the additional bank base material); 3) RCDD-5 would require an increase in ditch depth from 1.6 feet to a minimum depth of 1.9 feet (riprap sizing is adequate, however, additional rock material will be needed to cover the added bank base material); and, 4) RCDD-6 would require an increase in ditch depth from 1.7 feet to a minimum depth of 1.9 feet (riprap sizing is adequate, however, additional rock material will be needed to cover the increased height of channel bank base materia). Because it will be easier initially construct a ditch with sufficient capacity to convey operational and reclamation flows at the onset of mine construction, CPMC will construct disturbed ditches DD-6a, DD-8b, DD-10, DD-14a, DD-14b, DD-16, DD-17b, and DD-17c with capacity to also convey a 25-year, 24-hour event which might occur during the reclamation. All calculations supporting the design of the reclamation ditch are presented in Appendix H-1, SEDCAD Modeling for Reclamation Hydrology, and Appendix H-2, Reclamation Ditch Modeling.

The RCDD will subsequently be removed following the completion of Phase I reclamation, and UDOGM gives approval to remove the interim drainage and sediment control structures.

Four permanent drainage features (PMCs) will be established to carry storm runoff from the majority of the upgradient undisturbed areas through the reclaimed mine facilities area. These channels will be designed to approximate the geometry of the existing natural drainage channels. The permanent channels will be designed with a 3H:1V side slope to ensure channel stability. Map 21A, Mine Surface Facilities Area - Postmining Topography, shows the location of the four permanent channels. To comply with UDOGM regulations, these drainage features were designed to pass peak flows from the 100-year, 6-hour storm event (R645-301-742.323). Table 13-15, Permanent Postmine Drainage Channels provides the design schedule for the four permanent drainage features. All calculations supporting the design of the PMCs are presented in Appendix H-3, Permanent Postmine Channel Modeling.

Calculations for riprap sizing for the permanent postmining drainage channels are included in Appendix H-3, Permanent Postmine Channel Modeling. The thickness, and thus the volume, of the riprap for each channel is related to the average proposed riprap stone diameter. Channel riprap D_{50} requirements were determined using the SEDCAD Channel Utility Simons/OSM method. The Simons/OSM methods provides a conservative estimate of riprap size.

It is essential for a riprap layer to be composed of rock having a gradation such that the voids between the larger particles are filled with smaller particles to reduce interstitial flows and provide overall stability to the system (Fiske, et al., 1994). Table 13-10, Riprap Gradation Particle Sizes displays an appropriate particle size gradation for use in riprapping structures. Proper placement of the rock course is necessary to fully realize the erosion mitigation potential of a riprap design. The thickness of a riprap is typically a function of the rock size and is expressed in terms of the riprap D_{50}. The riprap layer design will follow these general guidelines:

- The thickness of a riprap layer will be at least 1.5 to 2 times the D_{50}
- Riprap layers will be at least 12 inches in thickness

- Where the D_{50} is greater than 8 inches, the placement procedures will include a certain amount of individual placement (using specialized equipment or hand labor) to ensure that the proper thickness and cover is achieved.

Filter fabric with a gravel protective layer of a gravel filter blanket will be placed beneath any riprap course to stabilize the riprap layer and prevent erosion in the in-situ base material underlying the riprap. The filter blanket will consist of granular material placed to a depth of 0.5 the riprap D_{50} or a minimum of six inches, which ever is greater.

4.5.3.2 Reclamation Culvert Design

One existing operational culvert will remain in place during Phase I reclamation. Culvert, DC-15, an existing 24 inch CMP, which conveys storm runoff under the Main Mine Access road, Road "A", will remain in place until the road is removed.

Two new culverts, RC-1 and RC-2, will be installed during Phase I reclamation along the RCDD where the ditch crosses two of the permanent drainage features. Table 13-16, Reclamation Culvert Design, summarizes the design schedule for the remaining operational and two new culverts. Map 21B, Mine Surface Facilities Area - Interim Drainage Control shows the location of the two reclamation culverts. Calculations for the design of the reclamation culverts are presented in Appendix H-2, Reclamation Ditch Modeling.

All three culverts will subsequently be removed following the completion of Phase I reclamation.

4.5.3.3 Reclamation Sedimentation Ponds

During Phase I reclamation, Pond 001 will be retained for the mine face-up area and the associated surface facilities area sediment control. Since the diversions routing undisturbed area runoff around the disturbed area will be removed, some undisturbed areas will contribute storm event runoff to the pond. The operational design for Pond 001 was conservative. UDOGM regulations require that a sedimentation structure be large enough to fully contain runoff volumes from any storm event less than or equal to the 10-year, 24-hour event (R645-301-742.221). The operational 10-year, 24-hour design storm runoff volume is 2.28 acre-feet. The top of the pond embankment is at 6,171.0 feet above mean sea level (MSL). The elevation of the emergency spillway invert and the top of the principal spillway are at 6,168.5 feet above MSL, while the decant orifices on the principal spillway are at 6,165.5 feet. Pond 001 has a total operational storage capacity of 6.88 acre-feet. The storage capacity below the decant elevation, assuming that the pond is completely empty of any water and/or sediment, is 4.39 acre-feet. An additional 2.49 acre-feet of storage is available between the decant elevation and the emergency spillway invert elevation.

CPMC expects to have the ASCM's in place within approximately 36 weeks following the beginning of reclamation activities. During Phase I reclamation, for the worst-case scenario (barren soil on the reclaimed area with no ASCM's in place), the runoff volume from the 10-year, 24-hour design storm event was calculated to be 3.96 acre-feet. The computation of the runoff volume assumed a reclamation phase drainage area of 64.8 acres. The reclaimed area was calculated at 23.2 acres with a curve number of 91 (SCS, 1986), while the contributing undisturbed area was calculated at 41.6 acres with curve numbers ranging from 74 to 78. The time that the mine surface facilities area will be actually exposed under the worst-case scenario will be minimized through the implementation of ASCM's as quickly as possible.

The runoff volume from the 10-year, 24-hour storm event, with ASCM's in place, was calculated to be 3.26 acre-feet. The assumptions for undisturbed areas remained the same. For the reclaimed area, the acreage remains 23.2 acres and the curve number was assumed to be 85 (SCS, 1986). The calculated runoff from the reclamation watershed following implementation of the ASCM's and the successful establishment of vegetation is 2.81 acre-feet.

This analysis suggests that Pond 001, as designed, will be adequate to control and treat runoff from the 10-year, 24-hour storm event during Phase I reclamation. However, to assure that Pond 001 retains the necessary storage capacity, any sediment accumulated in the pond from the operational phase must be removed following the

- Where the D_{50} is greater than 8 inches, the placement procedures will include a certain amount of individual placement (using specialized equipment or hand labor) to ensure that the proper thickness and cover is achieved.

Filter fabric with a gravel protective layer of a gravel filter blanket will be placed beneath any riprap course to stabilize the riprap layer and prevent erosion in the in-situ base material underlying the riprap. The filter blanket will consist of granular material placed to a depth of 0.5 the riprap D_{50} or a minimum of six inches, which ever is greater.

4.5.3.2 Reclamation Culvert Design

One existing operational culvert will remain in place during Phase I reclamation. Culvert, DC-15, an existing 24 inch CMP, which conveys storm runoff under the Main Mine Access road, Road 'A', will remain in place until the road is removed.

Two new culverts, RC-1 and RC-2, will be installed during Phase I reclamation along the RCDD where the ditch crosses two of the permanent drainage features. Table 13-16, Reclamation Culvert Design, summarizes the design schedule for the remaining operational and two new culverts. Map 21B, Mine Surface Facilities Area - Interim Drainage Control shows the location of the two reclamation culverts. Calculations for the design of the reclamation culverts are presented in Appendix H-2, Reclamation Ditch Modeling.

All three culverts will subsequently be removed following the completion of Phase I reclamation.

4.5.3.3 Reclamation Sedimentation Ponds

During Phase I reclamation, Pond 001 will be retained for the mine face-up area and the associated surface facilities area sediment control. Since the diversions routing undisturbed area runoff around the disturbed area will be removed, some undisturbed areas will contribute storm event runoff to the pond. The operational design for Pond 001 was conservative. UDOGM regulations require that a sedimentation structure be large enough to fully contain runoff volumes from any storm event less than or equal to the 10-year, 24-hour event (R645-301-742.221). The operational 10-year, 24-hour design storm runoff volume is 2.28 acre-feet. The top of the pond embankment is at 6,171.0 feet above mean sea level (MSL). The elevation of the emergency spillway invert and the top of the principal spillway are at 6,168.5 feet above MSL, while the decant orifices on the principal spillway are at 6,165.5 feet. Pond 001 has a total operational storage capacity of 6.88 acre-feet. The storage capacity below the decant elevation, assuming that the pond is completely empty of any water and/or sediment, is 4.39 acre-feet. An additional 2.49 acre-feet of storage is available between the decant elevation and the emergency spillway invert elevation.

CPMC expects to have the ASCM's in place within approximately 36 weeks following the beginning of reclamation activities. During Phase I reclamation, for the worst-case scenario (barren soil on the reclaimed area with no ASCM's in place), the runoff volume from the 10-year, 24-hour design storm event was calculated to be 3.96 acre-feet. The computation of the runoff volume assumed a reclamation phase drainage area of 64.8 acres. The reclaimed area was calculated at 23.2 acres with a curve number of 91 (SCS, 1986), while the contributing undisturbed area was calculated at 41.6 acres with curve numbers ranging from 74 to 78. The time that the mine surface facilities area will be actually exposed under the worst-case scenario will be minimized through the implementation of ASCM's as quickly as possible.

The runoff volume from the 10-year, 24-hour storm event, with ASCM's in place, was calculated to be 3.26 acre-feet. The assumptions for undisturbed areas remained the same. For the reclaimed area, the acreage remains 23.2 acres and the curve number was assumed to be 85 (SCS, 1986). The runoff from the reclamation watershed following implementation of the ASCM's and the successful establishment of vegetation is 2.81 acre-feet.

This analysis suggests that Pond 001, as designed, will be adequate to control and treat runoff from the 10-year, 24-hour storm event during Phase I reclamation. However, to assure that Pond 001 retains the necessary storage capacity, any sediment accumulated in the pond from the operational phase must be removed following the cessation of mining operations and prior to the initiation of Phase I reclamation. Additionally, once the water/sediment level elevation reaches 6,163.5 feet during Phase I reclamation, the water level must be reduced and the accumulated sediment must be removed. SEDCAD modeling supporting the pond sizing adequacy analysis is included in Appendix H-1, SEDCAD Modeling for Reclamation Hydrology.

The 25-year, 6-hour storm event is the required storm event (R645-301-742.223) to assess the adequacy of the existing spillway under reclamation conditions. The estimated precipitation for this event is 1.7 inches. Computations assumed that the pond contained the maximum allowable sediment volume and that the pond was full of water up to the spillway invert elevation. From the analysis of the 25-year, 6-hour storm event, the maximum combined inflow rate to the pond structure is 43.6 cfs and the maximum outflow rate is 25.6 cfs. The corresponding high water elevation is 6169.16 feet, 1.34 feet below the top of the embankment elevation. Thus, Pond 001 will adequately pass the 25-year, 6-hour peak flow with adequate freeboard. However, since the emergency spillway invert is at an elevation of 6,168.5 feet, and the water surface elevation for the 25-year, 6-hour event is 6,167.53 feet, under normal pond conditions, the 25-year, 6-hour storm event will not pass through the emergency spillway. The calculations for the spillway analysis are included in Appendix H-1, SEDCAD Modeling for Reclamation Hydrology.

Pond 001 will serve to collect sediment for a minimum of two years following the completion of all grading and seeding activities. The pond will not be removed until the removal is authorized by UDOGM, vegetation over the reclaimed area has been properly established in accordance with R645-301-763.100, and the water quality bond release standards of R645-301-880.320 are complied with. Sediment will be removed from the reclamation sediment pond when sediment reaches the 60% clean-out level. The sediment will first be evaluated to determine if it contains acid and/or toxic forming compounds prior to disposal in the School House Canyon refuse facility.

Ponds 002 and 003 will be removed and alternative sediment control measures used to treat sediment from storm event runoff generated from those areas which operationally drain to those two ponds. The ASCM's for the areas which contribute runoff to the two ponds are discussed in Section 4.5.3.

4.5.4 Reclamation Timetable

Since the proposed Willow Creek Mine will be an underground mine with surface support facilities, the disturbed surface area will incur ongoing use during the proposed life of the mine. The reclamation of surface disturbance areas will commence following cessation of mining operations and related activities. Reclamation activities could begin as early as 2017. The following projected time frames can be used to estimate the length of time for reclamation:

• Demolition	Week 1-24
• Grading	Week 20-30
• Installation of Alternative Sediment Control Measures (ASCM)	Week 20-30
• Topsoiling	Week 30-36
• Seed bed preparation	Week 37
• Seeding and Mulching	Week 38 (after October 1)
• Pond and ASCM maintenance	0 - 2 years after seeding
• Removal of Pond 001 and ASC structures	All sediment control structures will remain in place for a minimum of two years after the last seeding, until the removal is authorized by UDOGM, until vegetation over the reclaimed area is properly established in accordance with R645-301-763.100, and water quality bond release standards of R645-301-880.320 are complied with.
• Vegetation and water monitoring	2 - 10 years after seeding
• Reclamation monitoring	Until bond release

TABLE 13-15
POSTMINE DRAINAGE DITCH DESIGN SCHEDULE

Drainage Ditch	Design Flow (cfs)[1]	Ditch Geometry	Side Slope (H:V)	Ditch Slope (%)[2]	Manning's n	Flow Depth (ft)[3]	Velocity (fps)[3]	Minimum Ditch Depth (ft)[4]	Ditch Top Width (ft)	Minimum Flow Area (sf)[3]	Riprap D_{50} (inches)[5]
PMC-1	35.7	Trapezoidal[6]	3:1	16	0.051	0.6	7.3	1.1	12.6	4.91	12
PMC-2	5.9	Trapezoidal[6]	3:1	19	0.050	0.2	4.3	0.7	10.2	1.38	9
PMC-3	10.9	Trapezoidal[6]	3:1	17	0.049	0.3	5.2	0.8	10.8	2.11	9
PMC-4	26.2	Trapezoidal[6]	3:1	15	0.048	0.5	6.7	1.0	12.0	3.89	12

Notes:
(1) Design flow from the 100-year 6-hour storm event; peak flow calculated using SEDCAD computer model
(2) Ditch slope determined by direct measurement from 1" = 200' computer generated map
(3) Calculated using FlowMaster I computer model
(4) Maximum ditch depth = flow depth + 0.5 feet of freeboard
(5) Riprap sizing calculated with SEDCAD Riprap utility Simons/OSM Method
(6) Trapezoidal ditch with 6 foot bottom width

TABLE 13-16
POSTMINE CULVERT DESIGN[1]

Culvert	Design Discharge (cfs)[2]	Entrance Loss Coefficient	Pipe Length (ft)	Pipe Slope (%)	Manning's n	Maximum Headwater (ft)[3]	Minimum Pipe Diameter (inches)	Recommended Pipe Diameter (inches)
TC-1	11.6	0.9	30	0.025	0.015	2.5	21	36
TC-2	27.3	0.9	30	0.083	0.015	3.0	36	48

Notes: (1) Culvert design calculations performed with SEDCAD3 computer model
(2) Design discharge based on 25-year 24-hour storm event
(3) Headwater depth in diameters (H:D)

5.0 LITERATURE CITED

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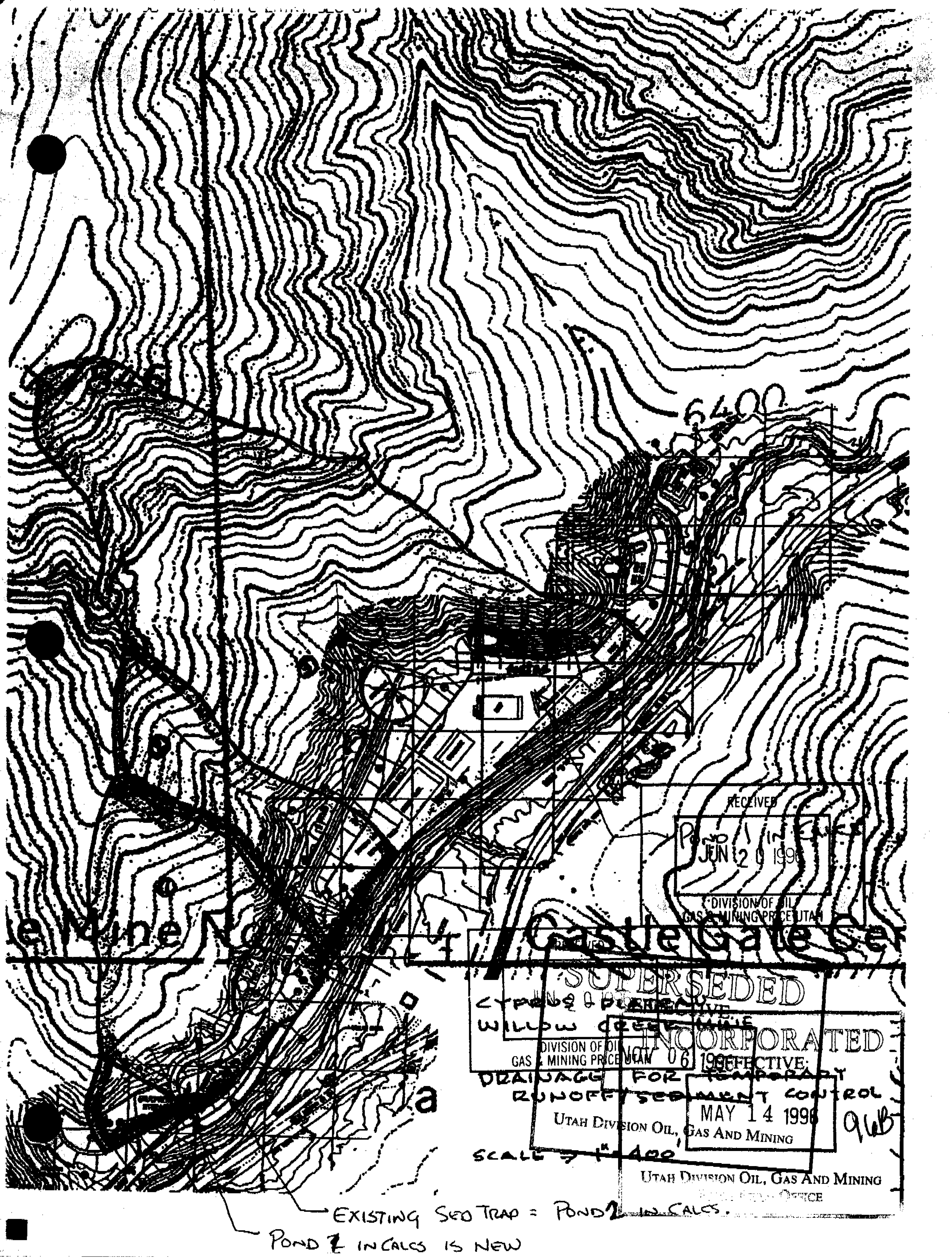

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DIVISION OF OIL GAS & MINING PRICE UTAH
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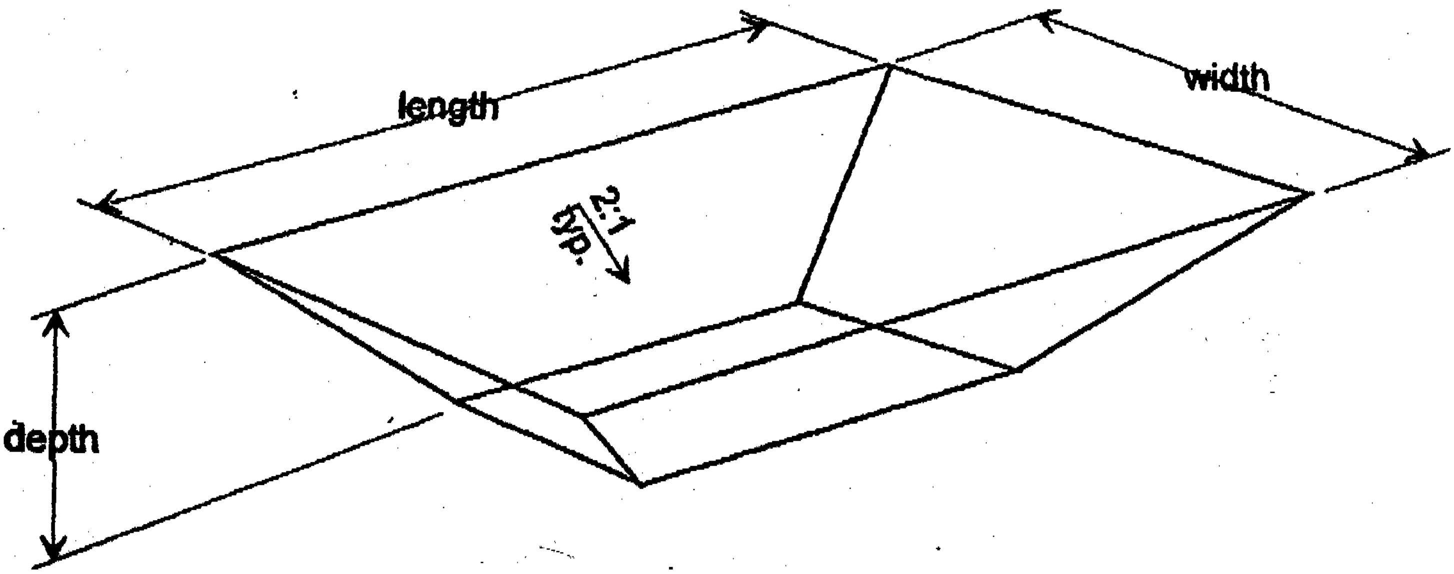
WILLOW CREEK MINE
DRAINAGE FOR TEMPORARY
RUNOFF/SEDIMENT CONTROL
MAY 14 1996
UTAH DIVISION OIL, GAS AND MINING
SCALE 1"=400
UTAH DIVISION OIL, GAS AND MINING
EXISTING SED TRAP = POND 2 IN CALCS.
POND 1 IN CALCS IS NEW

CYPRUS PLATEAU WILLOW CREEK MINE
SEDIMENT TRAPS/PONDS FOR TEMPORARY RUNOFF CONTROL
MAY 7, 1996
BY: GLENN BARTON



Ponds are based on 5 year-24 hour storms using SCS-TP-149 "Runnoff in Small Watersheds" Two (2) feet of freeboard is allowed for (1 foot deep spillway + 1 foot additional freeboard) See attached drainage basin map for drainage areas.

POND 1 @ intersection of SC-1 and SC-2
Length=80 feet
Width=45 feet
Depth=10.5 feet

EXISTING SED TRAP

POND 2 @ Ramp up to stockpile area via SC-1
Length=70 feet
Width=35 feet
Depth=10 feet

NEW

POND 3 @ portal face area (includes drainage from areas 2 & 3)
Length=100 feet
Width=80 feet
Depth=12.5 feet

EXISTING PORTAL AREA

CEntry CONSULTANTS & ENGINEERS SALT LAKE CITY, UTAH	PROJECT: CYPRUS - PLATEAU	PROJ NO. E95007
	SUBJECT: TOPSOIL STRIPPING	CALC NO.
		BY 93 DATE
	TEMP SED CONTROL	CHK DATE
		SHEET OF REV

Temporarary Trap #1 at SC-1 to SC-2 Transfer
Area = 14.60 AC (Larger area = 16.03 AC) (from 1"=400' map)
Temporarary Trap #2 at Ramp up to Reclaim via SC-1 road
Area = 9.51 AC (Partial)
= 50.95 AC

5 YR 24 HOUR STORM = 1.8 inches per TerraMatrix Data
HYDROLOGIC SOILS GROUP = C PER TerraMatrix Data
AVE RCN ≙ 76
→ use SCS-TP-149 Runoff from small watersheds page 5, figure 3

DIRECT RUNOFF = .32 in

TRAP #1

Runoff = $\frac{14.6 \times .32}{12}$ = .39 AC-FT or 16988 CF

$(16.03 \times .32)/12$ = .427 AC-FT or 18620 CF ←

TRAP #2

SMALL AREA = $\frac{9.51 \times .32}{12}$ = .25 AC-FT or 10890 CF ←

TRAP #2

LARGE AREA = $(50.95 \times .32)/12$ = 1.36 AC-FT or 59242 CF

ASSUME PRISIM SHAPED RECTANGULAR PONDS

$$V = \frac{1}{3} D \left(A_T + A_B + \sqrt{A_T \times A_B}\right)$$

A_T = TOP AREA
A_B = BOTTOM AREA
D = DEPTH

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NOV 06 1996
UTAH DIVISION OIL, GAS AND MINING

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JUN 20 1996
DIVISION OF OIL GAS & MINING PRICE UTAH

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EFFECTIVE:
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UTAH DIVISION OIL, GAS AND MINING
PRICE FIELD OFFICE

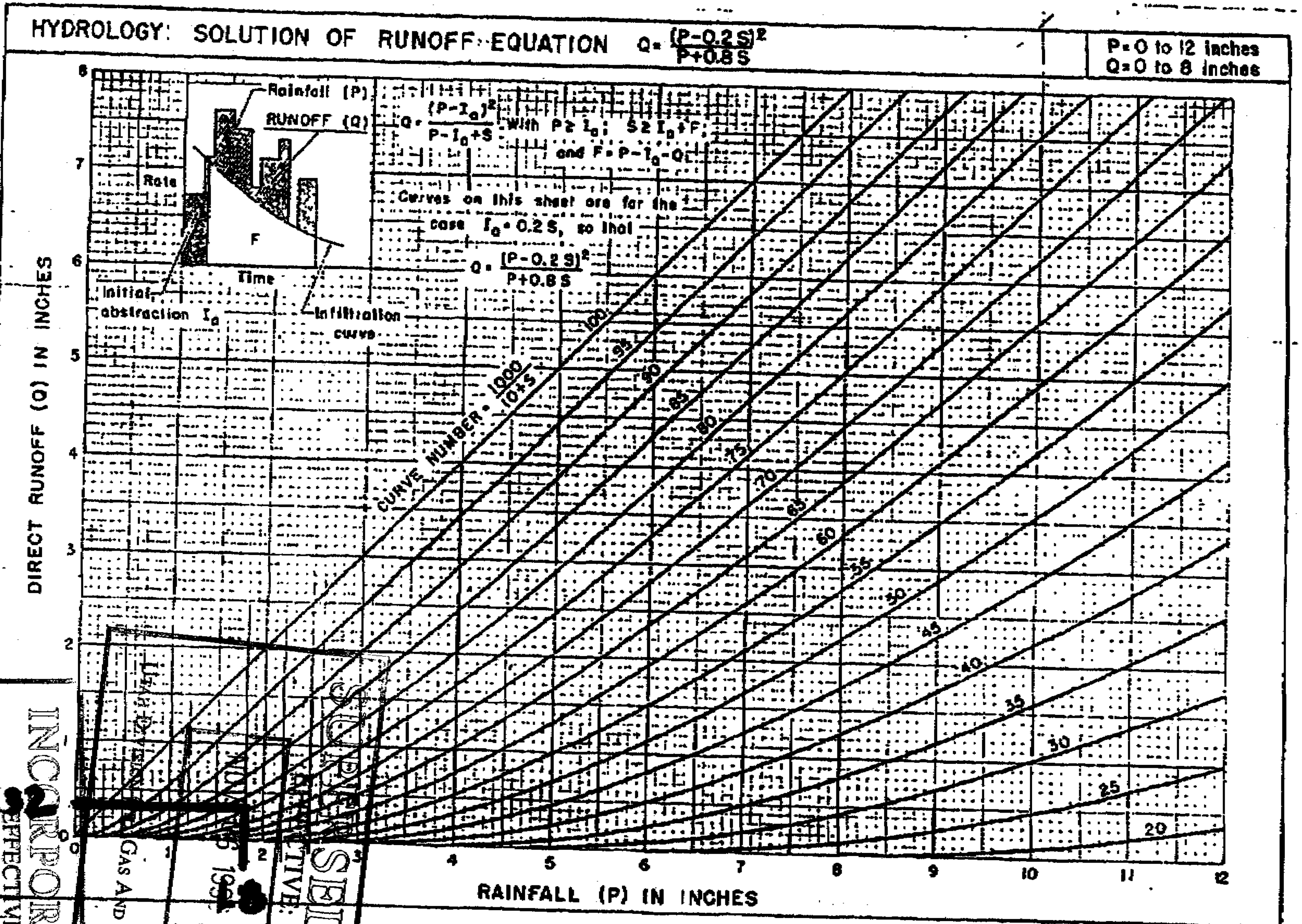

Figure 3.--Solution of the runoff equation, $Q = \frac{(P - 0.2S)^2}{P + 0.8S}$

$CN = \frac{1000}{10+S}$

$\therefore S = \frac{1000 - 10CN}{CN}$

LIST OF MAPS

866/PERMIT/TOC.MAP
05/02/95 5:40pm WP51/sn

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801
(801) 538-5340
(801) 359-3940 (Fax)

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
James W. Carter
Division Director

November 6, 1996

Ben Grimes, Senior Project Engineer
Cyprus-Plateau Mining Corporation
P. O. Box P.M.C.
Price, Utah 84501

RE: Railroad Loading Tracks #1 and #2 Retaining Walls/Southern Embankment of Sediment Pond 12B, Willow Creek Preparation Plant, ACT/007/038-96D, Folder #2, Carbon County, Utah

Dear Mr. Grimes:

A review by Division personnel of the second submittal as received by the Price Field Office on November 4, 1996 of the aforementioned permit amendment indicates that the responses submitted are adequate to negate the concerns previously expressed by Mr. Steven Johnson, Mr. Randy Harden and myself.

It is felt that the amendment now meets all the requirements mandated by the R645 regulations; amendment 96D is approved, effective November 6, 1996. A stamped copy is enclosed for incorporation into your MRP.

Although the amendment is now considered adequate, I want to remind you of the requirements of R645-301-514.310, R645-301-514.311, and R645-301-514.312 regarding regular inspections/reporting of impoundment structures during the construction phase. Please make sure Mr. Barton, P.E., or his designated specialist/inspector experienced in the construction of impoundments is aware of these requirements so that the design specifications for pond 12B may be met, and that a compliance issue regarding same may be avoided.

If you have any further comments please feel free to contact me. Thank you.

Sincerely,

Peter Hess
Reclamation Specialist III

sd
enclosures
cc: Ranvir Singh, OSM, Denver
Mark Bailey, BLM, Price
Mark Page, State Eng, Price, w/o
Dave Ariotti, DEQ, Price, w/o
Bill Bates, DWR, Price, w/o
David Terry, Trust Lands, SLC, w/o
Joe Helfrich, DOGM, SLC

CYPRUS PLATEAU MINING CORPORATION
A Cyprus Amax Company

Cyprus Plateau Mining Corporation
Post Office Drawer PMC
Price, Utah 84501
(801) 637-2875

November 4, 1996

2/19/97
REVISED TEXT REVISED MAPS
INCORPORATED INTO THIS SUBMITTAL.
BGG.

Mr. Pete Hess
Utah Department of Natural Resources
Division of Oil, Gas and Mining
451 East 400 North
Price, Utah 84501

Dear Mr. Hess,

RE: WILLOW CREEK PERMIT MODIFICATION REVIEW RESPONSES
RAILROAD MODIFICATION

Enclosed are responses to the Division comments on the railroad permit modification. The responses have been prepared by Hansen, Allen and Luce. They are hand delivering four copies to the Salt Lake Division office today.

If you have further comments please contact me as soon as possible.

Respectfully,

Ben Grimes
Sr. Staff Project Engineer

Enclosures

C: DOGM- SLC
File: WCENV 2.5.2.12.5.1
Chron: BG961101

RECEIVED
FEB 24 1997
DIV. OF OIL, GAS & MINING

HANSEN
ALLEN
& LUCE INC

SALT LAKE AREA OFFICE
6771 South 900 East
Midvale, Utah 84047
Phone: (801) 566-5599

Utah Division of Oil, Gas and Mining
451 East 400 North
Price, Utah 84501

October 31, 1996

Attention: Mr. Peter Hess

Re: Response to Deficiency Comments Pertaining to Willow Creek Mine Proposed Permit ACT/007/038 Modifications Due to the Railroad Realignment in the Preparation Plant Area

Gentlemen:

Cyprus Plateau Mining Company has received several letter communications from the Utah Division of Oil, Gas and Mining (UDOGM) that address deficiency comments pertaining to the Willow Creek Mine proposed permit modifications recently submitted. The modifications were submitted to reflect proposed changes to the permit due to the proposed railroad realignment in the Preparation Plant Area. The letter communications containing the deficiency comments include the following:

1. A memorandum to "File #2" from Mr. Steven M. Johnson, Reclamation Specialist with UDOGM, dated October 21, 1996.

2. A letter addressed to Mr. Ben Grimes from Mr. Peter Hess, Reclamation Specialist III with UDOGM, dated October 11, 1996.

3. A memorandum to Mr. Peter Hess of UDOGM from Mr. Randy Harden of UDOGM, dated October 11, 1996.

Cyprus Plateau has requested that Hansen, Allen & Luce, Inc. assist them in responding to the deficiency comments. Responses to the specific comments raised in these letter communications are presented below.

MR. STEVEN JOHNSON MEMORANDUM

Comment: "The following deficiencies must be addressed before the operational hydrologic section can be declared complete and accurate:

1. C-25 appears on Map 23E-1 and in Appendix D but the design is not summarized in Table 13-11."

Response:

The data presented for culvert C-24 in Table 13-11 is the data applicable to culvert C-25. "C-24" in Table 13-11 was a typographical error. It should have been "C-25". Culvert C-24 is a undisturbed area culvert which is addressed in Table 13-12. Therefore, attached is replacement Table 13-11 with the typographical error corrected.

Mr. Johnson also indicated in the analysis portion of the comment that reference is made to culverts C-26, C-27, and C-28 in the calculations that were to be added to Exhibit 13, Appendix D, and that these culverts are referred to as culverts CGC-10, CGC-9, and CGC-11, respectively in the text and on the maps. These culverts were originally numbered C-26 through C-28 and just prior to submittal the numbers were changed to CGC-10, CGC-9, and CGC-11. The number designations were changed in the written calculations but apparently not in the spreadsheets accompanying the written calculations. Therefore, please find attached replacement Sheets 11, 13, and 15 which have been corrected for the proper designation.

Comment: "The following deficiencies exist in the rail road relocation pond amendment. These deficiencies must be addressed prior to approval and final review of the amendment.

1. Map 15 still shows Pond 003 though it looks as if they attempted to remove it.

2. Map 16 is unreadable. It needs to either be in the original colors or completely reformatted to show all features clearly.

3. Map 18B has also been changed from a color format and is now unreadable."

Response:

Map 15 has been modified to delete reference to Pond 003. Revised copies of the map are attached.

As discussed with Mr. Johnson, our draftsman will modify each of the original Map 16 drawings at the UDOGM office such that the modifications will be on the original colored copies.

Map 18B has been reproduced in its original colored format. Attached are the revised copies of the map.

MR. PETER HESS LETTER

Comment: "In a letter from Mr. Brad Price, P.E., of RB&G Engineering, Mr. Price recommends that the eastern cut slope of pond 12B be redesigned from the 1.5/1 slope to a 2/1 slope in order to provide for an increased factor of safety. If the 1.5/1 slope is to be retained, the design must indicate that the slope will be over excavated, and a 6 foot thick horizontal thickness of sandy gravel be placed and compacted to attain a safety factor of 1.3. Although Mr. Barton, P.E., has certified map 26B, cross section A still shows the eastern cut slope of Pond B to be at the 1.5/1 slope. I have difficulty understanding why the expense of a geotechnical investigation was absorbed if the recommendations are not heeded by Mr. Barton."

Response:

According to Mr. Barton, the recommendations of RB&G Engineering have always been included in the design and are to be followed in construction. Separate construction documents have already been prepared for use (upon permit approval) in the field that ensure compliance with these requirements. In our attempt to expedite submission of the permit modifications, the detail containing RB&G's recommendation was inadvertently omitted from Map 26B.

Subsequent to the submittal, RB&G evaluated a third alternative associated with the 1.5:1 slope. This alternative will be followed during construction. This third alternative allows for over-excavation of the slope and then tapering the recommended layer of sandy gravel from 6 feet at the base to 2 feet at a height of 8.5 feet above the base. Attached please find the RB&G letter and accompanying calculations that address this third alternative. These are to be included in Appendix A-6 of Exhibit 13. Also please find attached revised pages EX 13-63 and EX 13-63A for the text of Exhibit 13 that reflect the discussion of this alternative.

Section D has been added to Map 26B that reflects RB&G's recommendations. Copies of this revised map are attached.

Comment: "The computer model using the Spencer Method to show the stability analysis is considered to be a satisfactory method for solving limiting equilibrium problems. Three computer runs have been made, all considering the pond to be full. The runs considered a 1.5/1 slope with loose coal refuse, a 2/1 slope, and a 1.5/1 slope with compacted gravel. The first page of each run indicates that **the results of computations performed using this computer program should not be used for design purposes unless they have been verified by <u>independent analysis</u>, experimental data, or field experience."**

If an independent analysis, (or any combination of the three) has been performed, where is the documentation to back up this design?"

Response:

Attached is a letter from RB&G Engineering dated October 28, 1996 which addresses this concern. According to RB&G:

"Spencer's procedure was developed in 1967. Dr. Stephen G. Wright developed UTEXAS in 1984 and UTEXAS2 in 1985. UTEXAS2 permits the user to select Spencer's procedure, Simplified Bishop's procedure, the Corps of Engineers Modified Swedish procedure, or the force equilibrium procedure with Lowe and Karaifath's side-force equilibrium for computing the factor of safety. The computer programs are tools which must be used in conjunction with engineering judgement to be effective.

RB&G Engineering has used UTEXAS2 for slope stability analysis on a routine basis since 1985. We have concluded that Spencer's method is the preferred procedure for modeling field conditions. The accuracy of the computer program is only as good as the input data. Based upon our experience, we have recognized the importance of defining the subsurface and embankment characteristics prior to performing analysis.

As a consequence, no analyses are performed without generating cross sections based upon field and laboratory testing and engineering judgement. This procedure was followed in performing the analysis for Pond 12B, as outlined in the September correspondence. The final computer runs are the results of several trial runs and represent our judgement of the most realistic conditions, based upon the results of field and laboratory data and our experience."

Comment: "Regarding the Hilfiker retaining wall design from Geotechnical Design Services, has Mr. Barton chosen not to heed the recommendation that the foundations for the Hilfiker wall be excavated and backfilled with compacted granular material? No mention is made of this on drawing 26B, Sedimentation Pond 12B."

Response:

According to Mr. Barton, CEntry intends to construct the retaining walls in strict accordance with the requirements of the geotechnical recommendations. Over excavation of loose and unsuitable foundation materials, and the removal of deleterious materials from the wall foundations is essential. Field personnel, including the earthwork sub-contractor will have copies of the geotechnical report. In addition, CEntry has now modified the permit drawing (Map 26B) to incorporate the geotechnical requirements for clarity. In our attempt to expedite submission of the permit modifications, the information containing RB&G's recommendation was inadvertently omitted from Map 26B. Note 3 has been added to the top of Map 26B that reflects RB&G's recommendation. Copies of this revised map are attached.

MR. RANDY HARDEN MEMORANDUM

Comment: "As stated in the plan in section 4.2.3.1, Pond Embankment Stability Evaluation, the requirements based on the RB&G Engineering report are that the pond be over excavated and that the slope materials be replaced at least 6 feet horizontally with suitable material. This alternative was selected over reduction of the slope from 1.5:1 to 2:1 due to the areal constraints of the facilities surrounding the pond. Map 26B does not indicate that this will be accomplished during construction. Map 26B should be revised to clearly indicate the extent of over-excavation and replacement of materials to occur in those areas necessary to maintain a minimum factor of safety for the inslopes of the pond embankment and over-excavation necessary for foundation preparation for the embankments."

Response:

See the response to the first comment in the Mr. Peter Hess letter.

Comment: "Design assumptions used in determination of embankment stability were based on steady state (pond full) conditions. These analyses should also consider embankment conditions during rapid drawdown (pond empty w/saturated embankments) and show that under these conditions, a minimum factor of safety of 1.1 can be achieved."

Response:

It should be noted that the lowest level to which the pond can drain via the outlet works to the pond is elevation 6095.3 feet. This is the elevation of the proposed decant pipes, which consist of three 2-inch diameter pipes connected into the primary spillway standpipe (see Map 26B). The invert elevation of the primary spillway is 6099.5 feet. The 10-year 24-hour event was routed through the pond, the results of which are already contained in Appendix A-3 "Modeling for Sediment Ponds 12A and 12B" of Exhibit 13. Based on these calculations it requires 3 plus days to dewater the pond (via the three decant pipes) down to the elevation of the decant pipes. Dewatering of the ponds below elevation 6095.3 feet is via evaporation and seepage losses.

Therefore, under these circumstances, it is not possible to have a "rapid draw-down" condition, and it is highly unlikely that the pond walls will be saturated when the pond is empty.

Attached is a letter from RB&G Engineering dated October 28, 1996 which also addresses this concern. According to RB&G:

> "It is our understanding that a rapid drawdown condition is unlikely for the sediment pond since drainage of the pond will either be from seepage loses or from two 2-inch drain pipes. Since the embankment materials consist of granular coal refuse and granular soils, we do not believe that pore pressures will develop in the embankment from the pond full to pond empty state. It will be observed from Figure 1 of the October 8 correspondence (figure attached) that a saturated unit weight has been used below the high water level and that the strength parameters have been reduced for the loose coal refuse below high water. The reduction in friction angle from 33° to 30° is considered to be conservative. An additional analysis has been performed using the saturated assumptions and varying the phreatic surface from pond empty with the water level at the base of the pond to pond drained. We believe that placing the phreatic surface at the base of the pond represents a worse case rapid drawdown condition. A factor of safety of 1.16 was obtained for the saturated embankment with the water level at the base of pond, increasing to 1.52 with the pond drained. Copies of the analysis are enclosed."

The letter from RB&G is to be added to Appendix A-6 of Exhibit 13.

Comment: "Additional concerns regarding the embankment stability of the northern inslopes of the pond are also apparent regarding ground vibration from trucks and trains on either side of the pond itself. Seismic evaluation of the embankment should be conducted based on ground velocities generated from truck and train traffic adjacent to the pond."

Response:

Attached is a letter from RB&G Engineering dated October 28, 1996 which also addresses this concern. According to RB&G:

"Reference is made to a report published by the Earthquake Engineering Research Center at the University of California at Berkeley. The report is entitled "Liquefaction Potential of Sand Deposits Under Low Levels of Excitation" by David P. Carter and H. Bolton Seed, Report No. UCB/EERC88/11, August 1988. Chapters 4 and 5, "Measurement of Ground Vibration Amplitudes Produced by Trains", and "Liquefaction Potential of Train Induced Ground Vibrations", address this concern. The authors were concerned that "the belief that ground vibrations produced by trains have caused large-scale liquefaction failures appears to be inconsistent with the relatively small amplitudes (of the train-induced ground vibration records) that are reported in the literature." Measurements of train-induced ground vibrations were taken as part of the study. 24 sets of records were recorded at a number of sites and at different distances from the tracks. The records were obtained for 4 passenger trains and 20 freight trains. The engines produced significantly higher amplitudes than the cars. Figures 4.4 and 4.6 (enclosed herewith) show the peak particle acceleration and peak particle velocity as a function of the distance from the nearest rail. These values are higher than previously reported values.

The liquefaction potentials were evaluated by both the shear stress approach and the shear strain approach. In section 5.6, Summary, the authors conclude:

> The liquefaction potentials of level loose sand sites subjected to train induced ground vibrations, for example, were evaluated by following both the shear strain and the shear stress approaches and since the levels of cyclic shear strain, predicted to be generated within the level sites that were analyzed, were only slightly greater in magnitude than the threshold strains for most sands, it seemed reasonable to conclude that the ground vibrations generated by trains are probably incapable of liquefying sands at distances greater than about 10 ft from the nearest rail; analyses were not performed at distances closer than 10 ft from the rail.
>
> The same general conclusion was also reached for those level sites analyzed using the shear stress approach. However while none of the shear strain analyses predicted that these sites would liquefy at distances beyond 10 ft from the tracks (see Figure 5.29), analyses using the shear stress approach indicated that liquefaction might occur up to distances of about 20 ft from the track under certain site conditions (Figure 5.30). Because the water tables at most sand sites probably lie more than 3 ft below the ground surface and the sands at all sites have almost certainly been subjected to

thousands of cycles of prior shaking, most level sand sites are not predicted to liquefy at distances greater than about 10 ft from the tracks as shown in Figure 5.31.

Figure 5.30 referred to above assumes the groundwater at the ground surface. Figure 5.31 (enclosed herewith), assumes the groundwater level to be greater than 3 feet below the surface. It will be observed that liquefaction is not predicted to occur beyond a distance of 10 feet from the nearest rail. It will be observed from the attached figure that the edge of the Retaining Wall is 10 feet in from the edge of the nearest railroad track, with the slope containing the loose coal refuse east of the wall. It is essential that the loose fill and refuse to be removed from the foundation area supporting the wall as recommended in the September 20 correspondence. .Seed and Carter also investigated road traffic as a non--seismic source to induce liquefaction. It was concluded that the ground vibrations generated by fully loaded trucks were probably incapable of inducing large-scale liquefaction failures. They cited the maximum particle velocity reported by Ames et al to be about 0.056 inches/sec at a distance of 17 feet from a fully-loaded fill haul truck traveling over San Francisco Bay Fill.

Based upon our review of information outlined above, and a comparison of the conditions considered in the report to those conditions at Pond 12B, we do not believe there to be a liquefaction problem from the truck or train traffic."

Comment: "The plan further indicates that the material used to backfill the Hilfiker retaining wall is normally free-draining material. Where the pond embankment abuts the retaining wall, the material adjacent to the wall has been sized to prevent excessive seepage from occurring. The Hilfiker retaining wall will become the southern embankment for the sediment pond. Based on the characterization of the materials described as fill materials for the Hilfiker embankment, it appears that excessive pond seepage may occur through the retaining wall itself. This presents concern regarding stability of the Hilfiker embankment should saturation of the embankment occur from the pond, as well as excessive seepage and water loss from the pond through the Hilfiker embankment. Their concerns need to be evaluated and discussed further in the proposal prior to approval."

Response:

Attached is a letter from Geotechnical Design Services, Inc. addressing this comment. This letter is to be included in Appendix A-6 of Exhibit 13. In response to this comment, Mr. Jerold A. Bishop of Geotechnical Design Services, Inc., indicates the following:

"In response to this concern I would indicate that the reinforcing for this wall is adequately designed for the additional saturated unit weight which may occur from time to time as such saturation occurs. With the seepage occurring from the front, there will be no buildup of hydrostatic forces against the back of the wall, and the external stability of the wall is not a concern. Therefore, with proper construction, the wall's structural stability is not expected to be degraded at any time by seepage.

With respect to seepage loss, a simplified streamtube analysis indicates that total flow through the length of the embankment will be on the order of 0.1±gpm; such seepage loss is not considered to be of concern. This is based upon a continuous 3 feet of head throughout the year (unlikely) and an assumed permeability of 100 feet per year (probably high considering the material gradation).

Based on these considerations, the concerns of UDOGM appear to be adequately addressed by the design. Modifications to the wall design are not recommended by Geotechnical Design Services."

Comment: "Foundation preparation and excavation requirements for the removal of unsuitable materials and sewage and water lines should also be provided in the construction details for the pond excavation. More detail needs to be provided in the text of the plan and on the drawings regarding foundation preparation and construction of the Hilfiker embankment. Appendix A-6 provides recommended details and design information, but the plan is inadequate in describing specifically which methods will be utilized during actual construction."

Response:

See the response to the third comment in the Mr. Peter Hess letter.

If there are any additional questions regarding our responses to the UDOGM comments as presented herein, please call.

Sincerely,

HANSEN, ALLEN & LUCE, INC.

Marvin E. Allen, P.E.
Principal

Attachments

cc: Mr. Steve Johnson, UDOGM - SLC
Mr. Randy Harden, UDOGM - SLC

CYPRUS PLATEAU MINING CORPORATION
A Cyprus Amax Company

Cyprus Plateau Mining Corporation
Post Office Drawer PMC
Price, Utah 84501
(801) 637-2875

September 23, 1996

RECEIVED
FEB 24 1997
DIV. OF OIL, GAS & MINING

Mr. Pete Hess
Utah Department of Natural Resources
Division of Oil, Gas and Mining
451 East 400 North
Price, Utah 84501

Dear Mr. Hess,

RE: WILLOW CREEK PERMIT MODIFICATION

Attached are permit modification forms detailing a requested modification to the Willow Creek permit. This modification has been discussed with the Division on several occasions, and includes the appropriate revisions to text, maps, tables and etc.

The only section of the permit that is not included is the right of entry information. Due to the recent merger of the railroad companies, we are having trouble getting the required documents through the process. When the right of entry information is completed we will send it in. In the meantime we ask the Division to process this modification as expeditiously as possible.

Included are two copies of Exhibit 13 with redline and strikeout of text changes to help in your review. I have included two copies, one for you and one for the Salt Lake Division office.

The modifications forms give instructions on replacements and changes, if you have any questions or problems please contact me at 636-2227 or 472-3310.

Respectfully,

Ben Grimes
Sr. Staff Project Engineer

Attachments

File: WCENV 2.5.2.12.5.1
Chron: BG960905

APPLICATION FOR PERMIT CHANGE

Title of Change: Modify Willow Creek Permit to allow Utah Railway to construct railroad tracks.	Permit Number: ACT/007/038 Mine: Willow Creek Permittee: Cyprus Plateau Mining Corp.

Description, include reason for change and timing required to implement:

Utah Railway desires to reconstruct the railroad tracks that serve the Willow Creek Mine. This construction requires modification of the Willow Creek Permit. Sediment Pond 003 will be covered by railroad traks necessitating expansion of existing Sediment Pond 12B. Also required are changes to the runoff control plan. Permit modification is requested as soon as possible to allow construction before winter conditions interfere with the schedule.

☐ Yes	☒ No	1. Change in the size of the Permit Area? ______ acres ☒ increase ☐ decrease.
☐ Yes	☒ No	2. Change in the size of the Disturbed Area? ______ acres ☒ increase ☐ decrease.
☐ Yes	☒ No	3. Will permit change include operations outside the Cumulative Hydrologic Impact Area?
☐ Yes	☒ No	4. Will permit change include operations in hydrologic basins other than currently approved?
☐ Yes	☒ No	5. Does permit change result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes	☒ No	6. Does permit change require or include public notice publication?
☐ Yes	☒ No	7. Permit change as a result of a Violation? Violation #
☐ Yes	☒ No	8. Permit change as a result of a Division Order? D.O.#
☐ Yes	☒ No	9. Permit change as a result of other laws or regulations? Explain:
☒ Yes	☐ No	10. Does permit change require or include ownership, control, right-of-entry, or compliance information?
☐ Yes	☒ No	11. Does the permit change affect the surface landowner or change the post mining land use?
☐ Yes	☒ No	12. Does permit change require or include collection and reporting of any baseline information?
☐ Yes	☒ No	13. Could the permit change have any effect on wildlife or vegetation outside the current disturbed area? See explanation attached
☐ Yes	☒ No	14. Does permit change require or include soil removal, storage or placement?
☐ Yes	☒ No	15. Does permit change require or include vegetation monitoring, removal or revegetation activities?
☒ Yes	☐ No	16. Does permit change require or include construction, modification, or removal of surface facilities?
☐ Yes	☒ No	17. Does permit change require or include water monitoring, sediment or drainage control measures?
☒ Yes	☐ No	18. Does permit change require or include certified designs, maps, or calculations?
☐ Yes	☒ No	19. Does permit change require or include underground design or mine sequence and timing?
☐ Yes	☒ No	20. Does permit change require or include subsidence control or monitoring?
☐ Yes	☒ No	21. Have reclamation costs for bonding been provided or revised for any change in the reclamation plan?
☐ Yes	☒ No	22. Is permit change within 100 feet of a public road or perennial stream or 500 feet of an occupied dwelling?
☐ Yes	☒ No	23. Is this permit change coal exploration activity ☐ inside ☒ outside of the permit area?

☒ Attach 5 complete copies of proposed permit change as it would be incorporated into the Mining and Reclamation Plan.

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

Bon Grimes Sr. Proj. Eng 9/23/96

Signed - Name - Position - Date

Subscribed and sworn to before me this 23 day of Sept, 19 96

John C. Pappas

Notary Public

My Commission Expires: 3-7, 19 98

Attest: STATE OF UTAH

COUNTY OF CARBON

JOHN C. PAPPAS
NOTARY PUBLIC • STATE of UTAH
1646 EAST CASTLE CIRCLE
PRICE, UTAH 84501
COMM. EXP. 3-7-98

Received by Oil, Gas & Mining

ASSIGNED PERMIT CHANGE NUMBER

Application for Permit Change
Detailed Schedule of Changes to the Permit

Title of Change: Modify Willow Creek Permit to allow Utah Railway to construct railroad tracks.	Permit Number: ACT/007/038 Mine: Willow Creek Mine Permittee: Cyprus Plateau Mining Corp.

Provide a detailed listing of all changes to the mining and reclamation plan which will be required as a result of this proposed permit change. Individually list all maps and drawings which are to be added, replaced, or removed from the plan. Include changes of the table of contents, section of the plan, pages, or other information as needed to specifically locate, identify and revise the exiting mining and reclamation plan. Include page, section and drawing numbers as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIALS TO BE CHANGED
☐ ADD	☒ REPLACE	☐ REMOVE	List of maps to Volumes 1 through 7
☐ ADD	☒ REPLACE	☐ REMOVE	Replace all of text portion of Exhibit 13.
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Exhibit 13 Appendix A title sheet.
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Appendix A-1 title sheet.
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Appendix A-2 title sheet
☐ ADD	☒ REPLACE	☐ REMOVE	Replace all of Appendix A-3 with Appendix A-3 Modeling for Sediment Ponds 12A and 12B
☒ ADD	☐ REPLACE	☐ REMOVE	Add Appendix A-6 Sediment Pond 12B Embankment Stability Calculations
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Appendix B title sheet.
☐ ADD	☐ REPLACE	☒ REMOVE	Calculations for diversion ditches DD-21, DD-22, DD-23, DD-23a, and DD-24 from Appendix C.
☒ ADD	☐ REPLACE	☐ REMOVE	Add to Appendix C the following calculations: Diversion Ditches CGD-9, CGD-12, CGD-13, and D1-AA through D1-AH.
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Appendix D title sheet.
☐ ADD	☐ REPLACE	☒ REMOVE	Remove from Appendix D calculations for diversion ditches DC-10, and DC-11
☒ ADD	☐ REPLACE	☐ REMOVE	Add to Appendix D calculations for diversion ditches C18, C19, C23, C25, CGC-9, CGC-10 and CGC-11.
☒ ADD	☐ REPLACE	☒ REMOVE	Remove from Appendix E calculations for undisturbed diversion ditch DDD-24.
☐ ADD	☐ REPLACE	☐ REMOVE	Add to Appendix E calculations for ditches U6-F and U6-G.
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Appendix F title sheet.
☒ ADD	☐ REPLACE	☐ REMOVE	Add ad the end of Appendix F calculations for culvert C24.
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Appendix H-1 title sheet.
☒ ADD	☐ REPLACE	☐ REMOVE	Add at the end of Appendix H-1 calculations for Sediment Pond 12B - Phase I Reclamation
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Map 15
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Map 16
☒ ADD	☐ REPLACE	☐ REMOVE	Add Maps 16A and 16B
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Map 18B
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Maps 21A and 21B
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Map 23D
☒ ADD	☐ REPLACE	☐ REMOVE	Add Map 23D-1
☐ ADD	☒ REPLACE	☐ REMOVE	Replace Map 23E with Maps 23E-1 amd 23E-2
☐ ADD	☒ REPLACE	☐ REMOVE	In exhibit 19 Replace Map 26 with Maps 26A and 26B.
☒ ADD	☐ REPLACE	☐ REMOVE	Add instruction page at beginning of Exhibit 19 behind the green titile page.
☐ ADD	☐ REPLACE	☐ REMOVE	

Any other specific or special instructions required for insertion of this proposal into the Mining and Reclamation Plan?

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
James W. Carter
Division Director

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801
(801) 538-5340
(801) 359-3940 (Fax)

December 18, 1996

Ben Grimes, Senior Project Engineer
Cyprus Plateau Mining Corporation
Willow Creek Preparation Plant
P. O. Box PMC
Price, Utah 84501

RE: Request for Additional Copy, Railroad Yard Amendment/Sediment Pond 12B/Hilfiker Wall Impoundment Structure, Willow Creek Preparation Plant, ACT/007/038-96D, Folder #3, Carbon County, Utah

Dear Mr Grimes:

I must apologize for the Division, but only three copies of the aforementioned can be found in the DOGM Salt Lake Office by the young lady who disperses approved amendments to the various government agencies. We need one more copy.

Please forward an additional copy of 96D to the SLC office to the attention of Ms. Brandi Butcher. Thank you.

Sincerely,

Peter Hess
Reclamation Specialist III

sd
cc: Brandi Butcher

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
James W. Carter
Division Director

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801
(801) 538-5340
(801) 359-3940 (Fax)

November 6, 1996

Ben Grimes, Senior Project Engineer
Cyprus-Plateau Mining Corporation
P. O. Box P.M.C.
Price, Utah 84501

RE: Railroad Loading Tracks #1 and #2 Retaining Walls/Southern Embankment of Sediment Pond 12B, Willow Creek Preparation Plant, ACT/007/038-96D, Folder #2, Carbon County, Utah

Dear Mr. Grimes:

A review by Division personnel of the second submittal as received by the Price Field Office on November 4, 1996 of the aforementioned permit amendment indicates that the responses submitted are adequate to negate the concerns previously expressed by Mr. Steven Johnson, Mr. Randy Harden and myself.

It is felt that the amendment now meets all the requirements mandated by the R645 regulations; amendment 96D is approved, effective November 6, 1996. A stamped copy is enclosed for incorporation into your MRP.

Although the amendment is now considered adequate, I want to remind you of the requirements of R645-301-514.310, R645-301-514.311, and R645-301-514.312 regarding regular inspections/reporting of impoundment structures during the construction phase. Please make sure Mr. Barton, P.E., or his designated specialist/inspector experienced in the construction of impoundments is aware of these requirements so that the design specifications for pond 12B may be met, and that a compliance issue regarding same may be avoided.

If you have any further comments please feel free to contact me. Thank you.

Sincerely,

Peter Hess
Reclamation Specialist III

sd
enclosures
cc: Ranvir Singh, OSM, Denver
Mark Bailey, BLM, Price
Mark Page, State Eng, Price, w/o
Dave Ariotti, DEQ, Price, w/o
Bill Bates, DWR, Price, w/o
David Terry, Trust Lands, SLC, w/o
Joe Helfrich, DOGM, SLC

HANSEN ALLEN & LUCE INC

SALT LAKE AREA OFFICE
6771 South 900 East
Midvale, Utah 84047
Phone: (801) 566-5599

Utah Division of Oil, Gas and Mining
451 East 400 North
Price, Utah 84501

October 31, 1996

Attention: Mr. Peter Hess

Re: Response to Deficiency Comments Pertaining to Willow Creek Mine Proposed Permit ACT/007/038 Modifications Due to the Railroad Realignment in the Preparation Plant Area

Gentlemen:

Cyprus Plateau Mining Company has received several letter communications from the Utah Division of Oil, Gas and Mining (UDOGM) that address deficiency comments pertaining to the Willow Creek Mine proposed permit modifications recently submitted. The modifications were submitted to reflect proposed changes to the permit due to the proposed railroad realignment in the Preparation Plant Area. The letter communications containing the deficiency comments include the following:

1. A memorandum to "File #2" from Mr. Steven M. Johnson, Reclamation Specialist with UDOGM, dated October 21, 1996.

2. A letter addressed to Mr. Ben Grimes from Mr. Peter Hess, Reclamation Specialist III with UDOGM, dated October 11, 1996.

3. A memorandum to Mr. Peter Hess of UDOGM from Mr. Randy Harden of UDOGM, dated October 11, 1996.

Cyprus Plateau has requested that Hansen, Allen & Luce, Inc. assist them in responding to the deficiency comments. Responses to the specific comments raised in these letter communications are presented below.

MR. STEVEN JOHNSON MEMORANDUM

Comment: "The following deficiencies must be addressed before the operational hydrologic section can be declared complete and accurate:

1. C-25 appears on Map 23E-1 and in Appendix D but the design is not summarized in Table 13-11."

Response:

The data presented for culvert C-24 in Table 13-11 is the data applicable to culvert C-25. "C-24" in Table 13-11 was a typographical error. It should have been "C-25". Culvert C-24 is a undisturbed area culvert which is addressed in Table 13-12. Therefore, attached is replacement Table 13-11 with the typographical error corrected.

Mr. Johnson also indicated in the analysis portion of the comment that reference is made to culverts C-26, C-27, and C-28 in the calculations that were to be added to Exhibit 13, Appendix D, and that these culverts are referred to as culverts CGC-10, CGC-9, and CGC-11, respectively in the text and on the maps. These culverts were originally numbered C-26 through C-28 and just prior to submittal the numbers were changed to CGC-10, CGC-9, and CGC-11. The number designations were changed in the written calculations but apparently not in the spreadsheets accompanying the written calculations. Therefore, please find attached replacement Sheets 11, 13, and 15 which have been corrected for the proper designation.

Comment: "The following deficiencies exist in the rail road relocation pond amendment. These deficiencies must be addressed prior to approval and final review of the amendment.

1. Map 15 still shows Pond 003 though it looks as if they attempted to remove it.

2. Map 16 is unreadable. It needs to either be in the original colors or completely reformatted to show all features clearly.

3. Map 18B has also been changed from a color format and is now unreadable."

Response:

Map 15 has been modified to delete reference to Pond 003. Revised copies of the map are attached.

As discussed with Mr. Johnson, our draftsman will modify each of the original Map 16 drawings at the UDOGM office such that the modifications will be on the original colored copies.

Map 18B has been reproduced in its original colored format. Attached are the revised copies of the map.

MR. PETER HESS LETTER

Comment: "In a letter from Mr. Brad Price, P.E., of RB&G Engineering, Mr. Price recommends that the eastern cut slope of pond 12B be redesigned from the 1.5/1 slope to a 2/1 slope in order to provide for an increased factor of safety. If the 1.5/1 slope is to be retained, the design must indicate that the slope will be over excavated, and a 6 foot thick horizontal thickness of sandy gravel be placed and compacted to attain a safety factor of 1.3. Although Mr. Barton, P.E., has certified map 26B, cross section A still shows the eastern cut slope of Pond B to be at the 1.5/1 slope. I have difficulty understanding why the expense of a geotechnical investigation was absorbed if the recommendations are not heeded by Mr. Barton."

Response:

According to Mr. Barton, the recommendations of RB&G Engineering have always been included in the design and are to be followed in construction. Separate construction documents have already been prepared for use (upon permit approval) in the field that ensure compliance with these requirements. In our attempt to expedite submission of the permit modifications, the detail containing RB&G's recommendation was inadvertently omitted from Map 26B.

Subsequent to the submittal, RB&G evaluated a third alternative associated with the 1.5:1 slope. This alternative will be followed during construction. This third alternative allows for over-excavation of the slope and then tapering the recommended layer of sandy gravel from 6 feet at the base to 2 feet at a height of 8.5 feet above the base. Attached please find the RB&G letter and accompanying calculations that address this third alternative. These are to be included in Appendix A-6 of Exhibit 13. Also please find attached revised pages EX 13-63 and EX 13-63A for the text of Exhibit 13 that reflect the discussion of this alternative.

Section D has been added to Map 26B that reflects RB&G's recommendations. Copies of this revised map are attached.

Comment: "The computer model using the Spencer Method to show the stability analysis is considered to be a satisfactory method for solving limiting equilibrium problems. Three computer runs have been made, all considering the pond to be full. The runs considered a 1.5/1 slope with loose coal refuse, a 2/1 slope, and a 1.5/1 slope with compacted gravel. The first page of each run indicates that **the results of computations performed using this computer program should not be used for design purposes unless they have been verified by <u>independent analysis</u>, experimental data, or field experience.**"

If an independent analysis, (or any combination of the three) has been performed, where is the documentation to back up this design?"

Response:

Attached is a letter from RB&G Engineering dated October 28, 1996 which addresses this concern. According to RB&G:

"Spencer's procedure was developed in 1967. Dr. Stephen G. Wright developed UTEXAS in 1984 and UTEXAS2 in 1985. UTEXAS2 permits the user to select Spencer's procedure, Simplified Bishop's procedure, the Corps of Engineers Modified Swedish procedure, or the force equilibrium procedure with Lowe and Karaifath's side-force equilibrium for computing the factor of safety. The computer programs are tools which must be used in conjunction with engineering judgement to be effective.

RB&G Engineering has used UTEXAS2 for slope stability analysis on a routine basis since 1985. We have concluded that Spencer's method is the preferred procedure for modeling field conditions. The accuracy of the computer program is only as good as the input data. Based upon our experience, we have recognized the importance of defining the subsurface and embankment characteristics prior to performing analysis.

As a consequence, no analyses are performed without generating cross sections based upon field and laboratory testing and engineering judgement. This procedure was followed in performing the analysis for Pond 12B, as outlined in the September correspondence. The final computer runs are the results of several trial runs and represent our judgement of the most realistic conditions, based upon the results of field and laboratory data and our experience."

Comment: "Regarding the Hilfiker retaining wall design from Geotechnical Design Services, has Mr. Barton chosen not to heed the recommendation that the foundations for the Hilfiker wall be excavated and backfilled with compacted granular material? No mention is made of this on drawing 26B, Sedimentation Pond 12B."

Response:

According to Mr. Barton, CEntry intends to construct the retaining walls in strict accordance with the requirements of the geotechnical recommendations. Over excavation of loose and unsuitable foundation materials, and the removal of deleterious materials from the wall foundations is essential. Field personnel, including the earthwork sub-contractor will have copies of the geotechnical report. In addition, CEntry has now modified the permit drawing (Map 26B) to incorporate the geotechnical requirements for clarity. In our attempt to expedite submission of the permit modifications, the information containing RB&G's recommendation was inadvertently omitted from Map 26B. Note 3 has been added to the top of Map 26B that reflects RB&G's recommendation. Copies of this revised map are attached.

MR. RANDY HARDEN MEMORANDUM

Comment: "As stated in the plan in section 4.2.3.1, Pond Embankment Stability Evaluation, the requirements based on the RB&G Engineering report are that the pond be over excavated and that the slope materials be replaced at least 6 feet horizontally with suitable material. This alternative was selected over reduction of the slope from 1.5:1 to 2:1 due to the areal constraints of the facilities surrounding the pond. Map 26B does not indicate that this will be accomplished during construction. Map 26B should be revised to clearly indicate the extent of over-excavation and replacement of materials to occur in those areas necessary to maintain a minimum factor of safety for the inslopes of the pond embankment and over-excavation necessary for foundation preparation for the embankments."

Response:

See the response to the first comment in the Mr. Peter Hess letter.

Comment: "Design assumptions used in determination of embankment stability were based on steady state (pond full) conditions. These analyses should also consider embankment conditions during rapid drawdown (pond empty w/saturated embankments) and show that under these conditions, a minimum factor of safety of 1.1 can be achieved."

Response:

It should be noted that the lowest level to which the pond can drain via the outlet works to the pond is elevation 6095.3 feet. This is the elevation of the proposed decant pipes, which consist of three 2-inch diameter pipes connected into the primary spillway standpipe (see Map 26B). The invert elevation of the primary spillway is 6099.5 feet. The 10-year 24-hour event was routed through the pond, the results of which are already contained in Appendix A-3 "Modeling for Sediment Ponds 12A and 12B" of Exhibit 13. Based on these calculations it requires 3 plus days to dewater the pond (via the three decant pipes) down to the elevation of the decant pipes. Dewatering of the ponds below elevation 6095.3 feet is via evaporation and seepage losses.

Therefore, under these circumstances, it is not possible to have a "rapid draw-down" condition, and it is highly unlikely that the pond walls will be saturated when the pond is empty.

Attached is a letter from RB&G Engineering dated October 28, 1996 which also addresses this concern. According to RB&G:

> "It is our understanding that a rapid drawdown condition is unlikely for the sediment pond since drainage of the pond will either be from seepage loses or from two 2-inch drain pipes. Since the embankment materials consist of granular coal refuse and granular soils, we do not believe that pore pressures will develop in the embankment from the pond full to pond empty state. It will be observed from Figure 1 of the October 8 correspondence (figure attached) that a saturated unit weight has been used below the high water level and that the strength parameters have been reduced for the loose coal refuse below high water. The reduction in friction angle from 33° to 30° is considered to be conservative. An additional analysis has been performed using the saturated assumptions and varying the phreatic surface from pond empty with the water level at the base of the pond to pond drained. We believe that placing the phreatic surface at the base of the pond represents a worse case rapid drawdown condition. A factor of safety of 1.16 was obtained for the saturated embankment with the water level at the base of pond, increasing to 1.52 with the pond drained. Copies of the analysis are enclosed."

The letter from RB&G is to be added to Appendix A-6 of Exhibit 13.

Comment: "Additional concerns regarding the embankment stability of the northern inslopes of the pond are also apparent regarding ground vibration from trucks and trains on either side of the pond itself. Seismic evaluation of the embankment should be conducted based on ground velocities generated from truck and train traffic adjacent to the pond."

Response:

Attached is a letter from RB&G Engineering dated October 28, 1996 which also addresses this concern. According to RB&G:

"Reference is made to a report published by the Earthquake Engineering Research Center at the University of California at Berkeley. The report is entitled "Liquefaction Potential of Sand Deposits Under Low Levels of Excitation" by David P. Carter and H. Bolton Seed, Report No. UCB/EERC88/11, August 1988. Chapters 4 and 5, "Measurement of Ground Vibration Amplitudes Produced by Trains", and "Liquefaction Potential of Train Induced Ground Vibrations", address this concern. The authors were concerned that "the belief that ground vibrations produced by trains have caused large-scale liquefaction failures appears to be inconsistent with the relatively small amplitudes (of the train-induced ground vibration records) that are reported in the literature." Measurements of train-induced ground vibrations were taken as part of the study. 24 sets of records were recorded at a number of sites and at different distances from the tracks. The records were obtained for 4 passenger trains and 20 freight trains. The engines produced significantly higher amplitudes than the cars. Figures 4.4 and 4.6 (enclosed herewith) show the peak particle acceleration and peak particle velocity as a function of the distance from the nearest rail. These values are higher than previously reported values.

The liquefaction potentials were evaluated by both the shear stress approach and the shear strain approach. In section 5.6, Summary, the authors conclude:

> The liquefaction potentials of level loose sand sites subjected to train induced ground vibrations, for example, were evaluated by following both the shear strain and the shear stress approaches and since the levels of cyclic shear strain, predicted to be generated within the level sites that were analyzed, were only slightly greater in magnitude than the threshold strains for most sands, it seemed reasonable to conclude that the ground vibrations generated by trains are probably incapable of liquefying sands at distances greater than about 10 ft from the nearest rail; analyses were not performed at distances closer than 10 ft from the rail.
>
> The same general conclusion was also reached for those level sites analyzed using the shear stress approach. However while none of the shear strain analyses predicted that these sites would liquefy at distances beyond 10 ft from the tracks (see Figure 5.29), analyses using the shear stress approach indicated that liquefaction might occur up to distances of about 20 ft from the track under certain site conditions (Figure 5.30). Because the water tables at most sand sites probably lie more than 3 ft below the ground surface and the sands at all sites have almost certainly been subjected to

thousands of cycles of prior shaking, most level sand sites are not predicted to liquefy at distances greater than about 10 ft from the tracks as shown in Figure 5.31.

Figure 5.30 referred to above assumes the groundwater at the ground surface. Figure 5.31 (enclosed herewith), assumes the groundwater level to be greater than 3 feet below the surface. It will be observed that liquefaction is not predicted to occur beyond a distance of 10 feet from the nearest rail. It will be observed from the attached figure that the edge of the Retaining Wall is 10 feet in from the edge of the nearest railroad track, with the slope containing the loose coal refuse east of the wall. It is essential that the loose fill and refuse to be removed from the foundation area supporting the wall as recommended in the September 20 correspondence. .Seed and Carter also investigated road traffic as a non--seismic source to induce liquefaction. It was concluded that the ground vibrations generated by fully loaded trucks were probably incapable of inducing large-scale liquefaction failures. They cited the maximum particle velocity reported by Ames et al to be about 0.056 inches/sec at a distance of 17 feet from a fully-loaded fill haul truck traveling over San Francisco Bay Fill.

Based upon our review of information outlined above, and a comparison of the conditions considered in the report to those conditions at Pond 12B, we do not believe there to be a liquefaction problem from the truck or train traffic."

Comment: "The plan further indicates that the material used to backfill the Hilfiker retaining wall is normally free-draining material. Where the pond embankment abuts the retaining wall, the material adjacent to the wall has been sized to prevent excessive seepage from occurring. The Hilfiker retaining wall will become the southern embankment for the sediment pond. Based on the characterization of the materials described as fill materials for the Hilfiker embankment, it appears that excessive pond seepage may occur through the retaining wall itself. This presents concern regarding stability of the Hilfiker embankment should saturation of the embankment occur from the pond, as well as excessive seepage and water loss from the pond through the Hilfiker embankment. Their concerns need to be evaluated and discussed further in the proposal prior to approval."

Response:

Attached is a letter from Geotechnical Design Services, Inc. addressing this comment. This letter is to be included in Appendix A-6 of Exhibit 13. In response to this comment, Mr. Jerold A. Bishop of Geotechnical Design Services, Inc., indicates the following:

"In response to this concern I would indicate that the reinforcing for this wall is adequately designed for the additional saturated unit weight which may occur from time to time as such saturation occurs. With the seepage occurring from the front, there will be no buildup of hydrostatic forces against the back of the wall, and the external stability of the wall is not a concern. Therefore, with proper construction, the wall's structural stability is not expected to be degraded at any time by seepage.

With respect to seepage loss, a simplified streamtube analysis indicates that total flow through the length of the embankment will be on the order of 0.1±gpm; such seepage loss is not considered to be of concern. This is based upon a continuous 3 feet of head throughout the year (unlikely) and an assumed permeability of 100 feet per year (probably high considering the material gradation).

Based on these considerations, the concerns of UDOGM appear to be adequately addressed by the design. Modifications to the wall design are not recommended by Geotechnical Design Services."

Comment: "Foundation preparation and excavation requirements for the removal of unsuitable materials and sewage and water lines should also be provided in the construction details for the pond excavation. More detail needs to be provided in the text of the plan and on the drawings regarding foundation preparation and construction of the Hilfiker embankment. Appendix A-6 provides recommended details and design information, but the plan is inadequate in describing specifically which methods will be utilized during actual construction."

Response:

See the response to the third comment in the Mr. Peter Hess letter.

If there are any additional questions regarding our responses to the UDOGM comments as presented herein, please call.

Sincerely,

HANSEN, ALLEN & LUCE, INC.

Marvin E. Allen, P.E.
Principal

Attachments

cc: Mr. Steve Johnson, UDOGM - SLC
Mr. Randy Harden, UDOGM - SLC

State of Utah
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November 6, 1996

Ben Grimes, Senior Project Engineer
Cyprus-Plateau Mining Corporation
P. O. Box P.M.C.
Price, Utah 84501

RE: Railroad Loading Tracks #1 and #2 Retaining Walls/Southern Embankment of Sediment Pond 12B, Willow Creek Preparation Plant, ACT/007/038-96D, Folder #2, Carbon County, Utah

Dear Mr. Grimes:

A review by Division personnel of the second submittal as received by the Price Field Office on November 4, 1996 of the aforementioned permit amendment indicates that the responses submitted are adequate to negate the concerns previously expressed by Mr. Steven Johnson, Mr. Randy Harden and myself.

It is felt that the amendment now meets all the requirements mandated by the R645 regulations; amendment 96D is approved, effective November 6, 1996.

Although the amendment is now considered adequate, I want to remind you of the requirements of R645-301-514.310, R645-301-514.311, and R645-301-514.312 regarding regular inspections/reporting of impoundment structures during the construction phase. Please make sure Mr. Barton, P.E., or his designated specialist/inspector experienced in the construction of impoundments is aware of these requirements so that the design specifications for pond 12B may be met, and that a compliance issue regarding same may be avoided.

If you have any further comments please feel free to contact me. Thank you.

Sincerely,

Peter Hess

Peter Hess
Reclamation Specialist III

sd
cc: Joe Helfrich, Permit Supervisor, Inspection, DOGM, SLC
Daron Haddock, Permit Supervisor, Permitting, DOGM, SLC
Steve Johnson, Reclamation Hydrologist, DOGM, SLC
Randy Harden, Reclamation Engineer, DOGM, SLC
John Borla, Site Manager, Cyprus, Price

11-7-96

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To Brandi	From Stephanie
	Co. hard copy
Will send	Phone # in
mail tomorrow	

State of Utah
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DIVISION OF OIL, GAS AND MINING

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October 16, 1996

TO: File #2

THRU: Joe Helfrich, Permit Supervisor

FROM: Steven M. Johnson, Reclamation Specialist

RE: RR1/RR2 Retaining Walls/Southern Embankment of Sediment Pond 12B, Willow Creek Mine, Cyprus Plateau Mining Corp, ACT/007/038-96D, Folder #2, Carbon County, Utah

SUMMARY

The railroad adjacent to the Willow Creek Mine's Castle Gate facilities is being realign in order that the grade will suit the trains' capabilities for loading. Because of this work Cyprus Plateau Mining Corp. (CPMC) will need to change the runoff and drainage control plan for effected areas. This is the hydrologic review of CPMC's intended changes.

ANALYSIS

HYDROLOGIC INFORMATION

Regulatory Reference: 30 CFR Sec. 773.17, 774.13, 784.14, 784.16, 784.29, 817.41, 817.42, 817.43, 817.45, 817.49, 817.56, 817.57; R645-300-140, -300-141, -300-142, -300-143, -300-144, -300-145, -300-146, -300-147, -300-147, -300-148, -301-512, -301-514, -301-521, -301-531, -301-532, -301-533, -301-536, -301-542, -301-720, -301-731, -301-732, -301-733, -301-742, -301-743, -301-750, -301-761, -301-764.

Analysis:

Diversion Designs

Additional pages have been proposed for Exhibit 13, Appendix D. These pages show the disturbed area culvert designs for C-18, C-19, C-23, C-25, C-26, C-27, and C-28. C-18, C-19, and C-23 are designed to convey the 25-year, 24-hour storm event, and C-25, C-26, C-27, and C-28 are designed for the 10-year, 6-hour storm event. Culverts C-26, C-27 and C-28 are referred to as culverts CGD-10, CGD-9 and CGD-11, respectively, in the text and on the maps. Table 13-11 has been updated to include culverts C-18, C-19, C-23, and C-24, but does not include C-25 or other culverts as named in the design appendix. C-24 is shown on Map 23E-1 and in Table 13-11 but there are no designs for it in Appendix D.

The locations of Culverts C-18, C-19 and C-25 are shown on Maps 23D-1 and 23E-1. The remaining Culverts are not shown on any map. A culvert noted on Map 23D-1 at the Existing Box Culvert is not design as an operational culvert.

Sediment Pond Design

Sediment Pond 003 will not be constructed as part of the Willow Creek Mining operation because of the construction of railroad tracks in the location it was proposed. Cyprus Plateau Mining Company (CPMC) will replace sediment control initially intended for this area by increasing the containment volume of Sediment Pond 12B. The designs for Sediment Pond 12A and 12B are found in Exhibit 13 along with the other sediment pond designs. Appendix A-3 of Exhibit 13 (formerly "Sediment Pond 003 Calculations") contains the hydrologic modeling for Sediment Ponds 12A and 12B. These ponds are designed to treat the 10-year, 24-hour storm runoff and sediment accumulations for three years.

Findings:

The following deficiencies must be address before the operational hydrologic section can be declared complete and accurate:

1. C-24 appears on Map 23E-1 and in Table 13-11 but there are no designs for it located in Appendix D.

2. C-25 appears on Map 23E-1 and in Appendix D but the design is not summarized in Table 13-11.

MAPS, PLANS, AND CROSS SECTIONS OF MINING OPERATIONS

Regulatory Reference: 30 CFR Sec. 784.23; R645-301-512, -301-521, -301-542, -301-632, -301-731, -302-323.

Hydrology Maps

Analysis:

Many maps have been submitted as part of this amendment. Some of the maps are replacing and updating previous versions while a few are new to the plan. In many cases the updated maps are black and white versions of color originals. These maps are difficult to read because the color was often important in identifying different characteristics.

Findings:

The following deficiencies exist in the rail road relocation pond amendment. These deficiencies must be addressed prior to approval and final review of the amendment.

1. Map 15 still shows Pond 003 though it looks as if they attempted to remove it.

2. Map 16 is unreadable. It needs to either be in the original colors or completely reformatted to show all features clearly.

3. Map 18B has also been changed from a color format and is now unreadable.

RECOMMENDATIONS

This amendment should not be approved until the listed deficiencies are approved. Analysis on bank stability is reliant on the reviews completed by a Division Engineer.

blb
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CC: Daron Haddock, DOGM Pemit Supervisor

State of Utah
DEPARTMENT OF NATURAL RESOURCES
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October 11, 1996

Ben Grimes, Senior Staff Project Engineer
Cyprus-Plateau Mining Corporation
Willow Creek Mine/Castle Gate Preparation Plant
P. O. Drawer PMC
Price, Utah 84501

RE: Railroad Loading Tracks #1 and #2 Retaining Walls/Southern Embankment of Sediment Pond 12B, Castle Gate Preparation Plant, ACT/007/038-96D, Folder #2, Carbon County, Utah

Willow Creek Permit.

Dear Ben:

I have reviewed the aforementioned submittal and I have the following comments:

1) In the letter from Brad Price, P. E., of RB & G Engineering, Mr. Price recommends that the eastern cut slope of pond 12B be redesigned from the 1.5/1 slope to a 2/1 slope in order to provide for an increased factor of safety. If the 1.5/1 slope is to be retained, the design must indicate that the slope will be over excavated, and a 6 foot thick horizontal thickness of sandy gravel be placed and compacted to attain a safety factor of 1.3. Although Mr. Barton, P. E., has certified map 26B, cross section A still shows the eastern cut slope of pond B to be at the 1.5/1 slope. I have difficulty understanding why the expense of a geotechnical investigation was absorbed if the recommendations are not heeded by Mr. Barton.

2) The computer model using the Spencer Method to show the stability analysis is considered to be a satisfactory method for solving limiting equilibrium problems. Three computer runs have been made, all considering the pond to be full. The runs considered a 1.5/1 slope with loose coal refuse, a 2/1 slope, and a 1.5/1 slope with compacted gravel. The first page of each run indicates that **the results of computations performed using this computer program should not be used for design purposes unless they have been verified by independent analysis, experimental data, or field experience.**

If an independent analysis, (or any combination of the three) has been performed, where is the documentation to back up this design?

3) Regarding the Hilfiker retaining wall design from Geotechnical Design Services, has Mr. Barton chosen not to heed the recommendation that the foundations for the Hilfiker wall be excavated and backfilled with compacted granular material? No mention is made of this on drawing 26B, Sedimentation Pond 12B.

In summation, I am not saying that this design is not adequate. I am saying that it is lacking to the point that it cannot be approved by the DOGM.

I have enclosed a copy of Mr. Randy Harden's comments regarding these same issues. If you have questions, please do not hesitate to call. Thank you for your attention in this matter.

Sincerely,

Peter Hess
Reclamation Specialist III

sd
cc: Joe Helfrich, DOGM, SLC
Daron Haddock, DOGM, SLC
Steve Johnson, DOGM, SLC