DESIGN REPORT

Temporary Sedimentation Structure

J19-B

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

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## INTRODUCTION

Sedimentation Structure J19-B will be an earthen embankment, designed and constructed by Peabody Western Coal Company as a temporary sedimentation structure to control runoff and sediment from portions of the proposed J-19 West disturbed surface mining area at the Kayenta Mine. The location of Structure J19-B and its watershed boundary are shown on Drawing No. 85400 (Sheets M-10) and Drawing No. 85405. The site-specific general construction plans are shown on the attached Exhibit #1.

This design report contains information specific to Structure J19-B. Mine-wide design, construction, and reclamation information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona, for Peabody Western Coal Company", December, 1985 (PAP), Chapter 6, Attachment D, Volume 2, along with the methods and results of analyses used for slope stability, hydrology, and hydraulics, and in Chapter 6, Pages 11 to 42, "Sediment and Water Control Facility Plan".

## INSPECTION

The construction site of the proposed Structure J19-B was inspected in September, 2001 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions existed. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized for embankment design and will be utilized during construction to construct a stable embankment.

# SITE DESCRIPTION

## LAND USE

The J19-B Structure has a watershed of 88.6 acres and is located on a tributary upstream of Red Peak Valley Wash at the Kayenta Mine. The 88.6-acre watershed, which contributes directly to structure J19-B is classified as 17% undisturbed, 44% spoil, 21% Topsoil Piles (vegetated) and 18% disturbed.

## DESIGN ANALYSES

## GENERAL

Structure J19-B was designed under the supervision of a Registered Professional Engineer from Peabody Western Coal Company. The design was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of Interior, Office of Surface Mining (OSM) and included a review of available project files. The most current information contained in the Peabody Western Coal Company files includes topographic maps developed from aerial photography flown in 1999 for Peabody Western Coal Company and was used in the analyses of the structure.

## STABILITY

Structure J19-B is assumed to be a Category A-3 embankment. The structure will be a homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 13 feet wide on top. A minimum upstream slope of 2.5H:1V and minimum downstream slope of 3.25H:1V were assumed. Based on the total embankment height of approximately 14.5 feet, these slopes are equal to or flatter than the recommended "worst case" embankment/foundation condition slopes in Table 3-6, Attachment D, Chapter 6; therefore, the embankment will be stable. The emergency spillway will be a minimum 15-foot wide, riprap-lined, trapezoidal channel.

## HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure J19-B is classified as a low hazard structure (see Drawing No. 85408). In addition, the mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and be less than 20 vertical feet in height from the upstream toe of the embankment of the natural stream elevation to the emergency spillway invert elevation. The spillway was analyzed using the 25-year, 6-hour storm. Structure J19-B was conservatively assumed to be full to the emergency spillway at the time of the design storm event. The storage capacity of structure J19-B was analyzed using the 10-year, 24-hour storm event. The pond was verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Red Peak Valley Wash.

The following parameters were used in the hydrologic analysis:

| | | |
|---|---|---|
| 1. | Water Course length, L | 0.590 mi. |
| 2. | Elevation Difference, H | 273 ft |
| 3. | Time of Concentration, $T_c$ | 0.163 hr |
| 4. | NRCS Curve Number | 85 |
| 5. | Rainfall Depth, 10-year, 24-hour storm<br>25-year, 6-hour storm | 2.1 in<br>1.9 in |
| 6. | Drainage Area | 88.6 ac |

Values reported represent the watershed, which drains directly to Pond J19-B.

## HYDRAULICS

The SEDCAD4 and Flow Master computer programs were used to evaluate inflow to the sedimentation structure, outflow from the structure and the resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following table (supporting calculations are presented in Appendices A, B, and C).

# J19-B SEDIMENTATION POND HYDRAULICS TABLE

| | Units | 10-Yr, 24-Hr Storm | 25-Yr, 6-Hr Storm | |
|---|---|---|---|---|
| Initial Reservoir Volume Condition | | Empty | Full to emergency spillway | |
| **Inflow** | | | | |
| Peak Flow | cfs | 70.8 | 86.2 | |
| Volume | ac-ft | 6.4 | 5.3 | |
| **Storage** | | | | |
| Peak Stage | msl | N/A | 6770.7 | |
| Emergency Spillway Elev. | msl | 6769.5 | 6769.5 | |
| Peak Storage | ac-ft | N/A | 14.6 | |
| Storage Capacity | ac-ft | 12.9 | 12.9 | |
| **Outflow** | | | | |
| Peak Flow | cfs | N/A | 54.9 | |
| Spillway Elevation | msl | 6769.5 | 6769.5 | |
| Embankment Crest Elev. | msl | 6772.2 | 6772.2 | |
| Peak Stage | msl | -- | 6770.7 | |
| Freeboard | ft | -- | 1.5 | |
| **Emergency Spillway Channel** | | | | |
| Flow Depth | ft | -- | 1.2 | |
| Critical Velocity | fps | -- | 4.6 | |
| Mannings "n" | -- | -- | 0.03 | |
| Width | ft | -- | 15 | |
| **Outflow Channel** | | | | |
| Slope | % | | 5 | 30.8 |
| Normal Velocity | fps | -- | 5.3 | 7.1 |
| Normal Depth | ft | -- | 0.6 | 0.5 |
| Mannings "n" | — | -- | 0.042 | 0.066 |
| Riprap $D_{50}$ | in | -- | 3 | 6 |

## EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J19-B will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit #1.

| | | | |
|---|---|---|---|
| Minimum Channel Depth | (Spillway) | 2.2 | ft |
| | (Outflow) | 1.5 | ft |
| Channel Width | | 15 | ft |
| Channel Length | (Spillway) | 28.75 | ft |
| | (Outflow) | 100 | ft |
| Side slopes (Horizontal to Vertical) | | 3:1 | or flatter |
| Average Slope | (Spillway) | 0 | % |
| Maximum Slope | (Outflow) | 30.8 | % |
| Spillway Elevation | | 6769.5 | ft |

A minimum 15-foot long riprap-lined channel will be constructed beyond the toe of the embankment as a transition into the downstream channel.


## STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit #1) is based on the design topography. Structure J19-B is designed to contain approximately 12.9 acre-feet.

The calculations for the sediment load entering structure J19-B were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

| | | |
|---|---|---|
| 1. | Rainfall Factor, R | 40 |
| 2. | Soil Erodibility Factor, K | 0.20 |
| 3. | Slope Factor, LS | 5.5 |
| 4. | Cover Factor, C | 0.69 |
| 5. | Erosion Control Factor, P | 0.79 |

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume is available for storing sediment. Structure J19-B has sufficient storage to contain the 10-year, 24-hour storm. The total storage capacity was determined for structure J19-B and the results of the analysis are presented below.

### Storage for Structure J19-B

| | |
|---|---|
| Total Storage Capacity | 12.9 ac-ft |
| 10-year, 24-hour Storm Inflow | 6.4 ac-ft |
| Available Sediment Storage Capacity | 6.5 ac-ft |
| Sediment Inflow Rate/Year | 0.94 ac-ft/yr |
| Sediment Storage Life | 6.9 years |

\*                                         \*                                         \*

The following appendices and drawing are attached and complete this design report.

Appendix A- Hydrology, Hydraulic, and Sedimentation Calculations

Appendix B- SEDCAD4 (Input and Output) 10-Year, 24-Hour Storm Event

Appendix C- SEDCAD4 (Input and Output) 25-Year, 6-Hour Storm Event

Exhibit #1- J19-B Proposed Sedimentation Ponds

Appendix D- J19-B Temporary Diversion

Exhibit #1- J19-B Temporary Diversion

# APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

# PEABODY WESTERN COAL COMPANY
# CALCULATED HYDROLOGIC DATA

## PROJECT: J19 AREA

## STRUCTURE: J19B Pond

*TIME OF CONCENTRATION:*

| | |
|---|---|
| Start Elevation (ft) = | 7023 |
| End Elevation (ft) = | 6750 |
| Elevation Difference, E (ft) = | 273 |
| Watercourse Length (ft) = | 3116 |
| Watercourse Length, L (mi) = | 0.590 |

$Tc = (11.9L^3/E)^{0.385} =$ ___0.163___ hours

*ROUTING PARAMETERS:*

Between structure routing parameters were calculated using the SCS Upland Method in SEDCAD4. Input and output parameters are shown on the SEDCAD4 printouts in Appendices C.

*SCS CURVE NUMBER:*

| Cover Type | Soil Group | Curve Number | Area (acres) | CN*Area |
|---|---|---|---|---|
| Pinyon Juniper | B | 65 | 0 | 0 |
| Pinyon Juniper | D | 83 | 14.8 | 1228.4 |
| Sagebrush | D | 79 | 0 | 0 |
| Disturbed - Mine | | 90 | 17 | 1530 |
| Disturbed - Spoil | | 86 | 38.3 | 3293.8 |
| Reclaimed | C | 81 | 18.5 | 1498.5 |
| TOTAL: | | | 88.6 | 7550.7 |

Weighted CN = Total CN*Area/ Total Area = ___85___

*DRAINAGE BASIN AREA:*

88.6   Acres

PROJECT:  J19B Pond

SOIL ERODIBILITY FACTOR:

| Soil Type | Erodibility Factor, K | Area (acres) | K*Area |
|---|---|---|---|
| 1B | 0.15 | 0 | 0.00 |
| 1C | 0.14 | 0 | 0.00 |
| 3BC | 0.16 | 14.8 | 2.37 |
| 5 | 0.58 | 0 | 0.00 |
| 12 | 0.38 | 0 | 0.00 |
| 13 | 0.41 | 0 | 0.00 |
| 15 | 0.37 | 0 | 0.00 |
| 34-spoil | 0.12 | 38.3 | 4.60 |
| Reclaimed | 0.38 | 18.5 | 7.03 |
| Mine Pits | 0.22 | 17 | 3.74 |
| TOTAL: | | 88.6 | 17.73 |

Weighted K = Total K*Area/ Total Area =        0.20

SLOPE FACTOR:

| Length (ft) | Elevation Change (ft) | Slope (%) | m | Slope Angle (deg) | LS Factor |
|---|---|---|---|---|---|
| 210 | 45 | 21.4% | 0.6 | 12.1 | 5.71 |
| 220 | 45 | 20.5% | 0.6 | 11.6 | 5.58 |
| 150 | 15 | 10.0% | 0.5 | 5.7 | 1.68 |
| 170 | 40 | 23.5% | 0.6 | 13.2 | 5.58 |
| 330 | 30 | 9.1% | 0.5 | 5.2 | 2.18 |
| 180 | 25 | 13.9% | 0.6 | 7.9 | 3.12 |
| 280 | 30 | 10.7% | 0.6 | 6.1 | 2.90 |
| 110 | 20 | 18.2% | 0.6 | 10.3 | 3.21 |
| 260 | 30 | 11.5% | 0.6 | 6.6 | 3.07 |
| 330 | 65 | 19.7% | 0.6 | 11.1 | 6.81 |
| 220 | 50 | 22.7% | 0.6 | 12.8 | 6.27 |
| 250 | 120 | 48.0% | 0.6 | 25.6 | 14.22 |
| 250 | 100 | 40.0% | 0.6 | 21.8 | 12.05 |
| 170 | 50 | 29.4% | 0.6 | 16.4 | 7.07 |
| 200 | 20 | 10.0% | 0.5 | 5.7 | 1.94 |
| 160 | 45 | 28.1% | 0.6 | 15.7 | 6.50 |
| 260 | 65 | 25.0% | 0.6 | 14.0 | 7.69 |
| 160 | 25 | 15.6% | 0.6 | 8.9 | 3.36 |

Average LS =        5.50

The LS Factor was calculated by:

$LS = (Slope\ Length/72.6)^m*(10.8*sin(slope\ angle) + 0.03)$  for Slopes < 9%

$LS = (Slope\ Length/72.6)^m*(16.8*sin(slope\ angle) - 0.5)$  for Slopes > 9%

Where:

| | |
|---|---|
| Slope < 3% | m = 0.3 |
| Slope = 4% | m = 0.4 |
| 5% > Slope < 10% | m = 0.5 |
| Slope > 10% | m = 0.6 |

**PROJECT:  J19B Pond**

*COVER AND PRACTICE FACTORS:*

| Cover Type | Cover (%) | Canopy (%) | Area (acres) | Cover Factor, C | C*Area | Practice Factor, P | P*Area |
|---|---|---|---|---|---|---|---|
| Pinyon Juniper | 20% | 25% | 14.8 | 0.22 | 3.26 | 1.00 | 14.80 |
| Sagebrush/Grass | 20% | 25% | 0 | 0.20 | 0.00 | 1.00 | 0.00 |
| Disturbed | 0% | 0% | 17 | 1.00 | 17.00 | 1.00 | 17.00 |
| Spoil | 0% | 0% | 38.3 | 1.00 | 38.30 | 0.80 | 30.64 |
| Reclaimed | 40% | 0% | 18.5 | 0.15 | 2.78 | 0.40 | 7.40 |
| TOTAL: | | | 88.6 | | 61.33 | | 69.84 |

Weighted C = Total C*Area/ Total Area =    0.692

Weighted P = Total P*Area/ Total Area =    0.788

*RAINFALL FACTOR:*

R = 40

# PEABODY WESTERN COAL COMPANY
## CALCULATED SEDIMENT YIELD

## PROJECT: J19B Pond

*The following spreadsheet calculates the predicted sediment yield for the project area. The gross sediment yie is determined according to the Revised Universal Soil Loss Equation.*

| PARAMETER DESCRIPTION | VALUE | |
|---|---|---|
| Annual Rainfall Factor | 40.00 | |
| Soil Erodibility Factor | 0.20 | |
| Length Slope Factor | 5.50 | |
| Cover Factor | 0.69 | |
| Practice Factor | 0.79 | |
| Gross Annual Sediment Yield | 24.01 | tons/acre/year |
| | | |
| Sediment Density | 94.00 | pcf |
| Gross Annual Sediment Yield | 0.0117 | acre-feet/acre/year |
| Sediment Delivery Ratio | 90% | |
| Estimated Annual Sediment Yield | 0.0106 | acre-feet/acre/year |
| | | |
| Watershed Area | 88.6 | acres |
| Watershed Annual Sediment Yield | 0.94 | acre-feet/year |
| | | |
| Number of years | 1 | years |
| Calculated Sediment Volume | 0.94 | acre-feet |

# J19-B Emergency Spillway Outflow

## Material: Riprap

### Trapezoidal Channel

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 15.00 | 3.0:1 | 3.0:1 | 30.8 | 1.00 | | |

### PADER Method - Steep Slope Design

|  | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 54.90 cfs | |
| Depth: | 0.47 ft | 1.47 ft |
| Top Width: | 17.82 ft | 23.82 ft |
| Velocity: | 7.12 fps | |
| X-Section Area: | 7.71 sq ft | |
| Hydraulic Radius: | 0.429 | |
| Froude Number: | 1.91 | |
| Manning's n: | 0.0660 | |
| Dmin: | 3.00 in | |
| D50: | 6.00 in | |
| Dmax: | 9.00 in | |

# J19-B Emergency Spillway Outflow

## Material: Riprap

### *Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 15.00 | 3.0:1 | 3.0:1 | 5.0 | 1.00 | | |

### PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 54.90 cfs | |
| Depth: | 0.61 ft | 1.61 ft |
| Top Width: | 18.68 ft | 24.68 ft |
| Velocity: | 5.31 fps | |
| X-Section Area: | 10.34 sq ft | |
| Hydraulic Radius: | 0.548 | |
| Froude Number: | 1.26 | |
| Manning's n: | 0.0420 | |
| Dmin: | 2.00 in | |
| D50: | 3.00 in | |
| Dmax: | 4.50 in | |

# Pond J19B, Em. Spilway Critical Velocity
## Worksheet for Trapezoidal Channel

## Project Description

| | |
|---|---|
| Project File | j:\2470172 peabody\task 22h\task 22h\flowmaster\j19d.fm2 |
| Worksheet | J19B Critical Velocity |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

## Input Data

| | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Channel Slope | 0.016000 ft/ft | |
| Left Side Slope | 3.000000 H : V | |
| Right Side Slope | 3.000000 H : V | |
| Bottom Width | 15.00 | ft |
| Discharge | 54.90 | cfs |

## Results

| | | |
|---|---|---|
| Depth | 0.70 | ft |
| Flow Area | 12.06 | ft² |
| Wetted Perimeter | 19.46 | ft |
| Top Width | 19.23 | ft |
| Critical Depth | 0.71 | ft |
| Critical Slope | 0.015526 ft/ft | |
| Velocity | 4.55 | ft/s |
| Velocity Head | 0.32 | ft |
| Specific Energy | 1.03 | ft |
| Froude Number | 1.01 | |
| Flow is supercritical. | | |

APPENDIX B

SEDCAD4 (Input and Output) 10-Year, 24-Hour Storm Event

# Peabody Western Pond J19B

## *10-year, 24-hour*

djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co.  80228

Phone:  303 763-5140

# General Information

## Storm Information:

| | |
|---|---|
| Storm Type: | NRCS Type II |
| Design Storm: | 10 yr - 24 hr |
| Rainfall Depth: | 2.100 inches |

## *Structure Summary:*

|     | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
| --- | --- | --- | --- | --- |
| #1  | 88.600 | 88.600 | 70.83 | 6.42 |

# *Subwatershed Hydrology Detail:*

| Stru # | SWS # | SWS Area (ac) | Time of Conc (hrs) | Musk K (hrs) | Musk X | Curve Number | UHS | Peak Discharge (cfs) | Runoff Volume (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| #1 | 1 | 88.600 | 0.163 | 0.000 | 0.000 | 85.000 | F | 70.83 | 6.417 |
| | Σ | 88.600 | | | | | | 70.83 | 6.417 |

APPENDIX C

SEDCAD4 (Input and Output) 25-Year, 6-Hour Storm Event

.

# <u>Peabody Western</u>
# <u>Pond J19-B</u>

## *25-year, 6-hour*

djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co.  80228

Phone:  303 763-5140

# *General Information*

## *Storm Information:*

| | |
|---|---|
| Storm Type: | NRCS Type II |
| Design Storm: | 25 yr - 6 hr |
| Rainfall Depth: | 1.900 inches |

## Structure Summary:

| | | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|---|
| #1 | In | 88.600 | 88.600 | 86.18 | 5.34 |
| | Out | | | 54.92 | 4.97 |

# Structure Detail:

## Structure #1 (Pond)

### runoff volume

### Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,769.50 |
| Initial Pool: | 12.94 ac-ft |

### Emergency Spillway

| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,769.50 | 28.75 | 3.00:1 | 3.00:1 | 15.00 |

### Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,770.73 |
| Dewater Time: | 2.98 days |

*Dewatering time is calculated from peak stage to lowest spillway*

### Elevation-Capacity-Discharge Table

| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) |
|---|---|---|---|---|
| 6,755.00 | 0.520 | 0.000 | 0.000 | |
| 6,755.50 | 0.542 | 0.265 | 0.000 | |
| 6,756.00 | 0.564 | 0.542 | 0.000 | |
| 6,756.50 | 0.587 | 0.830 | 0.000 | |
| 6,757.00 | 0.611 | 1.129 | 0.000 | |
| 6,757.50 | 0.634 | 1.441 | 0.000 | |
| 6,758.00 | 0.659 | 1.764 | 0.000 | |
| 6,758.50 | 0.683 | 2.099 | 0.000 | |
| 6,759.00 | 0.708 | 2.447 | 0.000 | |
| 6,759.50 | 0.734 | 2.808 | 0.000 | |
| 6,760.00 | 0.760 | 3.181 | 0.000 | |
| 6,760.50 | 0.786 | 3.568 | 0.000 | |
| 6,761.00 | 0.813 | 3.967 | 0.000 | |
| 6,761.50 | 0.839 | 4.380 | 0.000 | |
| 6,762.00 | 0.867 | 4.807 | 0.000 | |
| 6,762.50 | 0.895 | 5.247 | 0.000 | |
| 6,763.00 | 0.923 | 5.701 | 0.000 | |

| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,763.50 | 0.951 | 6.170 | 0.000 | | |
| 6,764.00 | 0.981 | 6.653 | 0.000 | | |
| 6,764.50 | 1.010 | 7.150 | 0.000 | | |
| 6,765.00 | 1.040 | 7.663 | 0.000 | | |
| 6,765.50 | 1.068 | 8.190 | 0.000 | | |
| 6,766.00 | 1.097 | 8.731 | 0.000 | | |
| 6,766.50 | 1.127 | 9.287 | 0.000 | | |
| 6,767.00 | 1.156 | 9.858 | 0.000 | | |
| 6,767.50 | 1.186 | 10.444 | 0.000 | | |
| 6,768.00 | 1.217 | 11.044 | 0.000 | | |
| 6,768.50 | 1.247 | 11.660 | 0.000 | | |
| 6,769.00 | 1.278 | 12.292 | 0.000 | | |
| 6,769.50 | 1.310 | 12.939 | 0.000 | | Spillway #1 |
| 6,770.00 | 1.355 | 13.605 | 0.119 | 67.59* | |
| 6,770.50 | 1.400 | 14.293 | 35.017 | 3.65 | |
| 6,770.73 | 1.421 | 14.621 | 54.918 | 0.25 | Peak Stage |
| 6,771.00 | 1.446 | 15.005 | 78.178 | | |
| 6,771.50 | 1.493 | 15.739 | 130.457 | | |
| 6,772.00 | 1.540 | 16.497 | 199.035 | | |
| 6,772.20 | 1.600 | 16.812 | 231.537 | | |

*Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,755.00 | 0.000 | 0.000 |
| 6,755.50 | 0.000 | 0.000 |
| 6,756.00 | 0.000 | 0.000 |
| 6,756.50 | 0.000 | 0.000 |
| 6,757.00 | 0.000 | 0.000 |
| 6,757.50 | 0.000 | 0.000 |
| 6,758.00 | 0.000 | 0.000 |
| 6,758.50 | 0.000 | 0.000 |
| 6,759.00 | 0.000 | 0.000 |
| 6,759.50 | 0.000 | 0.000 |
| 6,760.00 | 0.000 | 0.000 |
| 6,760.50 | 0.000 | 0.000 |
| 6,761.00 | 0.000 | 0.000 |

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,761.50 | 0.000 | 0.000 |
| 6,762.00 | 0.000 | 0.000 |
| 6,762.50 | 0.000 | 0.000 |
| 6,763.00 | 0.000 | 0.000 |
| 6,763.50 | 0.000 | 0.000 |
| 6,764.00 | 0.000 | 0.000 |
| 6,764.50 | 0.000 | 0.000 |
| 6,765.00 | 0.000 | 0.000 |
| 6,765.50 | 0.000 | 0.000 |
| 6,766.00 | 0.000 | 0.000 |
| 6,766.50 | 0.000 | 0.000 |
| 6,767.00 | 0.000 | 0.000 |
| 6,767.50 | 0.000 | 0.000 |
| 6,768.00 | 0.000 | 0.000 |
| 6,768.50 | 0.000 | 0.000 |
| 6,769.00 | 0.000 | 0.000 |
| 6,769.50 | 0.000 | 0.000 |
| 6,770.00 | 0.119 | 0.119 |
| 6,770.50 | 35.017 | 35.017 |
| 6,771.00 | 78.178 | 78.178 |
| 6,771.50 | 130.457 | 130.457 |
| 6,772.00 | 199.035 | 199.035 |
| 6,772.20 | 231.537 | 231.537 |

# *Subwatershed Hydrology Detail:*

| Stru # | SWS # | SWS Area (ac) | Time of Conc (hrs) | Musk K (hrs) | Musk X | Curve Number | UHS | Peak Discharge (cfs) | Runoff Volume (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| #1 | 1 | 88.600 | 0.163 | 0.000 | 0.000 | 85.000 | F | 86.18 | 5.336 |
| | Σ | 88.600 | | | | | | 86.18 | 5.336 |

# PEABODY WESTERN – KAYENTA MINE

# J-19 WEST AREA

# TEMPORARY DIVERSION CHANNELS

PURPOSE: To provide runoff control from potential mine disturbance areas and to provide stable temporary diversion channels in the J-19 West area of the Kayenta Mine. The following channel has been included in this design submittal:

### J-19 WEST AREA

- J19-B Diversion Channel, (see Exhibit #1, J19-B Temporary Diversion)

**Design Parameters – Channels**

To allow construction to be field-fitted for this temporary diversion channel, three alternative trapezoidal or triangular channels (Design A, Design B, or Design C) are recommended. The channel designs will vary based on channel slope and site conditions

The following design parameters are common to all temporary channel designs.

1.   All designs are based on the 10-year, 6-hour precipitation event = 1.6 inches.
2.   All areas are disturbed (mine, spoil, topsoil piles) or undisturbed. Curve numbers used include; mine = 90, spoil = 86, topsoil piles = 81(temp. reclaimed) and undisturbed = varies.

Note: The following applies to all channel designs:

1.   Design selection will be field-fitted to complement the site conditions.
2.   Sedcad4 Hydrology and Channel design outputs are attached.
3.   If bedrock is encountered during excavation, Design C will not require the installation of riprap.
4.   Minimum 20-ft length of ripraped or graveled channel between Design A and Designs B and C.
5.   See Chapter 26 for terrace and downdrain construction specifications.
6.   Maximum slope design for graded spoil-lined channel limited by critical slope.
7.   Depth of flow (d) based on minimum slope, Velocity (v) based on maximum slope.
8.   Side-slopes will be a minimum of 2H: 1V. or flatter.

Design A: Earth/Graded Spoil-lined trapezoidal or triangular channel. This design will apply to slopes up to the calculated Critical slope.

Design B: Gravel-lined trapezoidal or triangular channel. This design will apply until a velocity of 6.0 fps is exceeded.

Design C: Riprap-lined trapezoidal or triangular channel. This design will apply for all subsequent slopes until a limiting velocity of 10.0 fps is exceeded.

Design summaries for the channels are shown on Table J19-1. Hydrology calculations for the channel is attached as Appendix A. Channel designs and critical slope calculations are attached as Appendix B.

# J19-B Diversion Channel

## Material: Graded Spoil

### Triangular Channel

| Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Manning's n | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) | Limiting Velocity (fps) |
|---|---|---|---|---|---|---|---|
| 3.0:1 | 3.0:1 | 1.7 | 0.0300 | 1.00 | | | 6.0 |

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 13.00 cfs | |
| Depth: | 1.04 ft | 2.04 ft |
| Top Width: | 6.22 ft | 12.22 ft |
| Velocity: | 4.03 fps | |
| X-Section Area: | 3.22 sq ft | |
| Hydraulic Radius: | 0.492 | |
| Froude Number: | 0.99 | |

# J19-B Diversion Channel

## Material: Gravel

### *Triangular Channel*

| Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Manning's n | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) | Limiting Velocity (fps) |
|---|---|---|---|---|---|---|---|
| 3.0:1 | 3.0:1 | 1.8 | 0.0300 | 1.00 | | | 6.0 |

|  | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 13.00 cfs | |
| Depth: | 1.03 ft | 2.03 ft |
| Top Width: | 6.15 ft | 12.15 ft |
| Velocity: | 4.12 fps | |
| X-Section Area: | 3.15 sq ft | |
| Hydraulic Radius: | 0.486 | |
| Froude Number: | 1.01 | |

# J19-B Diversion Channel

## Material: Riprap

### Triangular Channel

| Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|
| 3.0:1 | 3.0:1 | 11.0 | 1.00 | | |

### PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 13.00 cfs | |
| Depth: | 0.81 ft | 1.81 ft |
| Top Width: | 4.88 ft | 10.88 ft |
| Velocity: | 6.55 fps | |
| X-Section Area: | 1.98 sq ft | |
| Hydraulic Radius: | 0.386 | |
| Froude Number: | 1.81 | |
| Manning's n: | 0.0400 | |
| Dmin: | 3.00 in | |
| D50: | 6.00 in | |
| Dmax: | 9.00 in | |