DESIGN REPORT

Permanent Impoundment

N7-E

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

OCT 2001
APPROVED

Registered Professional Engineer (Civil)
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AUG 10 2001

TABLE OF CONTENTS

Page

INTRODUCTION ..... 1

INSPECTION ..... 1

SITE DESCRIPTION ..... 2

LAND USE ..... 2

DESIGN ANALYSES ..... 2

GENERAL ..... 2

STABILITY ..... 2

WATER PERSISTENCE ..... 3

WATER QUALITY ..... 3

DIMINUTION OF ADJACENT WATER QUANTITY AND QUALITY ..... 4

HYDROLOGY ..... 6

HYDRAULICS ..... 6

INLET CHANNEL ..... 8

EMERGENCY SPILLWAY AND OUTFLOW CHANNEL ..... 9

STORAGE CAPACITY ..... 9

APPENDIX A - Hydrology, Hydraulic, and Sedimentation Calculations
APPENDIX B -Water Persistence Calculations
APPENDIX C - SEDCAD4 (Input and Output)
EXHIBIT #1 - N7-E Permanent Impoundment Design

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## INTRODUCTION

Pond N7-E is an existing impoundment constructed by Peabody Western Coal Company (PWCC) in 1990 in the N-7/N-8reclamation area. The N7-E Permanent Impoundment structure will be utilized as one of the original AZ-0001-D Permit structures to mitigate post-mining livestock and wildlife watering sources, (see Chapter 6, Permanent Impoundment section). The location of structure N7-E and its watershed boundary are shown on Drawing No. 85400 (sheet K-7) 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 N7-E. 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 49, "Sediment and Water Control Facility Plan".

## INSPECTION

The N7-E reclamation site was inspected in July, 2001 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. 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.

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## SITE DESCRIPTION

### LAND USE

Structure N7-E has a 246.9-acre tributary drainage area in a subwatershed of Yellow Water Canyon Wash and is located in the N-7/N-8 area at the Kayenta Mine. The watershed is classified as 100% reclaimed mined land.

### DESIGN ANALYSES

### GENERAL

Structure N7-E has been designed under the supervision of a Registered Professional Engineer from Peabody Western Coal Company. The existing emergency spillway structure will remain intact. 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 1989 for Peabody Western Coal Company and was used in the analyses of the structure.

### STABILITY

Structure N7-E is a Category A-4 embankment. The structure is a homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 15 feet wide on top. The upstream and downstream slopes are equal to or greater than 3.0:1 (horizontal to vertical). Based on the total embankment height of approximately 8 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 is a 30-foot wide, riprap-lined, trapezoidal channel.

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WATER PERSISTENCE

To determine water persistence for Structure N7-E, run-off volume calculated from average annual precipitation was compared to annual evaporation and infiltration. This comparison was performed on a monthly basis. The analysis was performed beginning on the first month of the year (January) with the pond assumed to be empty. Run-off for each month was determined using the NRCS Curve Number Method and the mean monthly precipitation. To simulate actual site conditions, a curve number of 77 was used in the analysis. The curve number was determined in the following manner. Precipitation occurs at the site under antecedent I and antecedent II conditions. Antecedent I represents a condition when the soils and subsoils are dry, and antecedent II represents average conditions. It was assumed that antecedent I condition occur 1/4 of the time, and antecedent II conditions occurs 3/4 of the time. Using a curve number of 81 for antecedent II (see Appendix A) and a curve number 64 for antecedent I, a weighted average results in a curve number of 77. The run-off volume was calculated for each month and added to the pond. A water elevation and surface area for each month was determined from the pond Stage Storage curve (see Appendix A). Total evaporation and infiltration rates were calculated based on the monthly pond surface areas. The calculated evaporation and infiltration values were subtracted from the total run-off to determined the water volume increase or decrease to the pond. The pond volume calculated for the first month (January) was used as the starting volume for the next month (February). The same steps were repeated for each month. This analysis was conducted for 8 years. The inputs and results are shown in Appendix B in graphical and tabular format. As shown in Appendix B, the final surface water elevation of the pond should stabilize between an elevation of 6557' (low seasonal mark) and 6559' (high seasonal mark). The final pond surface water elevation corresponds to a volume of between 4.9 ac-ft and 10.5 ac-ft.

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WATER QUALITY

Water contained in the proposed N7-E impoundment will originate from surface water run-off from reclaimed spoil areas. Given that neither the spoils or replaced topsoil in the reclaimed area do not contain material which could adversely impact surface water run-off, Peabody Western Coal Company does not anticipate any problems with water quality. Eleven full suite water quality analyses have been

performed on water samples collected from the N7-E to substantiate the aforementioned statement. A statistical analysis of the water quality parameters analyzed is presented in Table 1. In addition, a comparison of the chemical concentrations versus livestock drinking water standards is presented in Table 2. None of the livestock standards for any toxic chemical constituent were exceeded. Some total recoverable aluminum measurements exceeded the standard of 5 mg/l. Because none of the dissolved aluminum measurements were over 5 mg/l, it is clear the total recoverable exceedences were caused by sediment entrained with the water samples. Aluminum is soluble in an acid pH and is pulled off the sediment and dissolved during the total recoverable acid digestion. Based on the above-referenced chemical analyses, the water in the impoundment is quite well suited for its intended use as livestock and wildlife drinking water.

DIMINUTION OF ADJACENT WATER QUANTITY AND QUALITY

Peabody believes sufficient information has been submitted and evaluated by OSM in Hydrology Reports, Permits and other documents to demonstrate that this impoundment will not result in the diminution of the quantity and quality of water utilized by adjacent or surrounding landowners. Chapter 17 (Protection of the Hydrologic Balance) of the AZ-0001D Permit presents detailed descriptions of pre-existing water sources within the leasehold, including those proximate to the N-7/N-8 reclamation area. No pre-existing ponds or wells have been documented adjacent or immediately downstream of the N7-E impoundment. Plans for mitigation or replacement of pre-existing water sources that have been or may be affected by mining are presented in Chapter 17. There is very minimal potential for Permanent Impoundment N7-E to directly impact (positively or negatively) the adjacent downgradient water quality because it has a large storage volume in relation to its impounded watershed area. Historic monitoring indicates this pond has never discharged. The size rainfall event necessary to cause the pond to discharge would also produce a very large flow in the receiving channel, which would completely mask any chemical difference in the discharge from the pond.

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The Pond N7-E watershed of 246.9 acres represents approximately 0.9% of the drainage area of the encompassing watershed which drains this portion of Yellow Water Canyon Wash. If the watershed areas of N7-E and N7-D are combined, they only represent 3.6% of the Yellow Water Canyon watershed to this portion of the drainage. Based on this, any water quantity diminution due to Permanent Impoundments N7-E and N7-D is negligible. Water levels in alluvial wells (see Appendix D, Figures 1-3) adjacent and immediately downgradient in the alluvium from the pond show normal fluctuations in response to low and high stream flow years. There is no evidence of persistent diminished recharge to the alluvium from runoff, which could be potentially attributed to the loss of watershed area associated with Pond N7-E. In addition, Peabody has no evidence that flood irrigation has been practiced along this reach of Yellow Water Canyon Wash below the N7-E impoundment. Monitoring of stream flows in the main channels on Black Mesa since 1980 has shown extremely high sediment concentrations, which would preclude flood irrigation practices due to high maintenance costs.

Chapter 18 (Probable Hydrologic Consequences) of the AZ-0001D Permit presents analyses of the potential impacts of the mining operation, including a section that discusses the effects of dams, sediment ponds and permanent impoundments on downstream users. Although some localized decreases in receiving stream runoff may result after mining areas are reclaimed, these localized decreases will become less pronounced and unmeasurable further downstream, as lateral inflows from undisturbed basins will provide additional contributions to downstream runoff volumes. Channel transmission losses, evapotranspiration and other losses in the main channels to the Little Colorado River would completely mask any runoff reductions from the smaller reclaimed areas on the leasehold.

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OSM's Cumulative Hydrologic Impact Assessment (CHIA) and Environmental Impact Statement (EIS) which was written for the Black Mesa PAP in 1990, concluded that short- and long-term impacts from proposed permanent impoundments would be minor. Short- and long-term impacts of mining proposed in the PAP on the surface water quantity at Moenkopi Wash will be negligible.

Based on the above summaries, Peabody maintains this impoundment will not result in the diminution of the quantity or quality of water utilized by adjacent or surrounding landowners.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendix C). Structure N7-E is classified as a low hazard structure (see Drawing No. 85408). In addition, the Kayenta mine area is sparsely populated with no people living in the downstream flood plain. The emergency spillway is constructed through the embankment on the southern end of the pond and discharges to the Yellow Water Canyon Wash. The spillway will be designed to pass the peak flow from the 100-year, 6-hour storm

The following parameters were used in the hydrologic analysis:

| | | 100-Year, 6-Hour | |
|---|---|---|---|
| 1. | Water Course length, L | 1.447 | mi. |
| 2. | Elevation Difference, H | 301 | ft. |
| 3. | Time of Concentration, $T_c$ | 0.442 | hr. |
| 4. | NRCS Curve Number | 81 | |
| 5. | 100-Year, 6-Hour Storm Rainfall Depth | 2.4 | in. |
| 6. | Pond Watershed Area | 246.9 | ac. |

HYDRAULICS

The SEDCAD4 computer program was used to evaluate inflow to Structure N7-E 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 Appendix C).

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## POND N7-E HYDRAULICS TABLE

| | Units | 100-Yr, 6-Hr Storm | |
|---|---|---|---|
| Initial Reservoir Volume Condition | | Full to emergency spillway | |
| Inflow | | | |
| Peak Flow | cfs | 207.1 | |
| Volume | ac-ft | 17.9 | |
| Storage | | | |
| Peak Stage | msl | 6564.0 | |
| Emerg. Spillway Elev. | msl | 6562.4 | |
| Peak Storage | ac-ft | 23.8 | |
| Storage Capacity | ac-ft | 18.9 | |
| Outflow | | | |
| Peak Flow | cfs | 131.5 | |
| Spillway Elevation | msl | 6562.4 | |
| Embankment Crest Elev. | msl | 6571.8 | |
| Peak Stage | msl | 6564.0 | |
| Freeboard | ft | 7.8 | |
| Emergency Spillway Channel | | | |
| Flow Depth | ft | 1.5 | |
| Critical Velocity | fps | 5.0 | |
| Mannings "n" | -- | .03 | |
| Width | ft | 30 | |
| Outflow Channel | | | |
| Slope | % | 1.0 | 6.0 |
| Normal Velocity | fps | 4.3 | 6.4 |
| Normal Depth | ft | 0.9 | 0.7 |
| Mannings "n" | -- | 0.031 | 0.041 |
| Riprap $D_{50}$ | in | 1.5 | 3.0 |

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## N7-E POND HYDRAULICS TABLE

| | Units | Inflow (100-yr, 6-hr storm) |
|---|---|---|
| Initial Reservoir Volume Condition | | |
| Peak Flow | cfs | 131.5 |
| Volume | ac-ft | 17.9 |
| Peak Elevation | ft | 6564' |
| Pond Crest Elevation | ft | 6571.8' |
| Freeboard | ft | 7.8 |

## INLET CHANNEL

Inlet channels will be constructed at locations as shown on Exhibit #1. The channels will be armored to control erosion. The channels were designed to control the flows produced by the 100-year, 6-hour storm event. Hydrology modeling and channel designs are included in Appendix A. A summary of the inlet channel designs is presented below.

| Input Parameters | Inlet Channel A | | Inlet Channel B |
|---|---|---|---|
| Design Storm | 100-year, 6-hour | | 100-year, 6-hour |
| Precipitation (in) | 2.4 | | 2.4 |
| Watershed Area (ac) | 246.9 | | 246.9 |
| Curve Number | 81 | | 81 |
| Channel Design | | | |
| Peak Flow (cfs) | 207.1 | | 207.1 |
| Slope (%) | 18 | 30 | 14 |
| Width (ft) | 30 | 30 | 25 |
| Velocity (fps) | 8.9 | 9.0 | 9.0 |
| Rip rap (in, d50) | 6 | 9 | 6 |

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for N7-E is a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit #1.

| | |
|---|---|
| Minimum Channel Depth (Spillway) | 2.5 ft |
| (Outflow) | 1.7 ft |
| Channel Width | 30 ft |
| Channel Length (Spillway) | 30 ft |
| (Outflow) | 55 ft |
| Sideslopes (Horizontal to Vertical) | 3:1or flatter |
| Average Slope (Spillway) | 0% |
| Maximum Slope (Outflow) | 6% |
| Spillway Elevation | 6562.4 ft |

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

STORAGE CAPACITY

The impoundment stage-capacity table (see Appendix C) is based on the proposed regrading plan for N7-E developed by Peabody Western Coal Company.

The calculations for the sediment load entering structure N7-E were made utilizing the Revised Universal Soil Loss Equation (RUSLE) using the following parameters:

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| | | |
|---|---|---|
| 1. | Rainfall Factor, R | 40 |
| 2. | Soil Erodibility Factor, K | 0.38 |
| 3. | Slope Factor, LS | 6.04 |
| 4. | Cover Factor, C | 0.20 |
| 5. | Erosion Control Factor, P | 0.80 |

The storage capacity for N7-E is shown in Appendix C and the results of the runoff and sediment inflow analysis are summarized in the following table.

N7-E STORAGE

| | | |
|---|---|---|
| Total Storage Volume | 18.9 | ac-ft |
| High Water Mark Volume | 10.5 | ac-ft |
| Volume Available for Sediment Storage | 8.4 | ac-ft |
| Sediment Inflow Rate | 1.6 | ac-ft/yr. |
| Sediment Storage Life | 5.3 | years |

See Appendix A for sediment inflow calculations.

* * *

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

Appendix A - Hydrology, Hydraulic, and Sedimentology Calculations

Appendix B -Water Persistence Calculations

Appendix C - SEDCAD4 (Input and Output)

Exhibit #1 - N7-E Permanent Impoundment Design

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Table 1

# Peabody Western - Black Mesa Complex
## Paradox Hydrology System
## Water Quality Statistics

Sample Point : N7-E-P PERM IMPOUND N7-E

Location:

Elevation:

| | Uncensored Data | | | | | Censored Data | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No of Obs | Mean | StDv | Min | Max | No of Obs | | Min | | Max |
| **Field Parameters** | | | | | | | | | | |
| Field Ph S.U. | 10 | 7.93 | | 7.43 | 8.76 | 1 | < | 7.93 | < | 7.93 |
| Temperature C | 10 | 21.71 | 7.96 | 10.80 | 32.40 | 1 | < | 3.80 | < | 3.80 |
| Conductivity UMHOS/CM | 11 | 429.45 | 255.23 | 141.00 | 1014.00 | | | | | |
| Field Salinity 0/00 | 10 | .15 | .10 | 0.00 | .30 | | | | | |
| **Laboratory Parameters** | | | | | | | | | | |
| Acidity MG/L | 2 | 0.00 | | 0.00 | 0.00 | 1 | < | 2.00 | < | 2.00 |
| Alk As CaCO3, Ph 4.5 MG/L | 11 | 82.64 | 26.72 | 48.00 | 128.00 | | | | | |
| Alk, Bicarb As CaCO3 MG/L | 9 | 87.00 | 26.80 | 59.00 | 128.00 | | | | | |
| Alk, Carb As CaCO3 MG/L | | | | | | 9 | < | 2.00 | < | 2.00 |
| Alk, Hydrox As CaCO3 MG/L | | | | | | 9 | < | 2.00 | < | 2.00 |
| Aluminum, Dissolved MG/L | 1 | .21 | | .21 | .21 | 2 | < | .03 | < | .05 |
| Antimony, Dissolved UG/L | 1 | 1.00 | | 1.00 | 1.00 | 2 | < | 1.00 | < | 2.00 |
| Arsenic, Dissolved UG/L | 1 | 1.00 | | 1.00 | 1.00 | 2 | < | 1.00 | < | 1.00 |
| Barium, Dissolved UG/L | 3 | 65.33 | 15.01 | 50.00 | 80.00 | | | | | |
| Boron, Dissolved UG/L | 10 | 56.00 | 15.06 | 30.00 | 110.00 | 1 | < | 10.00 | < | 10.00 |
| Cadmium, Dissolved UG/L | | | | | | 3 | < | 3.00 | < | 5.00 |
| Calcium, Dissolved MG/L | 11 | 48.03 | 28.42 | 10.60 | 109.00 | | | | | |
| C.O.D. MG/L | 2 | 35.00 | | 30.00 | 40.00 | 1 | < | 20.00 | < | 20.00 |
| Chloride MG/L | 10 | 6.60 | 3.49 | 1.00 | 14.00 | 1 | < | 1.00 | < | 1.00 |
| Chromium, Dissolved UG/L | | | | | | 3 | < | 10.00 | < | 10.00 |
| Conductivity UMS/CM2 | 11 | 437.27 | 245.63 | 152.00 | 965.00 | | | | | |
| Copper, Dissolved UG/L | 1 | 10.00 | | 10.00 | 10.00 | 2 | < | 10.00 | < | 10.00 |
| Fluoride MG/L | 11 | .50 | .11 | .20 | .70 | | | | | |
| Hardness As CaCO3 MG/L | 11 | 184.09 | 115.59 | 39.00 | 439.00 | | | | | |
| Iron, Total MG/L | 11 | 11.28 | 14.67 | .89 | 51.00 | | | | | |
| Iron, Dissolved MG/L | 11 | .07 | .04 | .01 | .13 | | | | | |
| Lead, Dissolved UG/L | | | | | | 3 | < | 20.00 | < | 20.00 |
| Magnesium, Dissolved MG/L | 11 | 15.58 | 10.99 | 3.10 | 40.40 | | | | | |
| Manganese, Total MG/L | 11 | .23 | .26 | .03 | .94 | | | | | |
| Manganese, Dissolved MG/L | 9 | .03 | .02 | .01 | .10 | 2 | < | .01 | < | .01 |
| Mercury, Dissolved UG/L | | | | | | 3 | < | .20 | < | .20 |

Conditions: From: 01/01/1986...To: 12/20/2000...Sites: N7-D-P OR N7-E-P...

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Tab[illegible]1. (cont.)

# Peabody Western Black Mesa Complex
## Paradox Hydrology System
## Water Quality Statistics

Sample Point : N7-E-P PERM IMPOUND N7-E
Location:
Elevation:

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| | Uncensored Data | | | | | Censored Data | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No of Obs | Mean | StDv | Min | Max | No of Obs | | Min | | Max |
| **Laboratory Parameters** | | | | | | | | | | |
| Molybdenum, Dissolved UG/L | 1 | 1.00 | | 1.00 | 1.00 | 2 | < | 1.00 | < | 1.00 |
| Nickel, Dissolved UG/L | | | | | | 3 | < | 10.00 | < | 20.00 |
| Ammonia Nitrogen_N MG/L | 3 | .27 | .18 | .06 | .41 | | | | | |
| Nitrate Nitrogen_N MG/L | 10 | .96 | 1.72 | .03 | 5.70 | 1 | < | .02 | < | .02 |
| Nitrite Nitrogen_N MG/L | 6 | .11 | .06 | .04 | .22 | 5 | < | .01 | < | .01 |
| NO3_NO2 Nitrogen_N MG/L | 10 | 1.03 | 1.75 | .03 | 5.80 | 1 | < | .02 | < | .02 |
| Ph At 25 Deg. Cent. S.U. | 11 | 7.35 | | 6.80 | 8.30 | | | | | |
| Phosphorus, Orthophos MG/L | 1 | .01 | | .01 | .01 | 2 | < | .01 | < | .01 |
| Potassium, Dissolved MG/L | 11 | 10.65 | 4.39 | 2.70 | 17.20 | | | | | |
| Selenium, Dissolved UG/L | | | | | | 3 | < | 1.00 | < | 1.00 |
| Silica, Dissolved MG/L | 11 | 7.96 | 5.84 | 1.70 | 21.00 | | | | | |
| Silver, Dissolved UG/L | | | | | | 3 | < | 5.00 | < | 10.00 |
| Sodium, Dissolved MG/L | 11 | 17.97 | 12.34 | 2.70 | 40.50 | | | | | |
| Solids, Dissolved MG/L | 11 | 302.91 | 191.30 | 60.00 | 730.00 | | | | | |
| Solids, Suspended MG/L | 11 | 313.82 | 541.72 | 18.00 | 1870.00 | | | | | |
| Sulfate MG/L | 10 | 145.70 | 109.76 | 30.00 | 400.00 | 1 | < | 10.00 | < | 10.00 |
| Vanadium, Dissolved UG/L | | | | | | 3 | < | 5.00 | < | 10.00 |
| Zinc, Dissolved MG/L | 1 | .02 | | .02 | .02 | 2 | < | .01 | < | .01 |
| Bicarbonate As HCO3 MG/L | 11 | 100.91 | 32.51 | 59.00 | 156.00 | | | | | |
| Carbonate As CO3 MG/L | 2 | 0.00 | | 0.00 | 0.00 | 9 | < | 2.00 | < | 2.00 |
| Hydroxide As OH MG/L | | | | | | 9 | < | 2.00 | < | 2.00 |
| Phosphate As PO4 MG/L | | | | | | 3 | < | .02 | < | .10 |
| Cation_Anion Balance PERCENT | 11 | -1.47 | 7.63 | -21.70 | 4.80 | | | | | |
| SAR RATIO | 11 | .54 | .26 | .16 | .97 | | | | | |
| Solids, Diss. (Calc) MG/L | 11 | 288.82 | 177.49 | 64.00 | 670.00 | | | | | |
| Sum Of Anions MEQ/L | 9 | 4.77 | 3.05 | 1.40 | 10.50 | | | | | |
| Sum Of Cations MEQ/L | 9 | 4.78 | 3.27 | .90 | 11.00 | | | | | |
| Total Recoverable Al MG/L | 11 | 10.35 | 14.69 | .28 | 49.90 | | | | | |
| Total Recoverable As UG/L | 6 | 5.00 | | 1.00 | 14.00 | 5 | < | 1.00 | < | 10.00 |
| Total Recoverable Ba UG/L | 3 | 91.00 | 42.93 | 60.00 | 140.00 | | | | | |
| Total Recoverable Cd UG/L | 2 | 3.50 | | 3.00 | 4.00 | 9 | < | 3.00 | < | 30.00 |
| Total Recoverable Cr UG/L | 3 | 13.33 | | 10.00 | 20.00 | 8 | < | 10.00 | < | 100.00 |

Conditions: From: 01/01/1986...To: 12/20/2000...Sites: N7-D-P OR N7-E-P...

Table 1. (cont.)

# Peabody Western - Black Mesa Complex
## Paradox Hydrology System
## Water Quality Statistics

Sample Point : N7-E-P PERM IMPOUND N7-E

Location:

Elevation:

| | Uncensored Data | | | | | Censored Data | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No of Obs | Mean | StDv | Min | Max | No of Obs | | Min | | Max |
| **Laboratory Parameters** | | | | | | | | | | |
| Total Recoverable Cu UG/L | 6 | 48.33 | | 10.00 | 200.00 | 5 | < | 10.00 | < | 50.00 |
| Total Recoverable Fe MG/L | 3 | 4.06 | 3.69 | 1.60 | 8.30 | | | | | |
| Total Recoverable Pb UG/L | 2 | 30.00 | | 20.00 | 40.00 | 9 | < | 20.00 | < | 400.00 |
| Total Recoverable Mn MG/L | 3 | .10 | .07 | .03 | .17 | | | | | |
| Total Recoverable Hg UG/L | 1 | .60 | | .60 | .60 | 10 | < | .20 | < | .20 |
| Total Recoverable Mo UG/L | 1 | 2.00 | | 2.00 | 2.00 | 2 | < | 1.00 | < | 1.00 |
| Total Recoverable Ni UG/L | | | | | | 3 | < | 10.00 | < | 20.00 |
| Total Recoverable Se UG/L | 4 | 1.50 | | 1.00 | 2.00 | 7 | < | 1.00 | < | 5.00 |
| Total Recoverable Ag UG/L | | | | | | 3 | < | 5.00 | < | 10.00 |
| Total Recoverable Zn MG/L | 11 | .10 | .03 | .01 | .32 | | | | | |
| TDS Ratio ANAL/CALC | 11 | 1.04 | .05 | .93 | 1.11 | | | | | |
| Total Recoverable Sb UG/L | 1 | 1.00 | | 1.00 | 1.00 | 2 | < | 1.00 | < | 2.00 |
| Total Recoverable V UG/L | 6 | 37.67 | | 20.00 | 70.00 | 5 | < | 5.00 | < | 10.00 |
| Field Nitrite MG/L | 2 | .05 | .06 | .00 | .09 | | | | | |

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Conditions: From: 01/01/1986...To: 12/20/2000...Sites: N7-D-P OR N7-E-P...

Table

---- Excursion Summary Report ----

| Analyte | Standard | No. Sites | Sites | Frequency | Exceedence Date Range | Exceedence Value Range | Exceedence Median |
|---|---|---|---|---|---|---|---|
| Aluminum, Dissolved | 0.0000 - 5.0000 | 0 | none | | | | |
| Arsenic, Dissolved | 0.0000 - 200.0000 | 0 | none | | | | |
| Boron, Dissolved | 0.0000 - 5000.0000 | 0 | none | | | | |
| Cadmium, Dissolved | 0.0000 - 50.0000 | 0 | none | | | | |
| Chloride | 0.0000 - 2000.0000 | 0 | none | | | | |
| Chromium, Dissolved | 0.0000 - 1000.0000 | 0 | none | | | | |
| Copper, Dissolved | 0.0000 - 500.0000 | 0 | none | | | | |
| Fluoride | 0.0000 - 2.0000 | 0 | none | | | | |
| Lead, Dissolved | 0.0000 - 100.0000 | 0 | none | | | | |
| Mercury, Dissolved | 0.0000 - 10.0000 | 0 | none | | | | |
| Nickel, Dissolved | 0.0000 - 1000.0000 | 0 | none | | | | |
| Nitrate Nitrogen_N | 0.0000 - 100.0000 | 0 | none | | | | |
| Nitrite Nitrogen_N | 0.0000 - 10.0000 | 0 | none | | | | |
| Ph At 25 Deg. Cent. | 6.5000 - 8.5000 | 1 | N7-D-P | 1/8 | 03/04/98-03/04/98 | 6.4000 - 6.4000 | 6.4000 |
| Selenium, Dissolved | 0.0000 - 50.0000 | 0 | none | | | | |
| Solids, Dissolved | 0.0000 - 5000.0000 | 0 | none | | | | |
| Sulfate | 0.0000 - 3000.0000 | 1 | N7-D-P | 1/8 | 12/09/92-12/09/92 | 3482.0000 - 3482.0000 | 3482.0000 |
| Total Recoverable Al | 0.0000 - 5.0000 | 2 | N7-D-P | 1/8 | 09/01/99-09/01/99 | 17.0000 - 17.0000 | 17.0000 |
| | | | N7-E-P | 6/11 | 09/02/93-07/10/99 | 5.8500 - 49.9000 | 11.1800 |
| Total Recoverable As | 0.0000 - 200.0000 | 0 | none | | | | |
| Total Recoverable Cd | 0.0000 - 50.0000 | 0 | none | | | | |
| Total Recoverable Cr | 0.0000 - 1000.0000 | 0 | none | | | | |
| Total Recoverable Cu | 0.0000 - 500.0000 | 0 | none | | | | |
| Total Recoverable Hg | 0.0000 - 10.0000 | 0 | none | | | | |
| Total Recoverable Ni | 0.0000 - 1000.0000 | 0 | none | | | | |
| Total Recoverable Pb | 0.0000 - 100.0000 | 1 | N7-E-P* | 2/11 | 08/05/97-07/10/99 | 200.0000 - 400.0000 | 300.0000 |
| Total Recoverable Se | 0.0000 - 50.0000 | 0 | none | | | | |
| Total Recoverable V | 0.0000 - 100.0000 | 0 | none | | | | |

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Table 2. (cont.)

| | | | | |
|---|---|---|---|---|
| Total Recoverable Zn | 0.0000 - | 25.0000 | 0 | none |
| Vanadium, Dissolved | 0.0000 - | 100.0000 | 0 | none |
| Zinc, Dissolved | 0.0000 - | 25.0000 | 0 | none |

* = Sample below detection limit and detection limit greater than standard.

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Fig[illegible] 1

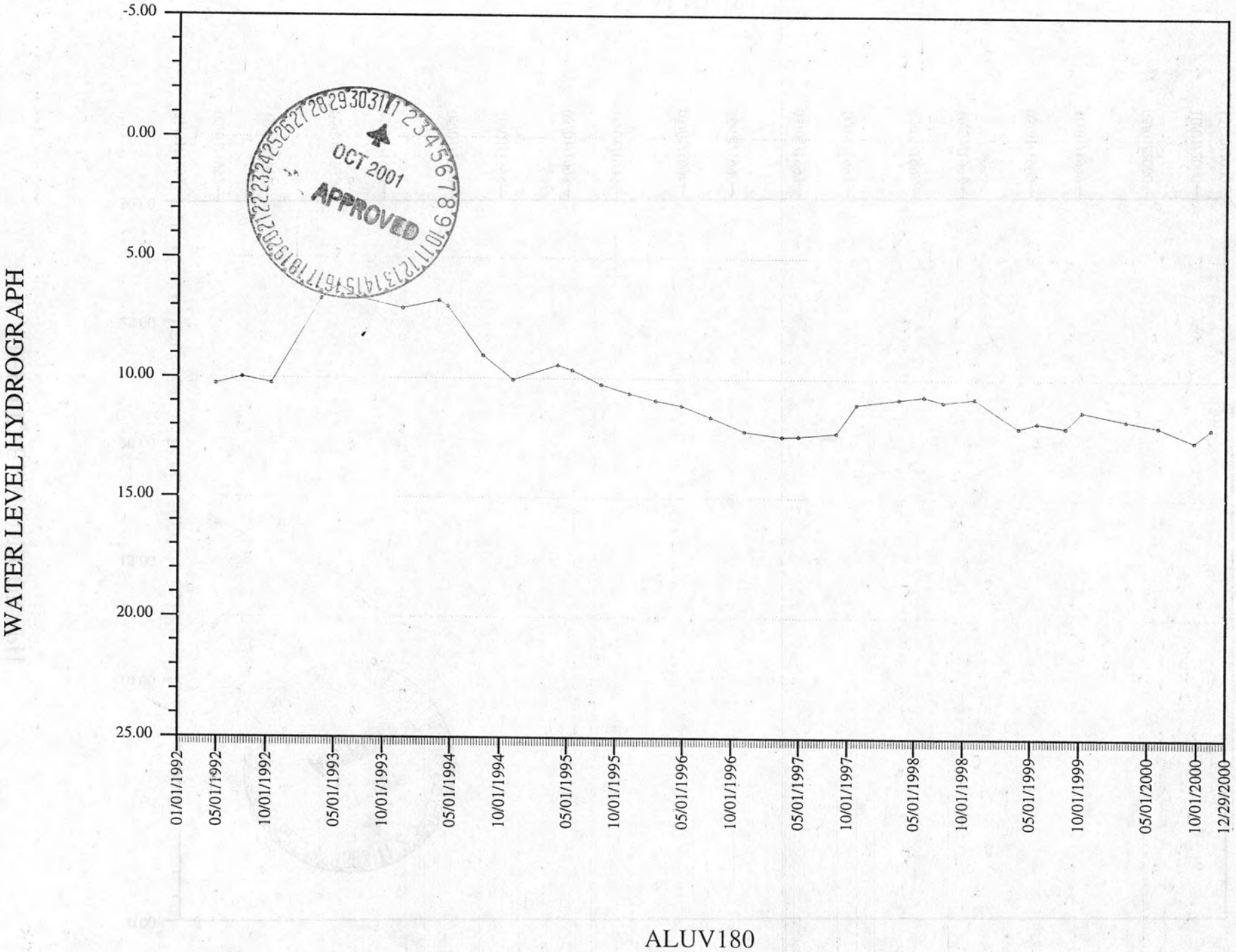


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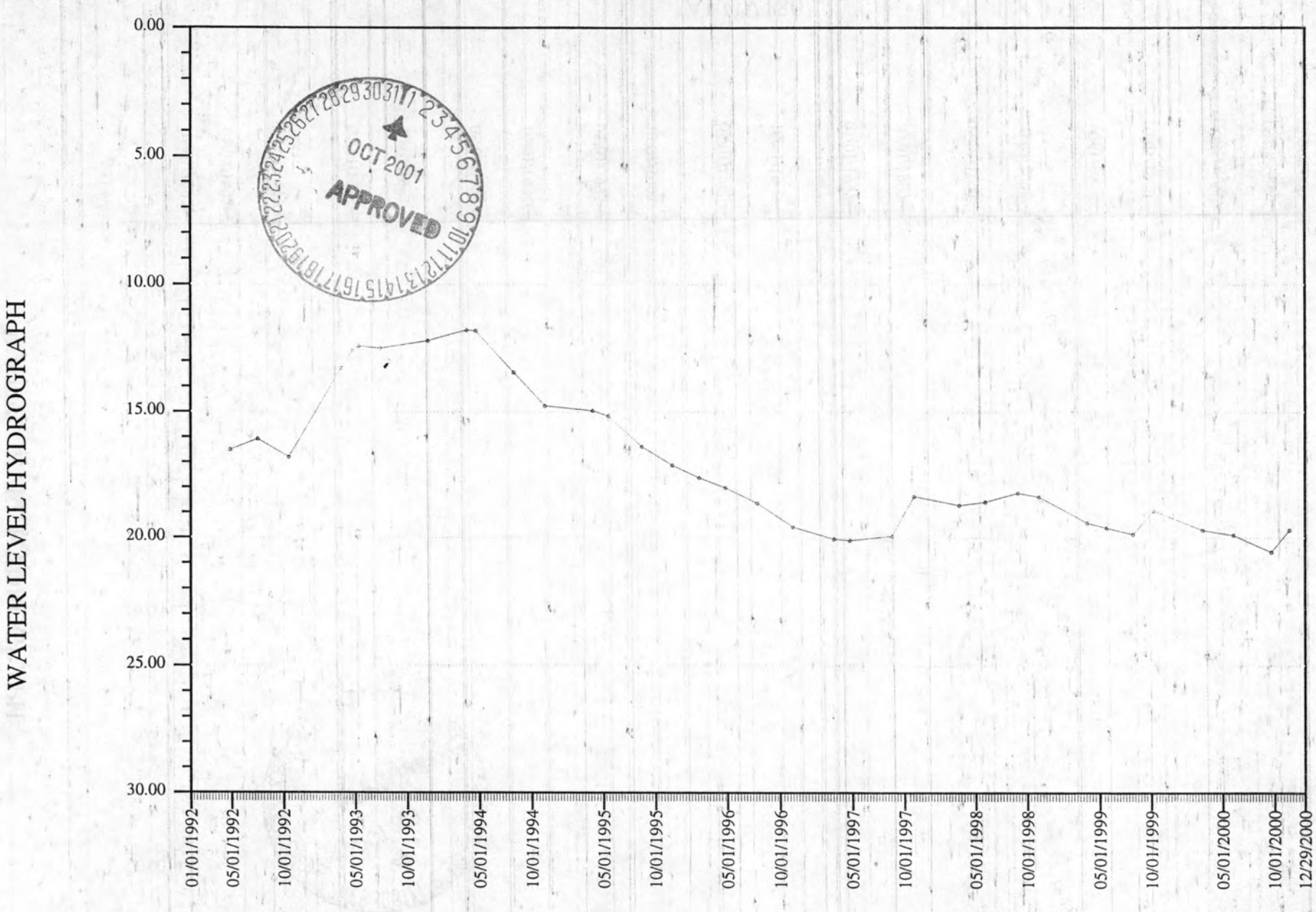
Figure 2

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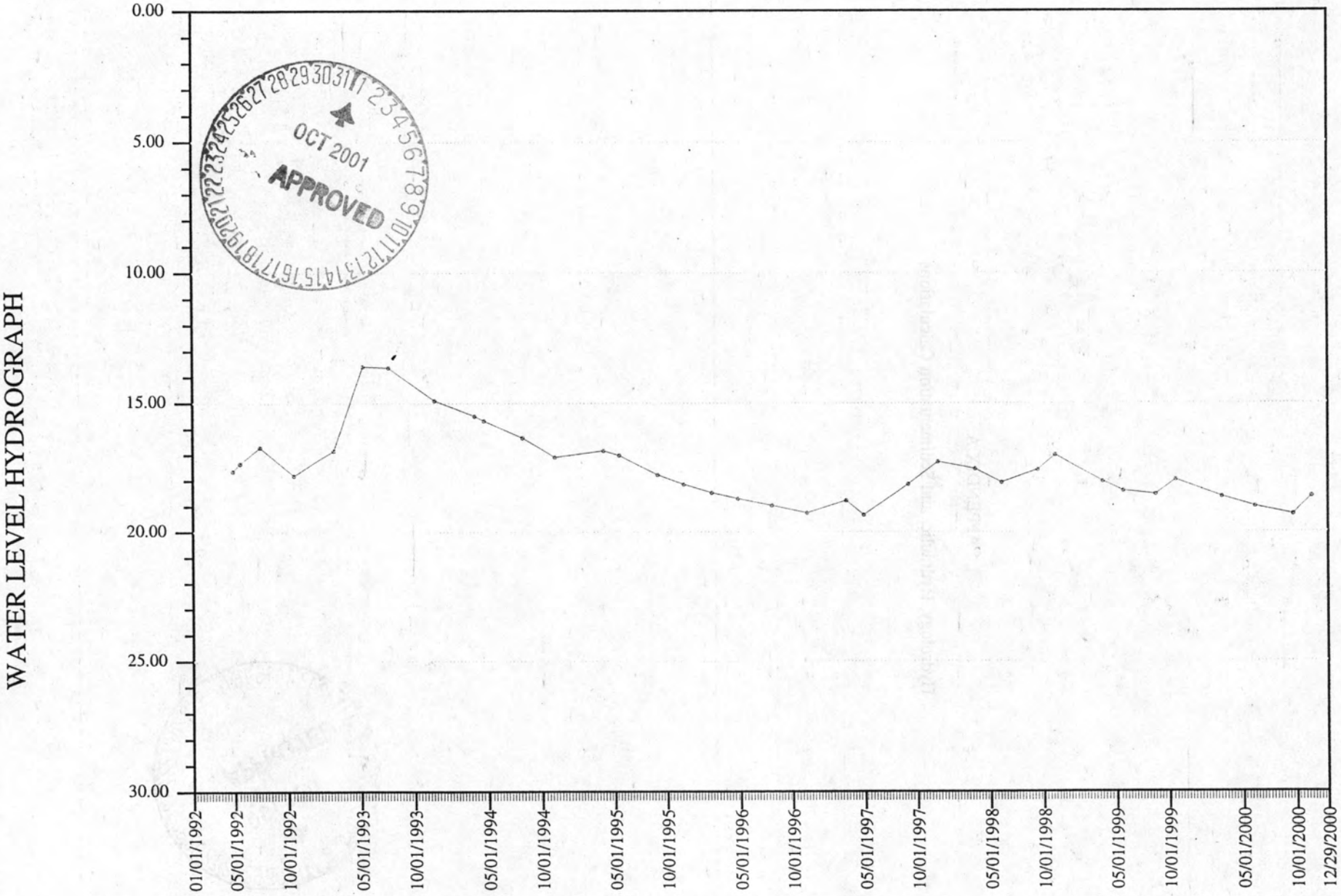
Figu[illegible]3

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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## PEABODY WESTERN COAL COMPANY
## CALCULATED HYDROLOGIC DATA

### PROJECT: N7/N8 Reclaim Area

### STRUCTURE: N7E Pond

***TIME OF CONCENTRATION:***

| | |
|---|---|
| Start Elevation (ft) = | 6854 |
| End Elevation (ft) = | 6553 |
| Elevation Difference, E (ft) = | 301 |
| Watercourse Length (ft) = | 7640 |
| Watercourse Length, L (mi) = | 1.447 |
| Tc = (11.9L^3/E)^0.385 = | 0.442 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 |
|---|---|---|---|---|
| Reclaimed | C | 81 | 246.9 | 19998.9 |
| TOTAL: | | | 246.9 | 19998.9 |

Weighted CN = Total CN*Area/ Total Area = 81

***DRAINAGE BASIN AREA:***

246.9 Acres

***RAINFALL FACTOR:***

R = 40

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: N7E Pond

***SOIL ERODIBILITY FACTOR:***

| Soil Type | Erodibility Factor, K | Area (acres) | K*Area |
|---|---|---|---|
| 35 | 0.38 | 246.9 | 93.82 |
| TOTAL: | | 246.9 | 93.82 |

Weighted K = Total K*Area/ Total Area = 0.38

***SLOPE FACTOR:***

| Length (ft) | Elevation Change (ft) | Slope (%) | m | Slope Angle (deg) | LS Factor |
|---|---|---|---|---|---|
| 370 | 100 | 27.0% | 0.6 | 15.1 | 10.32 |
| 320 | 110 | 34.4% | 0.6 | 19.0 | 12.08 |
| 430 | 60 | 14.0% | 0.6 | 7.9 | 5.30 |
| 500 | 90 | 18.0% | 0.6 | 10.2 | 7.88 |
| 330 | 40 | 12.1% | 0.6 | 6.9 | 3.77 |
| 420 | 50 | 11.9% | 0.6 | 6.8 | 4.26 |
| 420 | 40 | 9.5% | 0.5 | 5.4 | 2.63 |
| 340 | 30 | 8.8% | 0.5 | 5.0 | 2.12 |

Average LS = 6.04

*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* |

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***COVER AND PRACTICE FACTORS:***

| Cover Type | Cover (%) | Canopy (%) | Area (acres) | Cover Factor, C | C*Area | Practice Factor, P | P*Area |
|---|---|---|---|---|---|---|---|
| Reclaimed (Post-Law) | 40% | 0% | 246.9 | 0.20 | 49.38 | 0.80 | 197.52 |
| TOTAL: | | | 246.9 | | 49.38 | | 197.52 |

Weighted C = Total C*Area/ Total Area = 0.200

Weighted P = Total P*Area/ Total Area = 0.800

## PEABODY WESTERN COAL COMPANY
## CALCULATED SEDIMENT YIELD

## PROJECT: N7E 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 | 0.38 | |
| Length Slope Factor | 6.04 | |
| Cover Factor | 0.20 | |
| Practice Factor | 0.80 | |
| Gross Annual Sediment Yield | 14.70 | tons/acre/year |
| | | |
| Sediment Density | 94.00 | pcf |
| Gross Annual Sediment Yield | 0.0072 | acre-feet/acre/year |
| Sediment Delivery Ratio | 90% | |
| Estimated Annual Sediment Yield | 0.0065 | acre-feet/acre/year |
| | | |
| Watershed Area | 246.9 | acres |
| Watershed Annual Sediment Yield | 1.60 | acre-feet/year |
| | | |
| Number of years | 1 | years |
| Calculated Sediment Volume | 1.60 | acre-feet |

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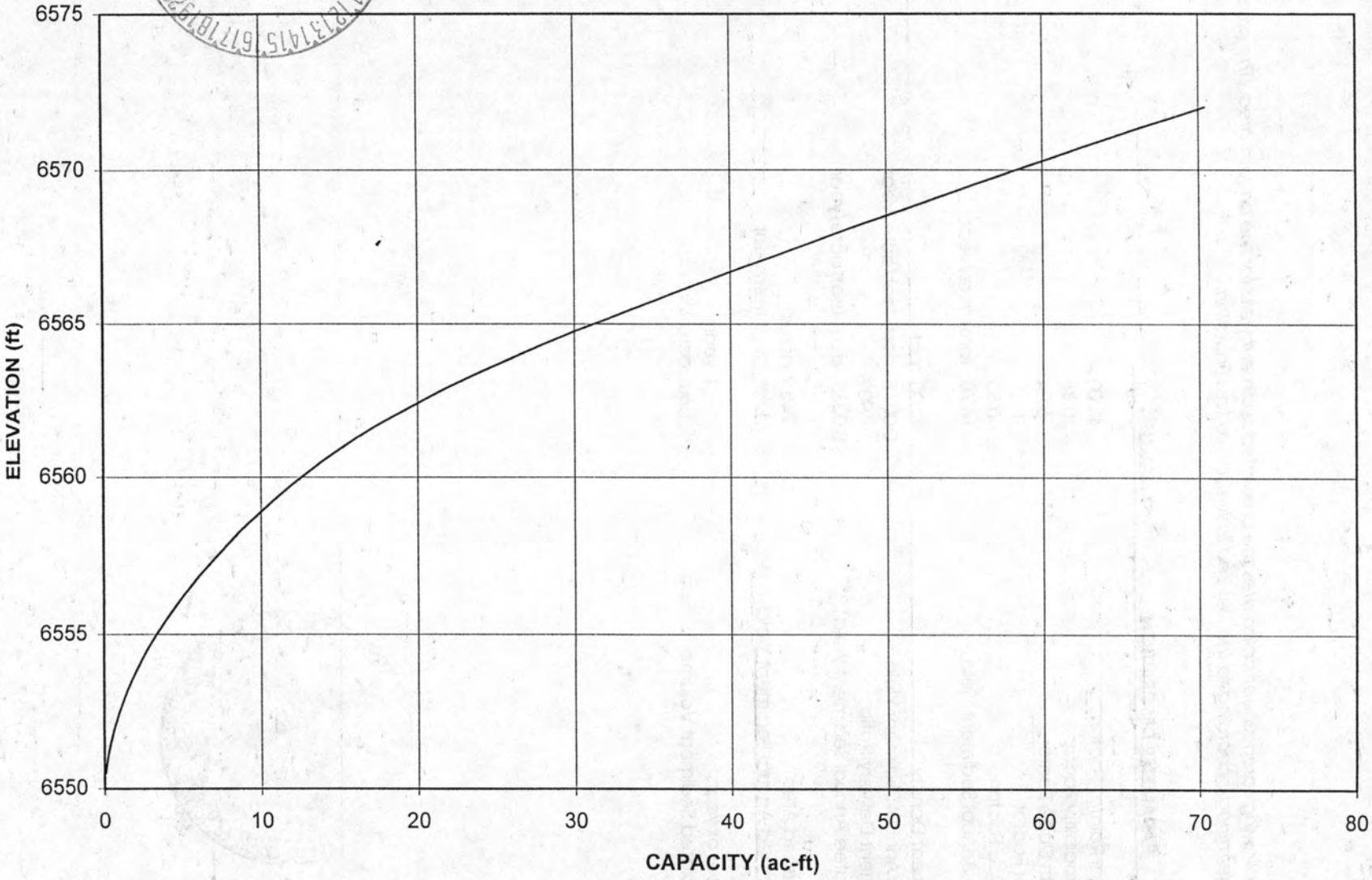
**PERMANENT IMPOUNDMENT N7E**
**ELEVATION /CAPACITY CURVE**



# POND N7E, INLET CHANNEL A

## Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 30.00 | 3.0:1 | 3.0:1 | 3.0 | 1.00 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 207.10 cfs | |
| Depth: | 0.99 ft | 1.99 ft |
| Top Width: | 35.95 ft | 41.95 ft |
| Velocity: | 6.34 fps | |
| X-Section Area: | 32.68 sq ft | |
| Hydraulic Radius: | 0.901 | |
| Froude Number: | 1.17 | |
| Manning's n: | 0.0380 | |
| Dmin: | 2.00 in | |
| D50: | 3.00 in | |
| Dmax: | 4.50 in | |

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# POND N7E, INLET CHANNEL A

## Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 30.00 | 3.0:1 | 3.0:1 | 18.0 | 1.00 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 207.10 cfs | |
| Depth: | 0.73 ft | 1.73 ft |
| Top Width: | 34.36 ft | 40.36 ft |
| Velocity: | 8.85 fps | |
| X-Section Area: | 23.39 sq ft | |
| Hydraulic Radius: | 0.676 | |
| Froude Number: | 1.89 | |
| Manning's n: | 0.0550 | |
| Dmin: | 3.00 in | |
| D50: | 6.00 in | |
| Dmax: | 9.00 in | |

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# POND N7E, INLET CHANNEL B

## Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 25.00 | 3.0:1 | 3.0:1 | 3.0 | 1.00 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 207.10 cfs | |
| Depth: | 1.11 ft | 2.11 ft |
| Top Width: | 31.69 ft | 37.69 ft |
| Velocity: | 6.55 fps | |
| X-Section Area: | 31.60 sq ft | |
| Hydraulic Radius: | 0.986 | |
| Froude Number: | 1.16 | |
| Manning's n: | 0.0390 | |
| Dmin: | 3.00 in | |
| D50: | 6.00 in | |
| Dmax: | 9.00 in | |

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# POND N7E, INLET CHANNEL B

## Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 25.00 | 3.0:1 | 3.0:1 | 14.0 | 1.00 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 207.10 cfs | |
| Depth: | 0.84 ft | 1.84 ft |
| Top Width: | 30.04 ft | 36.04 ft |
| Velocity: | 8.95 fps | |
| X-Section Area: | 23.13 sq ft | |
| Hydraulic Radius: | 0.763 | |
| Froude Number: | 1.80 | |
| Manning's n: | 0.0520 | |
| Dmin: | 3.00 in | |
| D50: | 6.00 in | |
| Dmax: | 9.00 in | |

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# POND N7E, OUTLET CHANNEL

## Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 30.00 | 3.0:1 | 3.0:1 | 1.0 | 1.00 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 131.50 cfs | |
| Depth: | 0.93 ft | 1.93 ft |
| Top Width: | 35.58 ft | 41.58 ft |
| Velocity: | 4.31 fps | |
| X-Section Area: | 30.49 sq ft | |
| Hydraulic Radius: | 0.850 | |
| Froude Number: | 0.82 | |
| Manning's n: | 0.0310 | |
| Dmin: | 1.00 in | |
| D50: | 1.50 in | |
| Dmax: | 3.00 in | |

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# POND N7E, OUTFLOW CHANNEL

## Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 30.00 | 3.0:1 | 3.0:1 | 6.0 | 1.00 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 131.50 cfs | |
| Depth: | 0.65 ft | 1.65 ft |
| Top Width: | 33.88 ft | 39.88 ft |
| Velocity: | 6.37 fps | |
| X-Section Area: | 20.64 sq ft | |
| Hydraulic Radius: | 0.606 | |
| Froude Number: | 1.44 | |
| Manning's n: | 0.0410 | |
| Dmin: | 2.00 in | |
| D50: | 3.00 in | |
| Dmax: | 4.50 in | |

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# POND N7E, EM. SPILLWAY CRITICAL SLOPE
## Worksheet for Trapezoidal Channel

| Project Description | |
|---|---|
| Project File | untitled.fm2 |
| Worksheet | TEST |
| Flow Element | Trapezoidal Channel |
| Method | Manning's Formula |
| Solve For | Channel Depth |

| Input Data | | |
|---|---|---|
| Mannings Coefficient | 0.030 | |
| Channel Slope | 0.014510 | ft/ft |
| Left Side Slope | 3.000000 | H : V |
| Right Side Slope | 3.000000 | H : V |
| Bottom Width | 30.00 | ft |
| Discharge | 131.50 | cfs |

| Results | | |
|---|---|---|
| Depth | 0.82 | ft |
| Flow Area | 26.57 | ft² |
| Wetted Perimeter | 35.18 | ft |
| Top Width | 34.91 | ft |
| Critical Depth | 0.82 | ft |
| Critical Slope | 0.014510 | ft/ft |
| Velocity | 4.95 | ft/s |
| Velocity Head | 0.38 | ft |
| Specific Energy | 1.20 | ft |
| Froude Number | 1.00 | |
| Flow is supercritical. | | |

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APPENDIX B

Water Persistence Calculations

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N7E PERMANENT IMPOUNDMENT POND WATER P

0

| | January | February | March | April | May | June | July | August | September | Octobe |
|---|---|---|---|---|---|---|---|---|---|---|
| Average Precipitation (inch) | 0.95 | 0.86 | 0.89 | 0.58 | 0.45 | 0.46 | 1.49 | 1.49 | 0.95 | 1.09 |
| Area (acres) | 246.9 | 246.9 | 246.9 | 246.9 | 246.9 | 246.9 | 246.9 | 246.9 | 246.9 | 246.9 |
| Curve Number | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 |
| S | 2.99 | 2.99 | 2.99 | 2.99 | 2.99 | 2.99 | 2.99 | 2.99 | 2.99 | 2.99 |
| Run-Off (inches) | 0.04 | 0.02 | 0.03 | 0.00 | 0.00 | 0.00 | 0.21 | 0.21 | 0.04 | 0.07 |
| Run-Off (ac-ft) | 0.77 | 0.44 | 0.54 | 0.00 | 0.00 | 0.00 | 4.23 | 4.23 | 0.77 | 1.43 |
| Starting Pond Volume (ac-ft) | 0 | 0.68 | 0.92 | 1.09 | 0.62 | 0.21 | 0.00 | 2.98 | 5.73 | 5.33 |
| Pond Volume + Runoff (ac-ft) | 0.77 | 1.12 | 1.46 | 1.09 | 0.62 | 0.21 | 4.23 | 7.21 | 6.50 | 6.77 |
| Water Elevation (ft) | 6552 | 6552.5 | 6553 | 6552.5 | 6551.5 | 6551 | 6555.5 | 6557.5 | 6557 | 6557 |
| Water Surface Area (acres) | 0.55 | 0.66 | 0.77 | 0.66 | 0.43 | 0.32 | 1.36 | 1.86 | 1.73 | 1.73 |
| Evaporation Rate (inches/month) | 0.87 | 2.63 | 4.68 | 7.38 | 10.54 | 10.77 | 9.95 | 8.49 | 7.08 | 4.68 |
| Evaporation (ac-ft) | 0.04 | 0.14 | 0.30 | 0.41 | 0.38 | 0.29 | 1.12 | 1.31 | 1.02 | 0.67 |
| Infiltration Rate (inches/month) | 1.054 | 0.952 | 1.054 | 1.02 | 1.054 | 1.02 | 1.054 | 1.054 | 1.02 | 1.054 |
| Infiltration (ac-ft) | 0.05 | 0.05 | 0.07 | 0.06 | 0.04 | 0.03 | 0.12 | 0.16 | 0.15 | 0.15 |
| Total Water Loss (ac-ft) | 0.09 | 0.20 | 0.37 | 0.46 | 0.42 | 0.31 | 1.24 | 1.48 | 1.17 | 0.83 |
| Total Water Change (ac-ft) | 0.68 | 0.24 | 0.17 | -0.46 | -0.42 | -0.31 | 2.98 | 2.75 | -0.40 | 0.61 |
| Ending Pond Volume | 0.68 | 0.92 | 1.09 | 0.62 | 0.21 | 0.00 | 2.98 | 5.73 | 5.33 | 5.94 |

Notes:

1) Run-off volumes based on SCS Runoff Curve Number method: Q = (P-0.2S)^2/(P+0.8S)

P= Accumulative Precipitation
S= (1000/CN)-10

2) Evaporation and infiltration rates based on data presented in the report entitled " Hydrologic and Engineering Studies at the Peal

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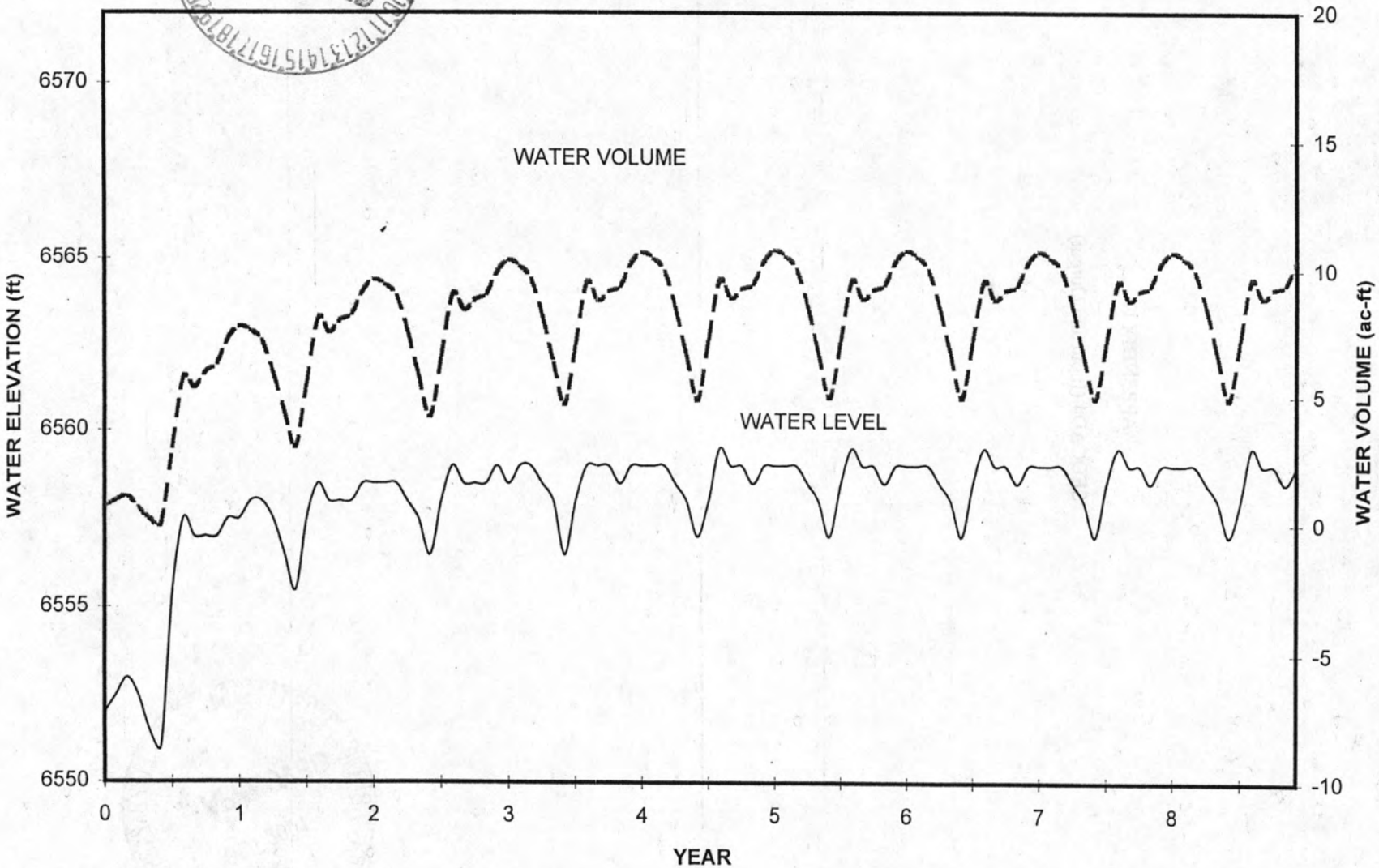
# N7E PERMANENT IMPOUNDMENT
# WATER PERSISTENCE EVALUATION



APPENDIX C

SEDCAD4 (Input and Output)

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# PEABODY WESTERN
# KAYENTA MINE
# POND N7E

***100 year, 6 hour***

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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: | 100 yr - 6 hr |
| Rainfall Depth: | 2.400 inches |

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# *Structure Networking:*

| Type | Stru # | (flows into) | Stru # | Musk. K (hrs) | Musk. X | Description |
|---|---|---|---|---|---|---|
| Pond | #1 | ==> | End | 0.000 | 0.000 | Pond N7E&E1 |

*#1*
*Pond*

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## *Structure Summary:*

| | | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|---|
| #1 | In | 246.900 | 246.900 | 207.12 | 17.94 |
| | Out | | | 131.47 | 17.94 |

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# *Structure Detail:*

*Structure #1 (Pond)*

*Pond N7E&E1*

Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,562.40 |
| Initial Pool: | 18.93 ac-ft |

Emergency Spillway

| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,562.40 | 70.00 | 3.75:1 | 3.00:1 | 30.00 |

Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,563.91 |
| Dewater Time: | 0.44 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) |
|---|---|---|---|---|
| 6,549.20 | 0.000 | 0.000 | 0.000 | |
| 6,549.70 | 0.037 | 0.006 | 0.000 | |
| 6,550.00 | 0.090 | 0.024 | 0.000 | |
| 6,550.20 | 0.116 | 0.045 | 0.000 | |
| 6,550.70 | 0.189 | 0.121 | 0.000 | |
| 6,551.20 | 0.280 | 0.237 | 0.000 | |
| 6,551.70 | 0.388 | 0.404 | 0.000 | |
| 6,552.00 | 0.460 | 0.531 | 0.000 | |
| 6,552.20 | 0.502 | 0.627 | 0.000 | |
| 6,552.70 | 0.613 | 0.905 | 0.000 | |
| 6,553.20 | 0.734 | 1.242 | 0.000 | |
| 6,553.70 | 0.867 | 1.641 | 0.000 | |
| 6,554.00 | 0.950 | 1.914 | 0.000 | |
| 6,554.20 | 1.003 | 2.109 | 0.000 | |
| 6,554.70 | 1.138 | 2.644 | 0.000 | |
| 6,555.20 | 1.283 | 3.249 | 0.000 | |
| 6,555.70 | 1.435 | 3.928 | 0.000 | |

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| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,556.00 | 1.530 | 4.372 | 0.000 | | |
| 6,556.20 | 1.585 | 4.684 | 0.000 | | |
| 6,556.70 | 1.723 | 5.511 | 0.000 | | |
| 6,557.20 | 1.868 | 6.408 | 0.000 | | |
| 6,557.70 | 2.018 | 7.379 | 0.000 | | |
| 6,558.00 | 2.110 | 7.998 | 0.000 | | |
| 6,558.20 | 2.142 | 8.424 | 0.000 | | |
| 6,558.70 | 2.223 | 9.515 | 0.000 | | |
| 6,559.20 | 2.305 | 10.647 | 0.000 | | |
| 6,559.70 | 2.389 | 11.821 | 0.000 | | |
| 6,560.00 | 2.440 | 12.545 | 0.000 | | |
| 6,560.20 | 2.471 | 13.036 | 0.000 | | |
| 6,560.70 | 2.550 | 14.291 | 0.000 | | |
| 6,561.20 | 2.630 | 15.586 | 0.000 | | |
| 6,561.70 | 2.711 | 16.921 | 0.000 | | |
| 6,562.00 | 2.760 | 17.741 | 0.000 | | |
| 6,562.20 | 2.966 | 18.315 | 0.000 | | |
| 6,562.40 | 3.180 | 18.928 | 0.000 | | Spillway #1 |
| 6,562.70 | 3.187 | 19.884 | 12.757 | 7.10 | |
| 6,563.20 | 3.200 | 21.481 | 33.998 | 2.05 | |
| 6,563.70 | 3.212 | 23.084 | 96.270 | 1.05 | |
| 6,563.91 | 3.218 | 23.770 | 131.471 | 0.35 | Peak Stage |
| 6,564.00 | 3.220 | 24.048 | 145.797 | | |
| 6,564.20 | 3.222 | 24.693 | 176.900 | | |
| 6,564.70 | 3.227 | 26.306 | 270.848 | | |
| 6,565.20 | 3.232 | 27.920 | 385.765 | | |
| 6,565.70 | 3.237 | 29.538 | 527.818 | | |
| 6,566.00 | 3.240 | 30.508 | 626.827 | | |
| 6,566.20 | 3.242 | 31.157 | 697.227 | | |
| 6,566.70 | 3.247 | 32.780 | 888.733 | | |
| 6,567.20 | 3.252 | 34.404 | 1,102.659 | | |
| 6,567.70 | 3.257 | 36.032 | 1,339.387 | | |
| 6,568.00 | 3.260 | 37.008 | 1,492.543 | | |
| 6,568.20 | 3.289 | 37.664 | 1,599.339 | | |
| 6,568.70 | 3.360 | 39.326 | 1,882.959 | | |
| 6,569.20 | 3.433 | 41.024 | 2,190.706 | | |
| 6,569.70 | 3.506 | 42.759 | 2,523.047 | | |
| 6,570.00 | 3.550 | 43.817 | 2,734.452 | | |
| 6,570.20 | 3.572 | 44.529 | 2,880.453 | | |
| 6,570.70 | 3.627 | 46.329 | 3,251.530 | | |
| 6,571.20 | 3.683 | 48.157 | 3,638.658 | | |

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| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) |
|---|---|---|---|---|
| 6,571.70 | 3.739 | 50.012 | 4,063.016 | |
| 6,571.80 | 3.750 | 50.387 | 4,152.778 | |

## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,549.20 | 0.000 | 0.000 |
| 6,549.70 | 0.000 | 0.000 |
| 6,550.00 | 0.000 | 0.000 |
| 6,550.20 | 0.000 | 0.000 |
| 6,550.70 | 0.000 | 0.000 |
| 6,551.20 | 0.000 | 0.000 |
| 6,551.70 | 0.000 | 0.000 |
| 6,552.00 | 0.000 | 0.000 |
| 6,552.20 | 0.000 | 0.000 |
| 6,552.70 | 0.000 | 0.000 |
| 6,553.20 | 0.000 | 0.000 |
| 6,553.70 | 0.000 | 0.000 |
| 6,554.00 | 0.000 | 0.000 |
| 6,554.20 | 0.000 | 0.000 |
| 6,554.70 | 0.000 | 0.000 |
| 6,555.20 | 0.000 | 0.000 |
| 6,555.70 | 0.000 | 0.000 |
| 6,556.00 | 0.000 | 0.000 |
| 6,556.20 | 0.000 | 0.000 |
| 6,556.70 | 0.000 | 0.000 |
| 6,557.20 | 0.000 | 0.000 |
| 6,557.70 | 0.000 | 0.000 |
| 6,558.00 | 0.000 | 0.000 |
| 6,558.20 | 0.000 | 0.000 |
| 6,558.70 | 0.000 | 0.000 |
| 6,559.20 | 0.000 | 0.000 |
| 6,559.70 | 0.000 | 0.000 |
| 6,560.00 | 0.000 | 0.000 |
| 6,560.20 | 0.000 | 0.000 |
| 6,560.70 | 0.000 | 0.000 |
| 6,561.20 | 0.000 | 0.000 |
| 6,561.70 | 0.000 | 0.000 |

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| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,562.00 | 0.000 | 0.000 |
| 6,562.20 | 0.000 | 0.000 |
| 6,562.40 | 0.000 | 0.000 |
| 6,562.70 | 12.757 | 12.757 |
| 6,563.20 | 33.998 | 33.998 |
| 6,563.70 | 96.270 | 96.270 |
| 6,564.00 | 145.797 | 145.797 |
| 6,564.20 | 176.900 | 176.900 |
| 6,564.70 | 270.848 | 270.848 |
| 6,565.20 | 385.765 | 385.765 |
| 6,565.70 | 527.818 | 527.818 |
| 6,566.00 | 626.827 | 626.827 |
| 6,566.20 | 697.227 | 697.227 |
| 6,566.70 | 888.733 | 888.733 |
| 6,567.20 | 1,102.659 | 1,102.659 |
| 6,567.70 | 1,339.387 | 1,339.387 |
| 6,568.00 | 1,492.543 | 1,492.543 |
| 6,568.20 | 1,599.339 | 1,599.339 |
| 6,568.70 | 1,882.959 | 1,882.959 |
| 6,569.20 | 2,190.706 | 2,190.706 |
| 6,569.70 | 2,523.047 | 2,523.047 |
| 6,570.00 | 2,734.452 | 2,734.452 |
| 6,570.20 | 2,880.453 | 2,880.453 |
| 6,570.70 | 3,251.530 | 3,251.530 |
| 6,571.20 | 3,638.658 | 3,638.658 |
| 6,571.70 | 4,063.016 | 4,063.016 |
| 6,571.80 | 4,152.778 | 4,152.778 |

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# *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 | 246.900 | 0.442 | 0.000 | 0.000 | 81.000 | F | 207.12 | 17.937 |
| | $\sum$ | **246.900** | | | | | | **207.12** | **17.937** |

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# PEABODY WESTERN
# KAYENTA MINE
# POND N7E

***10 year, 24 hour***

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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 |

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## *Structure Networking:*

| Type | Stru # | (flows into) | Stru # | Musk. K (hrs) | Musk. X | Description |
|---|---|---|---|---|---|---|
| Null | #1 | ==> | End | 0.000 | 0.000 | Runoff to Pond N7E |

*#1*
*Null*

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## *Structure Summary:*

| | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|
| #1 | 246.900 | 246.900 | 110.71 | 13.76 |

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# *Structure Detail:*

*Structure #1 (Null)*

*Runoff to Pond N7E*

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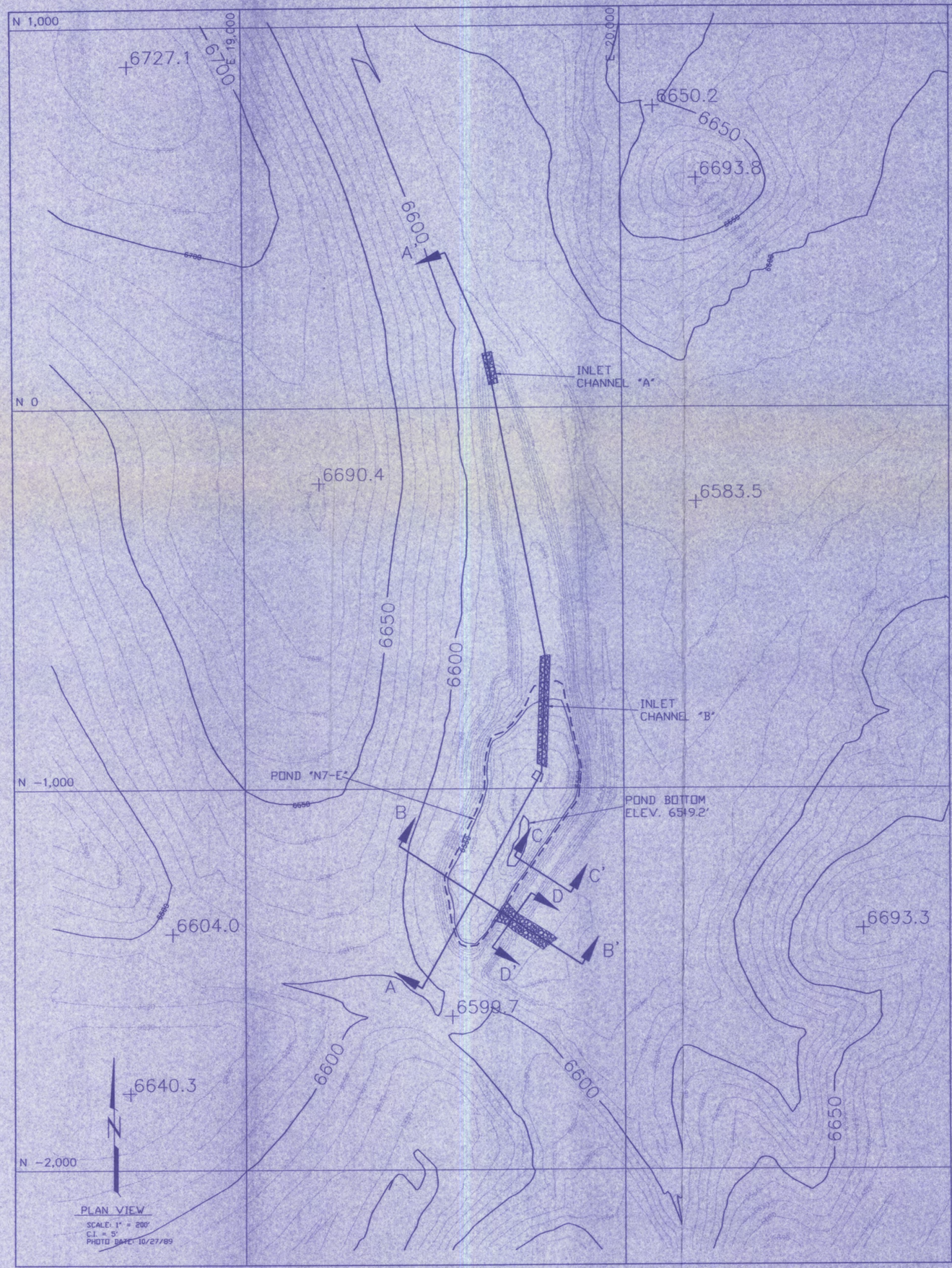
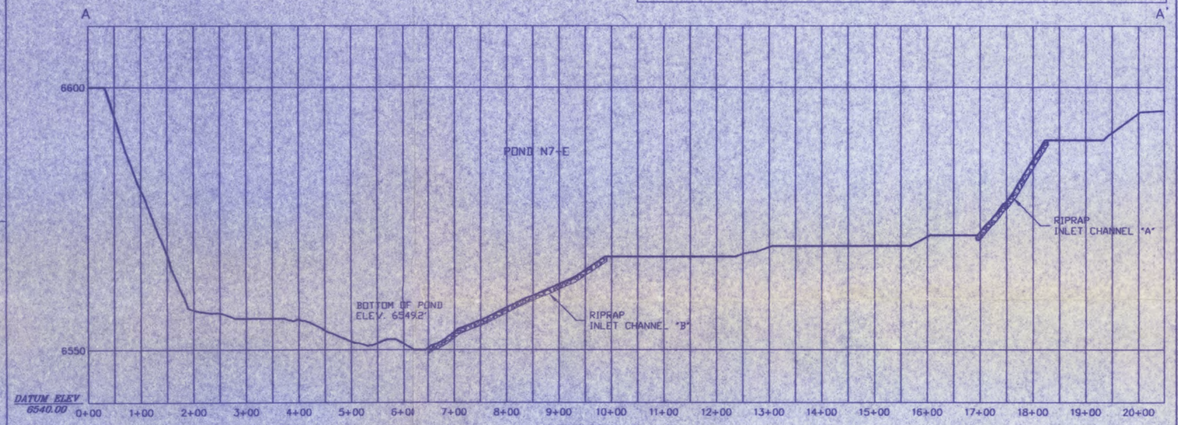



PLAN VIEW

SCALE: 1" = 200'
C.I. = 5'
PHOTO DATE: 10/27/99

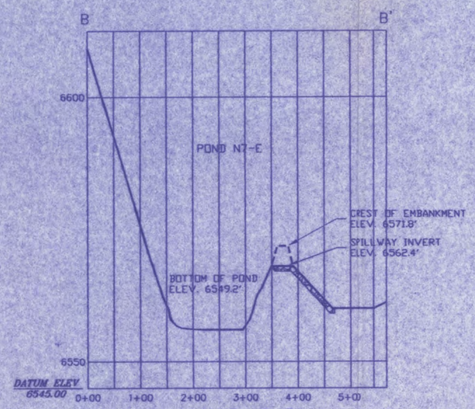
N7-E POND STAGE CAPACITY

| ELEV. (FT.-MSL) | STAGE (FT.) | AREA (ACRES) | TOT. CAP. (AC.-FT.) | DESCRIPTION |
|---|---|---|---|---|
| 6549.2 | 0.0 | 0.01 | 0.00 | BOTTOM OF POND |
| 6550.0 | 0.8 | 0.09 | 0.02 | |
| 6552.0 | 2.8 | 0.46 | 0.53 | |
| 6554.0 | 4.8 | 0.95 | 1.91 | |
| 6556.0 | 6.8 | 1.53 | 4.37 | |
| 6558.0 | 8.8 | 2.11 | 8.00 | |
| 6560.0 | 10.8 | 2.44 | 12.55 | |
| 6562.0 | 12.8 | 2.76 | 17.74 | |
| 6562.4 | 13.2 | 3.18 | 18.93 | EMERGENCY SPILLWAY |
| 6564.0 | 15.8 | 3.22 | 24.05 | |
| 6566.0 | 17.8 | 3.24 | 30.51 | |
| 6568.0 | 19.8 | 3.26 | 37.01 | |
| 6570.0 | 21.8 | 3.55 | 43.82 | |
| 6571.8 | 23.6 | 3.75 | 50.39 | CREST OF EMBANKMENT |



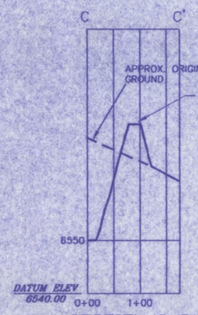

SECTION A-A'

SCALE: HORIZ. 1"=200'
VERT. 1"=20'



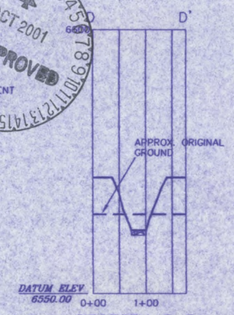

SECTION B-B'

SCALE: HORIZ. 1"=200'
VERT. 1"=20'



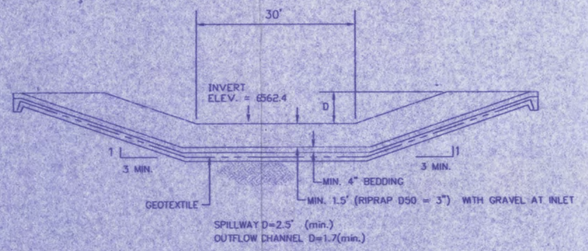

SECTION C-C'

SCALE: HORIZ. 1"=200'
VERT. 1"=20'




SECTION D-D'

SCALE: HORIZ. 1"=200'
VERT. 1"=20'




N7-E POND
TYPICAL CROSS-SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE

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Registered Professional Engineer (Civil)
CERTIFICATE NO.
JAMES GARY SCHLENDORF
ARIZONA, U.S.A.

ENGINEER'S CERTIFICATION
JAMES G. SCHLENDORF
MINING & RECLAMATION ENGINEER
PEABODY WESTERN COAL COMPANY
Signed.....
ARIZONA P.E. 18782
DATE: AUG 10 2001

NOTES:
1) General location, see Drawing No. 85400, Sheet K-7 and Drawing No. 85405.
2) See Chapter 1, Kayenta PAP, for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment B, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the distrubed area above the high esterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.
7) Detailed pond topo taken from Pond N7-E as-built, 02/07/90.

| REVISIONS | | |
|---|---|---|
| DATE | CHK'D | DESCRIPTION |

EXHIBIT #1
N7-E
PERMANENT IMPOUNDMENT DESIGN

KAYENTA MINE
PEABODY WESTERN COAL COMPANY
P. O. BOX 650 KAYENTA, ARIZONA 86033

| | |
|---|---|
| DESIGNED BY: DK | SCALE: 1"=100' |
| DRAWN BY: TH | DRAWING DATE: 08-01-01 |
| CHECKED BY: DK | PHOTO DATE: 04-21-99 |
| CONTOUR INT.: 5' | DWG FILE: N7-E.DWG |

DESIGN REPORT

Temporary Sedimentation Structure

N9-A (Lower)

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

SEP 2005 APPROVED

Registered Professional Engineer (Civil) CERTIFICATE NO. 19781 JAMES GARY SCHLENVOGT Date Signed ..... ARIZONA U.S.A.

DEC 23 2004

10

TABLE OF CONTENTS


| | Page |
|---|---|
| INTRODUCTION | 1 |
| INSPECTION | 1 |
| SITE DESCRIPTION | 2 |
| LAND USE | 2 |
| DESIGN ANALYSES | 2 |
| GENERAL | 2 |
| STABILITY | 2 |
| HYDROLOGY | 3 |
| HYDRAULICS | 4 |
| EMERGENCY SPILLWAY AND OUTLET CHANNEL | 6 |
| STORAGE CAPACITY | 6 |

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) 100-Year, 6-Hour Storm Event
EXHIBIT #1 -N9-A2, N9-A1, and N9-A Proposed Sedimentation Ponds


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## INTRODUCTION

Sedimentation Structure N9-A will be an earthen embankment, designed and constructed by Peabody Western Coal Company (PWCC) as a temporary sedimentation structure to control runoff and sediment from portions of the N9 disturbed surface mining area at the Kayenta Mine. The location of Structure N9-A and its watershed boundary are shown on Drawing No. 85400, (Sheet K-6), 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 N9-A that is in series with sedimentation structures N9-A1 & N9-A2. N9-A is the lower pond in the series. 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 N9-A was inspected in October, 2004 by a Registered Professional Engineer from Woodson Engineering, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. 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.

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## SITE DESCRIPTION

### LAND USE

The N9-A, N9-A1 and N9-A2 Structures have a combined watershed of 433.41 acres and are located on a tributary upstream of Yellow Water Canyon Wash at the Kayenta Mine. The 124.57-acre watershed, which contributes directly to structure N9-A, is classified as 11% undisturbed and 89% disturbed.

## DESIGN ANALYSES

### GENERAL

Structure N9-A 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 1984 for Peabody Western Coal Company and was used in the analyses of the structure.

### STABILITY

Structure N9-A 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 15 feet wide on top. A minimum upstream slope of 2H: 1V and minimum downstream slope of 4H: 1V were assumed. Based on the total embankment height of approximately 20 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 30-foot wide, riprap-lined, trapezoidal channel.

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HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure N9-A will be constructed in series with proposed Structures N9-A1 and N9-A2. Structure N9-A is the lower pond in the series and 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 three structures have a combined capacity greater than 20 acre-feet; therefore, the spillway was analyzed using the 100-year, 6-hour storm event in lieu of the 25-year, 6-hour storm. The structure was conservatively assumed to be full to the emergency spillway at the time of 100-year storm event. The storage capacity of structure N9-A was analyzed using the 10-year, 24-hour storm event. The combined ponds in series were verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Yellow Water Canyon Wash.

The following parameters were used in the hydrologic analysis:

| | | |
|---|---|---|
| 1. | Water Course length, L | 0.098 mi. |
| 2. | Elevation Difference, H | 20 ft |
| 3. | Time of Concentration, $T_c$ | 0.056 hr |
| 4. | NRCS Curve Number | 85 |
| 5. | Rainfall Depth, 10-year, 24-hour storm<br>100-year, 6-hour storm | 2.1 in<br>2.4 in |
| 6. | Drainage Area | 124.57 acres |

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Values reported represent the watershed, which drains directly to Pond N9-A. Hydrologic input parameters for structure N9-A1 and N9-A2 are presented in separate design reports.

Muskingum routing parameters were utilized to route the 100-year hydrographs between the three structures. The routing parameters are presented in Appendices B and C, and are shown on a sub-watershed basis.

HYDRAULICS

The SEDCAD4 and HYDROCALC 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).

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## N9-A SEDIMENTATION POND HYDRAULICS TABLE

| | Units | 10-Yr, 24-Hr Storm | 100-Yr, 6-Hr Storm |
|---|---|---|---|
| Initial Reservoir Volume Condition | | Empty | Full to emergency spillway |
| Inflow | | | |
| Peak Flow | cfs | 118.69 | 262.03 |
| Volume | ac-ft | 9.02 | 38.25 |
| Storage | | | |
| Peak Stage | msl | N/A | 6848.2 |
| Emerg. Spillway Elev. | msl | 6846.2 | 6846.2 |
| Peak Storage | ac-ft | N/A | 25.36 |
| Storage Capacity | ac-ft | 19.75 | 19.75 |
| Outflow | | | |
| Peak Flow | cfs | N/A | 226.11 |
| Spillway Elevation | msl | 6846.2 | 6846.2 |
| Embankment Crest Elev. | msl | 6849.9 | 6849.9 |
| Peak Stage | msl | -- | 6848.2 |
| Freeboard | ft | -- | 1.7 |
| Emergency Spillway Channel | | | |
| Flow Depth | ft | -- | 2.0 |
| Critical Velocity | fps | -- | 6.0 |
| Mannings "n" | -- | -- | 0.048 |
| Width | ft | -- | 30 |
| Outflow Channel | | | |
| Slope | % | -- | 25 |
| Normal Velocity | fps | -- | 8.9 |
| Normal Depth | ft | -- | 0.7 |
| Mannings "n" | -- | -- | 0.056 |
| Riprap $D_{50}$ | in | -- | 6 |

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for N9-A will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

| | | | |
|---|---|---|---|
| Minimum Channel Depth | (Spillway) | 2.5 | ft |
| | (Outflow) | 2.0 | ft |
| Channel Width | | 30 | ft |
| Channel Length | (Spillway) | 38 | ft |
| | (Outflow) | 165 | ft |
| Sideslopes (Horizontal to Vertical) | | 3:1 | or flatter |
| Average Slope | (Spillway) | 0 | % |
| Maximum Slope | (Outflow) | 25 | % |
| Spillway Elevation | | 6846.2 | 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 1984 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-A is designed to contain approximately 19.75 acre-feet.

The calculations for the sediment load entering structure N9-A were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

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| | | |
|---|---|---|
| 1. | Rainfall Factor, R | 40 |
| 2. | Soil Erodibility Factor, K | 0.11 |
| 3. | Slope Factor, LS | 7.58 |
| 4. | Cover Factor, C | 0.92 |
| 5. | Erosion Control Factor, P | 0.82 |

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. Structure N9-A has sufficient storage capacity to contain the 10-year, 24-hour storm and has additional capacity to store excess runoff from the N9-A1 and N9-A2 watersheds. The combined storage capacity was determined for all three structures in series and the results of the analysis are presented in the following table.

Combined Storage for Structures N9-A2, N9-A1 and N9-A

| | N9-A2 (Upper) | N9-A1 (Middle) | N9-A (Lower) | COMBINED |
|---|---|---|---|---|
| Total Storage Capacity (ac-ft) | 19.65 | 19.69 | 19.75 | 59.08 |
| 10-Year, 24-Hour Storm Inflow(ac-ft) | 19.66 | 1.41 | 9.02 | 30.10 |
| Available Sediment Storage Capacity | - | - | - | 28.99 |
| Sediment Inflow Rate/Year (ac-ft/yr) | 2.45 | 0.23 | 1.42 | 4.10 |
| Sediment Storage Life (yr) | - | - | - | 7.1 |

* * *

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) 100-Year, 6-Hour Storm Event

Exhibit #1- N9-A2, N9-A1and N9-A Proposed Sedimentation Ponds

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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**PEABODY WESTERN COAL COMPANY**
**CALCULATED HYDROLOGIC DATA**

**PROJECT: N-9 MINING AREA**

**STRUCTURE: A**

***TIME OF CONCENTRATION:***

| | | |
|---|---|---|
| Start Elevation (ft) = | 6850 | |
| End Elevation (ft) = | 6830 | |
| Elevation Difference, E (ft) = | 20 | |
| Watercourse Length (ft) = | 519 | |
| Watercourse Length (mi) = | 0.098 | |
| Tc = (11.9L^3/E)^0.385 = | 0.056 | hours |

***ROUTING PARAMETERS:***

Between structure routing parameters were calculated using the SCS Upland mathod 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 | 3.05 | 198.25 |
| Pinyon Juniper | D | 83 | 9.05 | 751.15 |
| Saltbrush | D | 79 | 0.07 | 5.53 |
| Sagebrush | B | 60 | 0.13 | 7.8 |
| Sagebrush | D | 79 | 0.89 | 70.31 |
| Distrubed Land | B | 86 | 111.39 | 9579.54 |
| TOTAL: | | | 124.58 | 10612.58 |

Weighted CN = Total CN * Area / Total Area = 85

Note: During Operations the open pit will collect most of the runoff from disturbed areas. The worst case is when the open pit is reclaimed and runoff from a larger area or regraded soil reports directly to the pond.

***DRAINAGE BASIN AREA:***

124.58 Acres

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# PEABODY WESTERN COAL COMPANY
# CALCULATED SEDIMENTOLOGY DATA

## STRUCTURE: A

***SOIL ERODIBILITY FACTOR:***

| Soil Type | Erodibility Factor, K | Area | K*Area |
|---|---|---|---|
| 12AB | 0.43 | 0.51 | 0.22 |
| 16CE | 0.05 | 2.668 | 0.13 |
| 3CD | 0.16 | 1.759 | 0.28 |
| 3F | 0.02 | 8.247 | 0.16 |
| Disturbed Land | 0.12 | 111.39 | 13.37 |
| | TOTAL | 124.574 | 14.17 |

Weighted K = Total K * Area / Total Area = 0.11

***SLOPE FACTOR:***

| Length (ft) | | Slope (%) | m | Slope Angle (deg) | LS Factor |
|---|---|---|---|---|---|
| 729 | 150 | 20.58% | 0.60 | 11.63 | 11.52 |
| 613 | 80 | 13.05% | 0.60 | 7.44 | 6.03 |
| 676 | 100 | 14.79% | 0.60 | 8.41 | 7.46 |
| 728 | 80 | 10.99% | 0.60 | 6.27 | 5.32 |

Average LS = 7.58

The LS Factor was calculated by:
LS=(Slope Length/72.6)^m*(10.8sin(slope angle)+.03) for slopes < 9%
LS=(Slope Length/72.6)^m*(16.8sin(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 |

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# STRUCTURE: A

***Cover and Practice Factors:***

| Cover Type | Cover (%) | Canopy ( %) | Area (acres) | Cover Factor, C | C * Area | Practive Factor, P | P * Area |
|---|---|---|---|---|---|---|---|
| Pinyon Juniper | 40% | 25% | 12.094 | 0.22 | 2.66 | 1.00 | 12.094 |
| Sagebrush, Grass | 40% | 25% | 1.017 | 0.2 | 0.20 | 1.00 | 1.017 |
| Saltbrush | 40% | 25% | 0.073 | 0.2 | 0.01 | 1.00 | 0.073 |
| Disturbed | 0% | 0% | 111.39 | 1 | 111.39 | 0.80 | 89.112 |
| TOTAL: | | | 124.574 | | 114.27 | | 102.296 |

Weighted C = Total C * Area / Total Area = 0.92

Weighted P = Total P * Area / Total Area = 0.82

***RAINFALL FACTOR:***

R= 40

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# PEABODY WESTERN COAL COMPANY
# CALCULATED SEDIMENT YIELD

## STRUCTURE: A

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

| PARAMETER DESCRIPTION | VALUE | |
|---|---|---|
| Annual Rainfall Factor ( R) | 40 | |
| Soil Erodibility Factor (K) | 0.11 | |
| Length Slope Factor (L) | 7.58 | |
| Cover Factor(C) | 0.92 | |
| Practice Factor (P) | 0.82 | |
| Gross Annual Sediment Yield | 25.98 | tons/acre/year |
| | | |
| Sediment Density | 94 | pcf |
| Gross Annual Sediment Yield | 0.0127 | acre-feet/acre/year |
| Sediment Delivery Ratio | 90% | |
| Estimated Annual Sediment Yield | 0.0114 | acre-feet/acre/year |
| | | |
| Watershed Area | 124.58 | acres |
| Watershed Annual Sediment Yield | 1.42 | acre-feet/year |
| | | |
| Number of Years | 1 | years |
| Calculated Sediment Volume | 1.42 | acre-feet |

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TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION
N9-A POND
November 15, 2004

PROGRAM INPUT DATA

| DESCRIPTION | VALUE |
|---|---|
| Flow Rate (cfs)..... | 262.03 |
| Channel Bottom Slope (ft/ft)..... | 0.005 |
| Manning's Roughness Coefficient (n-value)..... | 0.048 |
| Channel Left Side Slope (horizontal/vertical)..... | 3.0 |
| Channel Right Side Slope (horizontal/vertical)..... | 3.0 |
| Channel Bottom Width (ft)..... | 30.0 |

COMPUTATION RESULTS

| DESCRIPTION | VALUE |
|---|---|
| Critical Depth (ft)..... | 1.28 |
| Critical Slope (ft/ft)..... | 0.0326 |
| Flow Velocity (fps)..... | 6.07 |
| Froude Number..... | 1.0 |
| Velocity Head (ft)..... | 0.57 |
| Energy Head (ft)..... | 1.85 |
| Cross-Sectional Area of Flow (sq ft)..... | 43.15 |
| Top Width of Flow (ft)..... | 37.65 |

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# N9-A POND OUTFLOW CHANNEL

## Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 30.00 | 3.0:1 | 3.0:1 | 25.0 | 1.00 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 262.03 cfs | |
| Depth: | 0.84 ft | 1.84 ft |
| Top Width: | 35.02 ft | 41.02 ft |
| Velocity: | 9.63 fps | |
| X-Section Area: | 27.20 sq ft | |
| Hydraulic Radius: | 0.771 | |
| Froude Number: | 1.93 | |
| Manning's n: | 0.0650 | |
| Dmin: | 5.00 in | |
| D50: | 9.00 in | |
| Dmax: | 12.00 in | |

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APPENDIX B

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

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# Peabody Western Coal
# Kayenta Mine
# N9-A POND DESIGN
# 10YR 24HR STORM

Gary Altsisi

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# *General Information*

## *Storm Information:*

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

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## *Structure Summary:*

| | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|
| #1 | 124.570 | 124.570 | 118.69 | 9.02 |

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# *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 | 124.570 | 0.056 | 0.000 | 0.000 | 85.000 | F | 118.69 | 9.022 |
| | $\sum$ | **124.570** | | | | | | **118.69** | **9.022** |

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APPENDIX C

SEDCAD4 (Input and Output) 100-Year, 6-Hour Storm Event

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# Peabody Western Coal
# Kayenta Mine
# N9-A POND DESIGN
# 100YR 6HR STORM

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Gary Altsisi

# *General Information*

## *Storm Information:*

| | |
|---|---|
| Storm Type: | NRCS Type II |
| Design Storm: | 100 yr - 6 hr |
| Rainfall Depth: | 2.400 inches |

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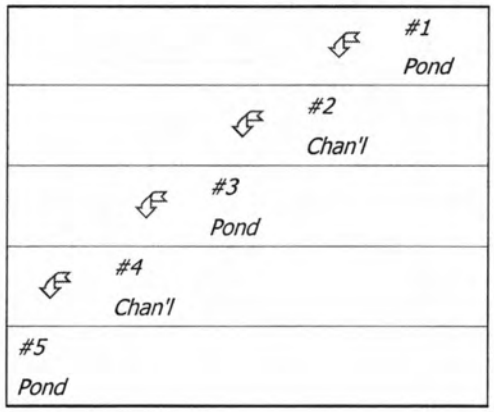
# *Structure Networking:*

| Type | Stru # | (flows into) | Stru # | Musk. K (hrs) | Musk. X | Description |
|---|---|---|---|---|---|---|
| Pond | #1 | ==> | #2 | 0.000 | 0.000 | N9-A2 POND |
| Channel | #2 | ==> | #3 | 0.000 | 0.000 | N9-A2 EMGY SPWY |
| Pond | #3 | ==> | #4 | 0.000 | 0.000 | N9-A1 POND |
| Channel | #4 | ==> | #5 | 0.000 | 0.000 | N9-A1 EMGY SPWY |
| Pond | #5 | ==> | End | 0.000 | 0.000 | N9-A POND |

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## *Structure Summary:*

| | | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume ac-ft) |
|---|---|---|---|---|---|
| #1 | In | 289.360 | 289.360 | 310.40 | 25.05 |
| | Out | | | 255.27 | 25.05 |
| #2 | | 0.000 | 289.360 | 255.27 | 25.05 |
| #3 | In | 19.480 | 308.840 | 262.13 | 26.84 |
| | Out | | | 217.22 | 26.84 |
| #4 | | 0.000 | 308.840 | 217.22 | 26.84 |
| #5 | In | 124.570 | 433.410 | 262.03 | 38.25 |
| | Out | | | 226.11 | 38.25 |

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# *Structure Detail:*

*Structure #1 (Pond)*

*N9-A2 POND*

Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,878.90 |
| Initial Pool: | 19.65 ac-ft |

## Emergency Spillway

| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,878.90 | 45.00 | 3.00:1 | 3.00:1 | 30.00 |

Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,881.05 |
| Dewater Time: | 0.27 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) |
|---|---|---|---|---|
| 6,865.00 | 0.750 | 0.000 | 0.000 | |
| 6,865.50 | 0.798 | 0.387 | 0.000 | |
| 6,866.00 | 0.847 | 0.798 | 0.000 | |
| 6,866.50 | 0.897 | 1.234 | 0.000 | |
| 6,867.00 | 0.949 | 1.695 | 0.000 | |
| 6,867.50 | 1.002 | 2.183 | 0.000 | |
| 6,868.00 | 1.057 | 2.698 | 0.000 | |
| 6,868.50 | 1.113 | 3.240 | 0.000 | |
| 6,869.00 | 1.171 | 3.811 | 0.000 | |
| 6,869.50 | 1.230 | 4.411 | 0.000 | |
| 6,870.00 | 1.291 | 5.042 | 0.000 | |
| 6,870.50 | 1.321 | 5.695 | 0.000 | |
| 6,871.00 | 1.351 | 6.363 | 0.000 | |
| 6,871.50 | 1.382 | 7.046 | 0.000 | |
| 6,872.00 | 1.413 | 7.744 | 0.000 | |
| 6,872.50 | 1.444 | 8.458 | 0.000 | |
| 6,873.00 | 1.475 | 9.188 | 0.000 | |

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| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,873.50 | 1.507 | 9.934 | 0.000 | | |
| 6,874.00 | 1.540 | 10.696 | 0.000 | | |
| 6,874.50 | 1.572 | 11.474 | 0.000 | | |
| 6,875.00 | 1.605 | 12.268 | 0.000 | | |
| 6,875.50 | 1.676 | 13.088 | 0.000 | | |
| 6,876.00 | 1.748 | 13.944 | 0.000 | | |
| 6,876.50 | 1.821 | 14.836 | 0.000 | | |
| 6,877.00 | 1.896 | 15.766 | 0.000 | | |
| 6,877.50 | 1.973 | 16.733 | 0.000 | | |
| 6,878.00 | 2.051 | 17.739 | 0.000 | | |
| 6,878.50 | 2.131 | 18.784 | 0.000 | | |
| 6,878.90 | 2.195 | 19.649 | 0.000 | | Spillway #1 |
| 6,879.00 | 2.191 | 19.869 | 6.606 | 2.90 | |
| 6,879.50 | 2.170 | 20.959 | 39.603 | 1.90 | |
| 6,880.00 | 2.149 | 22.039 | 72.600 | 0.95 | |
| 6,880.50 | 2.244 | 23.137 | 151.412 | 0.45 | |
| 6,881.00 | 2.342 | 24.283 | 243.729 | 0.30 | |
| 6,881.05 | 2.353 | 24.406 | 255.274 | 0.05 | Peak Stage |
| 6,881.50 | 2.442 | 25.479 | 356.187 | | |
| 6,882.00 | 2.543 | 26.725 | 494.400 | | |
| 6,882.50 | 2.647 | 28.023 | 656.283 | | |
| 6,883.00 | 2.753 | 29.373 | 841.363 | | |
| 6,883.50 | 2.861 | 30.776 | 1,039.085 | | |
| 6,883.90 | 2.948 | 31.938 | 1,216.134 | | |

## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,865.00 | 0.000 | 0.000 |
| 6,865.50 | 0.000 | 0.000 |
| 6,866.00 | 0.000 | 0.000 |
| 6,866.50 | 0.000 | 0.000 |
| 6,867.00 | 0.000 | 0.000 |
| 6,867.50 | 0.000 | 0.000 |
| 6,868.00 | 0.000 | 0.000 |
| 6,868.50 | 0.000 | 0.000 |
| 6,869.00 | 0.000 | 0.000 |
| 6,869.50 | 0.000 | 0.000 |

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| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,870.00 | 0.000 | 0.000 |
| 6,870.50 | 0.000 | 0.000 |
| 6,871.00 | 0.000 | 0.000 |
| 6,871.50 | 0.000 | 0.000 |
| 6,872.00 | 0.000 | 0.000 |
| 6,872.50 | 0.000 | 0.000 |
| 6,873.00 | 0.000 | 0.000 |
| 6,873.50 | 0.000 | 0.000 |
| 6,874.00 | 0.000 | 0.000 |
| 6,874.50 | 0.000 | 0.000 |
| 6,875.00 | 0.000 | 0.000 |
| 6,875.50 | 0.000 | 0.000 |
| 6,876.00 | 0.000 | 0.000 |
| 6,876.50 | 0.000 | 0.000 |
| 6,877.00 | 0.000 | 0.000 |
| 6,877.50 | 0.000 | 0.000 |
| 6,878.00 | 0.000 | 0.000 |
| 6,878.50 | 0.000 | 0.000 |
| 6,878.90 | 0.000 | 0.000 |
| 6,879.00 | 6.606 | 6.606 |
| 6,879.50 | 39.603 | 39.603 |
| 6,880.00 | 72.600 | 72.600 |
| 6,880.50 | 151.412 | 151.412 |
| 6,881.00 | 243.729 | 243.729 |
| 6,881.50 | 356.187 | 356.187 |
| 6,882.00 | 494.400 | 494.400 |
| 6,882.50 | 656.283 | 656.283 |
| 6,883.00 | 841.363 | 841.363 |
| 6,883.50 | 1,039.085 | 1,039.085 |
| 6,883.90 | 1,216.134 | 1,216.134 |

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*Structure #2 (Riprap Channel)*

*N9-A2 EMGY SPWY*

Trapezoidal Riprap Channel Inputs:

Material: Riprap

| Bottom Width (ft)} | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 25.00 | 3.0:1 | 3.0:1 | 25.0 | 4.11 | | |

Riprap Channel Results:

PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 255.27 cfs | |
| Depth: | 0.90 ft | 5.01 ft |
| Top Width: | 30.38 ft | 55.04 ft |
| Velocity: | 10.28 fps | |
| X-Section Area: | 24.84 sq ft | |
| Hydraulic Radius: | 0.810 | |
| Froude Number: | 2.00 | |
| Manning's n: | 0.0630 | |
| Dmin: | 5.00 in | |
| D50: | 9.00 in | |
| Dmax: | 12.00 in | |

*Structure #3 (Pond)*

*N9-A1 POND*

Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,865.20 |
| Initial Pool: | 19.69 ac-ft |

Emergency Spillway

| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,865.20 | 43.80 | 3.00:1 | 3.00:1 | 25.00 |

Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,867.34 |
| Dewater Time: | 0.34 days |

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

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Elevation-Capacity-Discharge Table

| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,850.00 | 0.450 | 0.000 | 0.000 | | |
| 6,850.50 | 0.511 | 0.240 | 0.000 | | |
| 6,851.00 | 0.576 | 0.512 | 0.000 | | |
| 6,851.50 | 0.644 | 0.817 | 0.000 | | |
| 6,852.00 | 0.717 | 1.157 | 0.000 | | |
| 6,852.50 | 0.793 | 1.534 | 0.000 | | |
| 6,853.00 | 0.874 | 1.951 | 0.000 | | |
| 6,853.50 | 0.958 | 2.408 | 0.000 | | |
| 6,854.00 | 1.046 | 2.909 | 0.000 | | |
| 6,854.50 | 1.137 | 3.455 | 0.000 | | |
| 6,855.00 | 1.233 | 4.047 | 0.000 | | |
| 6,855.50 | 1.241 | 4.666 | 0.000 | | |
| 6,856.00 | 1.250 | 5.288 | 0.000 | | |
| 6,856.50 | 1.258 | 5.915 | 0.000 | | |
| 6,857.00 | 1.267 | 6.547 | 0.000 | | |
| 6,857.50 | 1.275 | 7.182 | 0.000 | | |
| 6,858.00 | 1.284 | 7.822 | 0.000 | | |
| 6,858.50 | 1.292 | 8.466 | 0.000 | | |
| 6,859.00 | 1.301 | 9.114 | 0.000 | | |
| 6,859.50 | 1.310 | 9.767 | 0.000 | | |
| 6,860.00 | 1.318 | 10.424 | 0.000 | | |
| 6,860.50 | 1.402 | 11.104 | 0.000 | | |
| 6,861.00 | 1.488 | 11.826 | 0.000 | | |
| 6,861.50 | 1.576 | 12.592 | 0.000 | | |
| 6,862.00 | 1.668 | 13.403 | 0.000 | | |
| 6,862.50 | 1.761 | 14.260 | 0.000 | | |
| 6,863.00 | 1.857 | 15.164 | 0.000 | | |
| 6,863.50 | 1.956 | 16.118 | 0.000 | | |
| 6,864.00 | 2.058 | 17.121 | 0.000 | | |
| 6,864.50 | 2.162 | 18.176 | 0.000 | | |
| 6,865.00 | 2.268 | 19.283 | 0.000 | | |
| 6,865.20 | 1.820 | 19.691 | 0.000 | | Spillway #1 |
| 6,865.50 | 1.877 | 20.246 | 12.413 | 4.50 | |
| 6,866.00 | 1.974 | 21.208 | 33.114 | 1.50 | |
| 6,866.50 | 2.074 | 22.220 | 86.567 | 1.50 | |
| 6,867.00 | 2.176 | 23.283 | 158.763 | 0.45 | |
| 6,867.34 | 2.247 | 24.039 | 217.220 | 0.30 | Peak Stage |
| 6,867.50 | 2.281 | 24.397 | 244.922 | | |
| 6,868.00 | 2.388 | 25.564 | 351.808 | | |
| 6,868.50 | 2.497 | 26.785 | 481.035 | | |
| 6,869.00 | 2.609 | 28.061 | 633.478 | | |

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| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) |
|---|---|---|---|---|
| 6,869.50 | 2.723 | 29.394 | 800.698 | |
| 6,870.00 | 2.840 | 30.785 | 985.715 | |

## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,850.00 | 0.000 | 0.000 |
| 6,850.50 | 0.000 | 0.000 |
| 6,851.00 | 0.000 | 0.000 |
| 6,851.50 | 0.000 | 0.000 |
| 6,852.00 | 0.000 | 0.000 |
| 6,852.50 | 0.000 | 0.000 |
| 6,853.00 | 0.000 | 0.000 |
| 6,853.50 | 0.000 | 0.000 |
| 6,854.00 | 0.000 | 0.000 |
| 6,854.50 | 0.000 | 0.000 |
| 6,855.00 | 0.000 | 0.000 |
| 6,855.50 | 0.000 | 0.000 |
| 6,856.00 | 0.000 | 0.000 |
| 6,856.50 | 0.000 | 0.000 |
| 6,857.00 | 0.000 | 0.000 |
| 6,857.50 | 0.000 | 0.000 |
| 6,858.00 | 0.000 | 0.000 |
| 6,858.50 | 0.000 | 0.000 |
| 6,859.00 | 0.000 | 0.000 |
| 6,859.50 | 0.000 | 0.000 |
| 6,860.00 | 0.000 | 0.000 |
| 6,860.50 | 0.000 | 0.000 |
| 6,861.00 | 0.000 | 0.000 |
| 6,861.50 | 0.000 | 0.000 |
| 6,862.00 | 0.000 | 0.000 |
| 6,862.50 | 0.000 | 0.000 |
| 6,863.00 | 0.000 | 0.000 |
| 6,863.50 | 0.000 | 0.000 |
| 6,864.00 | 0.000 | 0.000 |
| 6,864.50 | 0.000 | 0.000 |
| 6,865.00 | 0.000 | 0.000 |
| 6,865.20 | 0.000 | 0.000 |

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| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,865.50 | 12.413 | 12.413 |
| 6,866.00 | 33.114 | 33.114 |
| 6,866.50 | 86.567 | 86.567 |
| 6,867.00 | 158.763 | 158.763 |
| 6,867.50 | 244.922 | 244.922 |
| 6,868.00 | 351.808 | 351.808 |
| 6,868.50 | 481.035 | 481.035 |
| 6,869.00 | 633.478 | 633.478 |
| 6,869.50 | 800.698 | 800.698 |
| 6,870.00 | 985.715 | 985.715 |

*Structure #4 (Riprap Channel)*

*N9-A1 EMGY SPWY*

Trapezoidal Riprap Channel Inputs:

Material: Riprap

| Bottom Width (ft)} | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 30.00 | 3.0:1 | 3.0:1 | 25.0 | 4.26 | | |

Riprap Channel Results:

PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 217.22 cfs | |
| Depth: | 0.74 ft | 5.00 ft |
| Top Width: | 34.45 ft | 60.01 ft |
| Velocity: | 9.08 fps | |
| X-Section Area: | 23.91 sq ft | |
| Hydraulic Radius: | 0.689 | |
| Froude Number: | 1.92 | |
| Manning's n: | 0.0640 | |
| Dmin: | 5.00 in | |
| D50: | 9.00 in | |
| Dmax: | 12.00 in | |

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*Structure #5 (Pond)*

*N9-A POND*

Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,846.20 |
| Initial Pool: | 19.75 ac-ft |

Emergency Spillway

| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,846.20 | 37.80 | 3.00:1 | 3.00:1 | 30.00 |

Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,848.17 |
| Dewater Time: | 0.44 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) |
|---|---|---|---|---|
| 6,830.00 | 0.010 | 0.000 | 0.000 | |
| 6,830.50 | 0.016 | 0.007 | 0.000 | |
| 6,831.00 | 0.024 | 0.017 | 0.000 | |
| 6,831.50 | 0.033 | 0.031 | 0.000 | |
| 6,832.00 | 0.044 | 0.050 | 0.000 | |
| 6,832.50 | 0.056 | 0.075 | 0.000 | |
| 6,833.00 | 0.070 | 0.107 | 0.000 | |
| 6,833.50 | 0.085 | 0.145 | 0.000 | |
| 6,834.00 | 0.102 | 0.192 | 0.000 | |
| 6,834.50 | 0.120 | 0.248 | 0.000 | |
| 6,835.00 | 0.140 | 0.313 | 0.000 | |
| 6,835.50 | 0.245 | 0.408 | 0.000 | |
| 6,836.00 | 0.376 | 0.562 | 0.000 | |
| 6,836.50 | 0.537 | 0.789 | 0.000 | |
| 6,837.00 | 0.726 | 1.104 | 0.000 | |
| 6,837.50 | 0.942 | 1.520 | 0.000 | |
| 6,838.00 | 1.190 | 2.051 | 0.000 | |
| 6,838.50 | 1.464 | 2.714 | 0.000 | |
| 6,839.00 | 1.767 | 3.520 | 0.000 | |
| 6,839.50 | 2.098 | 4.485 | 0.000 | |
| 6,840.00 | 2.457 | 5.623 | 0.000 | |
| 6,840.50 | 2.410 | 6.840 | 0.000 | |

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| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,841.00 | 2.363 | 8.033 | 0.000 | | |
| 6,841.50 | 2.317 | 9.203 | 0.000 | | |
| 6,842.00 | 2.272 | 10.350 | 0.000 | | |
| 6,842.50 | 2.226 | 11.475 | 0.000 | | |
| 6,843.00 | 2.182 | 12.577 | 0.000 | | |
| 6,843.50 | 2.137 | 13.657 | 0.000 | | |
| 6,844.00 | 2.094 | 14.714 | 0.000 | | |
| 6,844.50 | 2.050 | 15.750 | 0.000 | | |
| 6,845.00 | 2.007 | 16.765 | 0.000 | | |
| 6,845.50 | 2.397 | 17.864 | 0.000 | | |
| 6,846.00 | 2.820 | 19.167 | 0.000 | | |
| 6,846.20 | 3.000 | 19.749 | 0.000 | | Spillway #1 |
| 6,846.50 | 2.953 | 20.642 | 15.377 | 6.35 | |
| 6,847.00 | 2.876 | 22.099 | 41.023 | 1.70 | |
| 6,847.50 | 2.800 | 23.518 | 105.469 | 1.55 | |
| 6,848.00 | 2.725 | 24.899 | 191.140 | 0.60 | |
| 6,848.17 | 2.700 | 25.363 | 226.106 | 0.30 | Peak Stage |
| 6,848.50 | 2.651 | 26.243 | 292.496 | | |
| 6,849.00 | 2.578 | 27.550 | 417.761 | | |
| 6,849.50 | 2.506 | 28.821 | 567.760 | | |
| 6,850.00 | 2.435 | 30.056 | 743.428 | | |

## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,830.00 | 0.000 | 0.000 |
| 6,830.50 | 0.000 | 0.000 |
| 6,831.00 | 0.000 | 0.000 |
| 6,831.50 | 0.000 | 0.000 |
| 6,832.00 | 0.000 | 0.000 |
| 6,832.50 | 0.000 | 0.000 |
| 6,833.00 | 0.000 | 0.000 |
| 6,833.50 | 0.000 | 0.000 |
| 6,834.00 | 0.000 | 0.000 |
| 6,834.50 | 0.000 | 0.000 |
| 6,835.00 | 0.000 | 0.000 |
| 6,835.50 | 0.000 | 0.000 |
| 6,836.00 | 0.000 | 0.000 |

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| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,836.50 | 0.000 | 0.000 |
| 6,837.00 | 0.000 | 0.000 |
| 6,837.50 | 0.000 | 0.000 |
| 6,838.00 | 0.000 | 0.000 |
| 6,838.50 | 0.000 | 0.000 |
| 6,839.00 | 0.000 | 0.000 |
| 6,839.50 | 0.000 | 0.000 |
| 6,840.00 | 0.000 | 0.000 |
| 6,840.50 | 0.000 | 0.000 |
| 6,841.00 | 0.000 | 0.000 |
| 6,841.50 | 0.000 | 0.000 |
| 6,842.00 | 0.000 | 0.000 |
| 6,842.50 | 0.000 | 0.000 |
| 6,843.00 | 0.000 | 0.000 |
| 6,843.50 | 0.000 | 0.000 |
| 6,844.00 | 0.000 | 0.000 |
| 6,844.50 | 0.000 | 0.000 |
| 6,845.00 | 0.000 | 0.000 |
| 6,845.50 | 0.000 | 0.000 |
| 6,846.00 | 0.000 | 0.000 |
| 6,846.20 | 0.000 | 0.000 |
| 6,846.50 | 15.377 | 15.377 |
| 6,847.00 | 41.023 | 41.023 |
| 6,847.50 | 105.469 | 105.469 |
| 6,848.00 | 191.140 | 191.140 |
| 6,848.50 | 292.496 | 292.496 |
| 6,849.00 | 417.761 | 417.761 |
| 6,849.50 | 567.760 | 567.760 |
| 6,850.00 | 743.428 | 743.428 |

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# *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 | 289.360 | 0.383 | 0.000 | 0.000 | 84.000 | F | 310.40 | 25.052 |
| | ∑ | **289.360** | | | | | | **310.40** | **25.052** |
| **#2** | ∑ | **289.360** | | | | | | **255.27** | **25.052** |
| #3 | 1 | 19.480 | 0.104 | 0.000 | 0.000 | 85.000 | F | 34.23 | 1.785 |
| | ∑ | **308.840** | | | | | | **262.13** | **26.837** |
| **#4** | ∑ | **308.840** | | | | | | **217.22** | **26.837** |
| #5 | 1 | 124.570 | 0.056 | 0.000 | 0.000 | 85.000 | F | 218.89 | 11.412 |
| | ∑ | **433.410** | | | | | | **262.03** | **38.249** |

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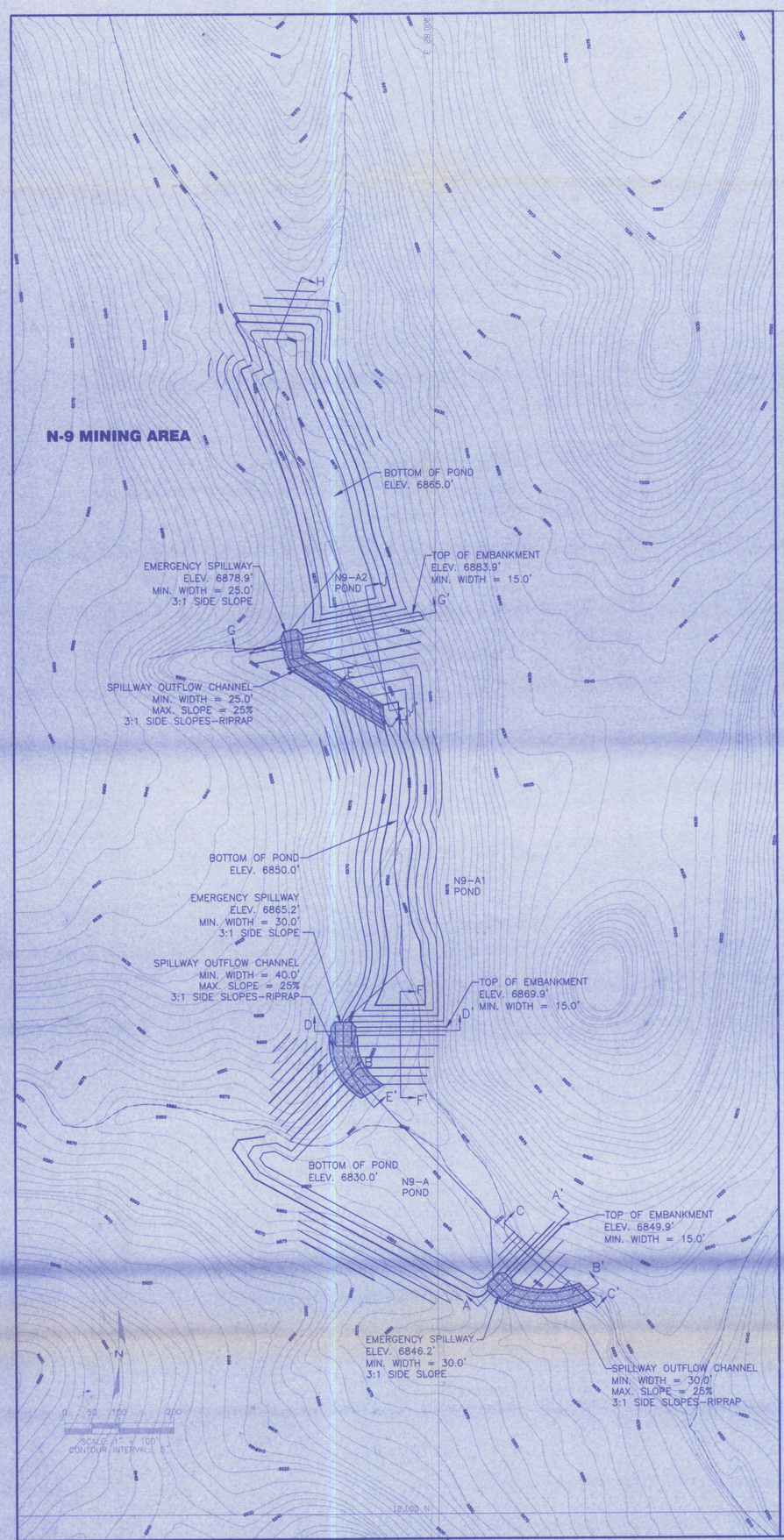



## N9-A POND STAGE CAPACITY TABLE

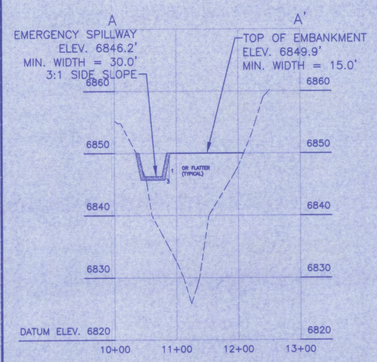
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6830.0 | 0.0 | 0.03 | 0.00 | BOTTOM OF POND |
| 6835.0 | 5.0 | 0.10 | 0.31 | INCISED ELEV. |
| 6840.0 | 10.0 | 2.02 | 5.62 | |
| 6845.0 | 15.0 | 2.43 | 16.76 | |
| 6846.2 | 16.2 | 2.54 | 19.75 | EMERGENCY SPILLWAY |
| 6849.9 | 19.9 | 2.88 | 30.05 | TOP OF EMBANKMENT |

## N9-A1 POND STAGE CAPACITY TABLE

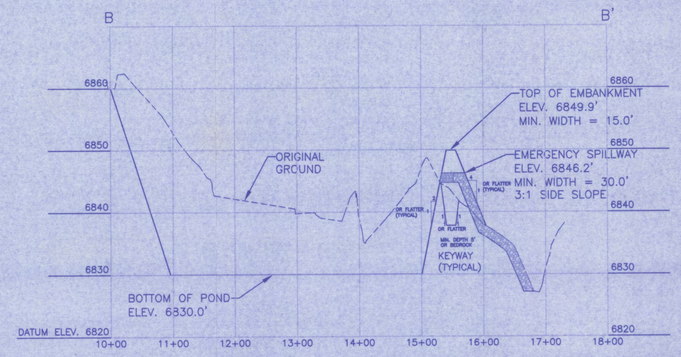
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6850.0 | 0.0 | 0.59 | 0.00 | BOTTOM OF POND |
| 6855.0 | 5.0 | 1.03 | 4.05 | INCISED ELEV. |
| 6860.0 | 10.0 | 1.52 | 10.42 | |
| 6865.0 | 15.0 | 2.03 | 19.28 | |
| 6865.2 | 15.2 | 2.05 | 19.69 | EMERGENCY SPILLWAY |
| 6869.9 | 19.9 | 2.57 | 30.78 | TOP OF EMBANKMENT |

## N9-A2 POND STAGE CAPACITY TABLE

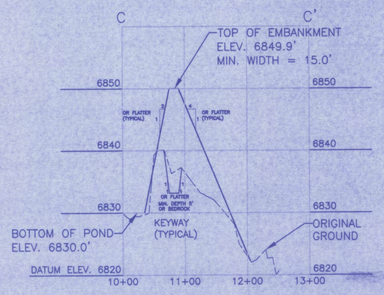
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6865.0 | 0.0 | 0.80 | 0.00 | BOTTOM OF POND |
| 6870.0 | 5.0 | 1.22 | 5.04 | INCISED ELEV. |
| 6875.0 | 10.0 | 1.68 | 12.27 | |
| 6878.9 | 13.9 | 2.11 | 19.65 | EMERGENCY SPILLWAY |
| 6880.0 | 15.0 | 2.23 | 22.04 | |
| 6883.9 | 18.9 | 2.84 | 31.94 | TOP OF EMBANKMENT |




SECTION A – A'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION B – B'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION C – C'
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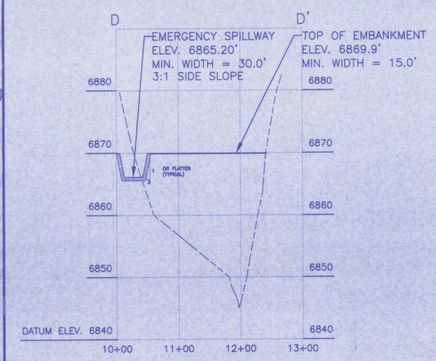
VERT. 1" = 10'




SECTION D – D'
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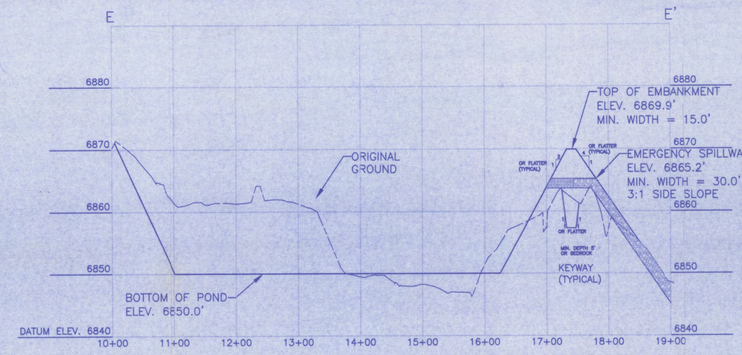
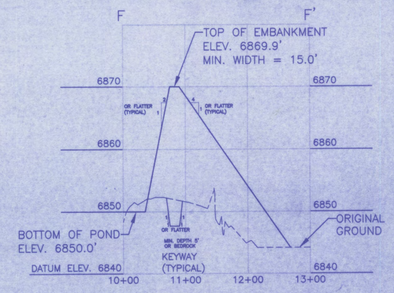
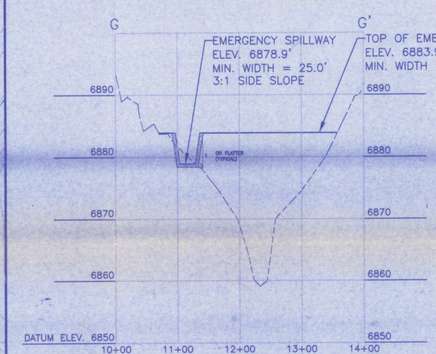



SECTION E – E'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION F – F'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION G – G'
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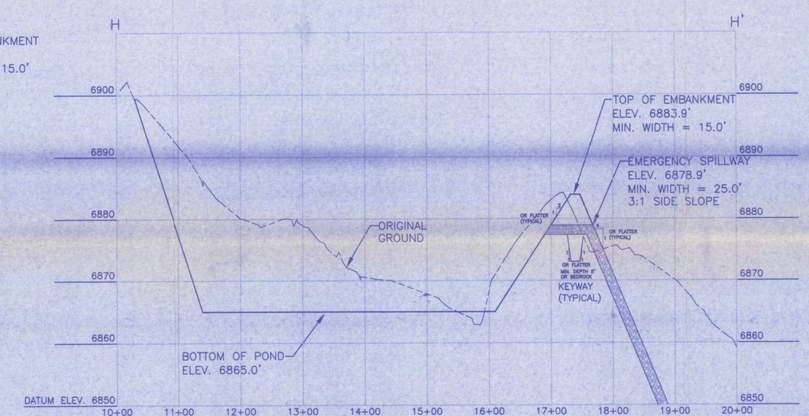
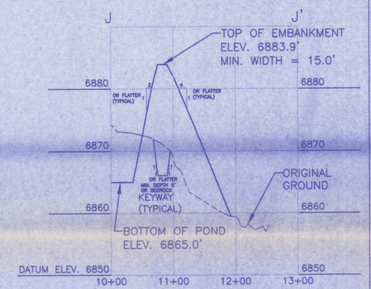
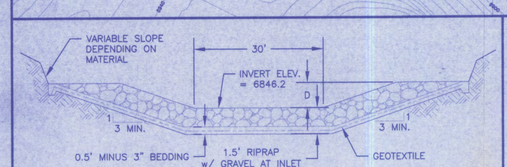
VERT. 1" = 10'



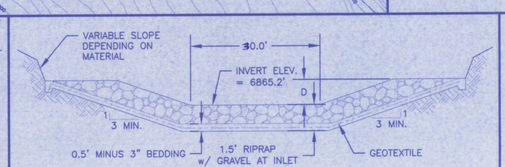

SECTION H – H'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



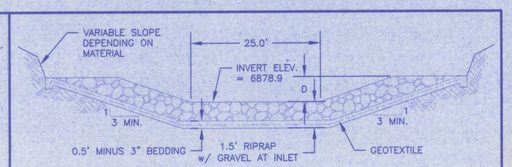

SECTION J – J'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-A POND




SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-A1 POND




SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-A2 POND

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ENGINEER'S CERTIFICATION

JAMES G. SCHLENVOGT
Engineering Supervisor
Peabody Western Coal Company

ARIZONA P.E. 18782
Date: DEC 23 2004

NOTES:
1) General location, see Drawing No. 85400, Sheet K-6 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the distrubed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.


WOODSON
ENGINEERING AND SURVEYING, INC.
124 N. ELDEN ST.
FLAGSTAFF, AZ 86001
PHONE: (928) 774-4636 FAX: (928) 774-4648


EXHIBIT # 1

# PROPOSED N9-A, A1 & A2 SEDIMENTATION POND DESIGN

KAYENTA MINE
PEABODY WESTERN COAL COMPANY
P. O. BOX 650 KAYENTA, ARIZONA 86033

| | |
|---|---|
| DESIGNED BY: GA | SCALE: AS NOTED |
| DRAWN BY: PEK | DRAWING DATE: 11-22-04 |
| CHECKED BY: JGS | PHOTO DATE: 11-84 |
| CONTOUR INTERVAL: 5 FT. | DWG FILE: POND N9-A,A1,A2.DWG |

DESIGN REPORT

Temporary Sedimentation Structure

N9-A1 (Middle)

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

SEP 2005 APPROVED

Registered Professional Engineer (Civil) CERTIFICATE NO. 18782 JAMES G. SCHLENVOGT Date Signed ..... ARIZONA, U.S.A.

DEC 23 2004

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TABLE OF CONTENTS


Page

INTRODUCTION ..... 1

INSPECTION ..... 1

SITE DESCRIPTION ..... 2

LAND USE ..... 2

DESIGN ANALYSES ..... 2

GENERAL ..... 2

STABILITY ..... 2

HYDROLOGY ..... 3

HYDRAULICS ..... 4

EMERGENCY SPILLWAY AND OUTLET CHANNEL ..... 6

STORAGE CAPACITY ..... 6

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) 100-Year, 6-Hour Storm Event
EXHIBIT #1 -N9-A2, N9-A1, and N9-A Proposed Sedimentation Ponds



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## INTRODUCTION

Sedimentation Structure N9-A1 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 N9 disturbed surface mining area at the Kayenta Mine. The location of Structure N9-A1 and its watershed boundary are shown on Drawing No. 85400 (Sheet K-6) 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 N9-A1 that is in series with sedimentation structures N9-A2 & N9-A. N9-A1 is the middle pond in the series. 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 N9-A1 was inspected in October, 2004 by a Registered Professional Engineer from Woodson Engineering, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. 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.

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## SITE DESCRIPTION

### LAND USE

The N9-A1, N9-A2 and N9-A Structures have a combined watershed of 433.41 acres and are located on a tributary upstream of Yellow Water Canyon Wash at the Kayenta Mine. The 19.48-acre watershed, which contributes directly to structure N9-A1 is classified as 16% undisturbed and 84% spoil.

## DESIGN ANALYSES

### GENERAL

Structure N9-A1 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 1984 for Peabody Western Coal Company and was used in the analyses of the structure.

### STABILITY

Structure N9-A1 (MIDDLE) 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 15 feet wide on top. A minimum upstream slope of 2H: 1V and minimum downstream slope of 4H: 1V were assumed. Based on the total embankment height of approximately 21 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 30-foot wide, riprap-lined, trapezoidal channel.

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HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure N9-A1 will be constructed in series with proposed Structures N9-A2 and N9-A. Structure N9-A1 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 combined capacity of N9-A1 and N9-A2 exceeds 20 acre-feet; therefore, the spillway was analyzed using the 100-year, 6-hour storm event in lieu of the 25-year, 6-hour storm. All structures were conservatively assumed to be full to the emergency spillway at the time of 100-year storm event. The storage capacity of structure N9-A1 was analyzed using the 10-year, 24-hour storm event. The combined ponds in series were verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Yellow Water Canyon Wash.

The following parameters were used in the hydrologic analysis:

| | | |
|---|---|---|
| 1. | Water Course length, L | 0.133 mi. |
| 2. | Elevation Difference, H | 10 ft |
| 3. | Time of Concentration, $T_c$ | 0.104 hr |
| 4. | NRCS Curve Number | 85 |
| 5. | Rainfall Depth, 10-year, 24-hour storm<br>100-year, 6-hour storm | 2.1 in<br>2.4 in |
| 6. | Drainage Area | 19.48 acres |

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Values reported represent the watershed, which drains directly to Pond N9-A1. Hydrologic input parameters for structure N9-A2 and N9-A are presented in separate design reports.

Muskingum routing parameters were utilized to route the 100-year hydrographs between the three structures. The routing parameters are presented in Appendices B and C, and are shown on a sub-watershed basis.

HYDRAULICS

The SEDCAD4 and HYDROCALC 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).

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## N9-A1 SEDIMENTATION POND HYDRAULICS TABLE

| | Units | 10-Yr, 24-Hr Storm | 100-Yr, 6-Hr Storm |
|---|---|---|---|
| Initial Reservoir Volume Condition | | Empty | Full to emergency spillway |
| Inflow | | | |
| Peak Flow | cfs | 18.56 | 254.48 |
| Volume | ac-ft | 1.41 | 26.84 |
| Storage | | | |
| Peak Stage | msl | N/A | 6867.3 |
| Emerg. Spillway Elev. | msl | 6865.2 | 6865.2 |
| Peak Storage | ac-ft | N/A | 24.0 |
| Storage Capacity | ac-ft | 19.69 | 19.69 |
| Outflow | | | |
| Peak Flow | cfs | N/A | 211.00 |
| Spillway Elevation | msl | 6865.2 | 6865.2 |
| Embankment Crest Elev. | msl | 6869.9 | 6869.9 |
| Peak Stage | msl | -- | 6867.3 |
| Freeboard | ft | -- | 2.6 |
| Emergency Spillway Channel | | | |
| Flow Depth | ft | -- | 2.1 |
| Critical Velocity | fps | -- | 6.0 |
| Mannings "n" | -- | -- | 0.048 |
| Width | ft | -- | 30 |
| Outflow Channel | | | |
| Slope | % | -- | 25 |
| Normal Velocity | fps | -- | 9.4 |
| Normal Depth | ft | -- | 0.8 |
| Mannings "n" | -- | -- | 0.066 |
| Riprap $D_{50}$ | in | -- | 9 |

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for N9-A1 will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

| | | | |
|---|---|---|---|
| Minimum Channel Depth | (Spillway) | 2.5 | ft |
| | (Outflow) | 2.0 | ft |
| Channel Width | | 30 | ft |
| Channel Length | (Spillway) | 44 | ft |
| | (Outflow) | 124 | ft |
| Sideslopes (Horizontal to Vertical) | | 3:1 | or flatter |
| Average Slope | (Spillway) | 0 | % |
| Maximum Slope | (Outflow) | 25 | % |
| Spillway Elevation | | 6865.2 | ft |

The riprapped-lined channel will extend a minimum of 15 feet beyond the toe of the embankment as shown on Exhibit 1.

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 1984 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-A1 is designed to contain approximately 19.69 acre-feet.

The calculations for the sediment load entering structure N9-A1 were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

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| | | |
|---|---|---|
| 1. | Rainfall Factor, R | 40 |
| 2. | Soil Erodibility Factor, K | 0.12 |
| 3. | Slope Factor, LS | 7.54 |
| 4. | Cover Factor, C | 0.87 |
| 5. | Erosion Control Factor, P | 0.83 |

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and

the remaining storage volume available for storing sediment. Structure N9-A1, combined with Structures N9-A2 and N9-A has adequate storage capacity to contain the 10-year, 24-hour storm and reasonable sediment storage capacity. The combined storage capacity was determined for all three structures in series and the results of the analysis are presented in the following table.

Combined Storage for Structures N9-A2, N9-A1 and N9-A

| | N9-A2 (UPPER) | N9-A1 (MIDDLE) | N9-A (LOWER) | COMBINED |
|---|---|---|---|---|
| Total Storage Capacity (ac-ft) | 19.75 | 19.69 | 19.65 | 59.08 |
| 10-Year, 24-Hour Storm Inflow(ac-ft) | 19.66 | 1.41 | 9.02 | 30.10 |
| Available Sediment Storage Capacity | - | - | - | 28.99 |
| Sediment Inflow Rate/Year (ac-ft/yr) | 2.45 | 0.23 | 1.42 | 4.10 |
| Sediment Storage Life (yr) | - | - | - | 7.1 |

* * *

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) 100-Year, 6-Hour Storm Event

Exhibit #1- N9-A2, N9-A1 and N9-A Proposed Sedimentation Ponds

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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**PEABODY WESTERN COAL COMPANY**
**CALCULATED HYDROLOGIC DATA**

**PROJECT: N-9 MINING AREA**

**STRUCTURE: A1**

***TIME OF CONCENTRATION:***

| | | |
|---|---|---|
| Start Elevation (ft) = | 6860 | |
| End Elevation (ft) = | 6850 | |
| Elevation Difference, E (ft) = | 10 | |
| Watercourse Length (ft) = | 704 | |
| Watercourse Length (mi) = | 0.133 | |
| Tc = (11.9L^3/E)^0.385 = | 0.104 | hours |

***ROUTING PARAMETERS:***

Between structure routing parameters were calculated using the SCS Upland mathod 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 | D | 83 | 2.22 | 184.26 |
| Sagebrush | D | 79 | 0.93 | 73.47 |
| Distrubed Land | B | 86 | 16.33 | 1404.38 |
| TOTAL: | | | 19.48 | 1662.11 |

Weighted CN = Total CN * Area / Total Area = 85

Note: During Operations the open pit will collect most of the runoff from disturbed areas. The worst case is when the open pit is reclaimed and runoff from a larger area or regraded soil reports directly to the pond.

***DRAINAGE BASIN AREA:***

19.48 Acres

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# PEABODY WESTERN COAL COMPANY
# CALCULATED SEDIMENTOLOGY DATA

## STRUCTURE: A1

***SOIL ERODIBILITY FACTOR:***

| Soil Type | Erodibility Factor, K | Area | K*Area |
|---|---|---|---|
| 3AB | 0.16 | 2.707 | 0.43 |
| 3CD | 0.16 | 0.073 | 0.01 |
| 3F | 0.02 | 0.372 | 0.01 |
| Disturbed | 0.12 | 16.33 | 1.96 |
| | TOTAL | 19.482 | 2.41 |

Weighted K = Total K * Area / Total Area = 0.12

***SLOPE FACTOR:***

| Length (ft) | | Slope (%) | m | Slope Angle (deg) | LS Factor |
|---|---|---|---|---|---|
| 611 | 100 | 16.37% | 0.60 | 9.29 | 7.94 |
| 593 | 90 | 15.18% | 0.60 | 8.63 | 7.13 |

Average LS = 7.53

The LS Factor was calculated by:

LS=(Slope Length/72.6)^m*(10.8sin(slope angle)+.03) for slopes < 9%
LS=(Slope Length/72.6)^m*(16.8sin(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 |

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# STRUCTURE: A1

***Cover and Practice Factors:***

| Cover Type | Cover (%) | Canopy (%) | Area (acres) | Cover Factor, C | C * Area | Practive Factor, P | P * Area |
|---|---|---|---|---|---|---|---|
| Pinyon Juniper | 40% | 25% | 2.225 | 0.22 | 0.49 | 1.00 | 2.225 |
| Sagebrush, Grass | 40% | 25% | 0.927 | 0.2 | 0.19 | 1.00 | 0.927 |
| Saltbrush | 40% | 25% | 0 | 0.2 | 0.00 | 1.00 | 0 |
| Disturbed | 0% | 0% | 16.33 | 1 | 16.33 | 0.80 | 13.064 |
| TOTAL: | | | 19.482 | | 17.00 | | 16.22 |

Weighted C = Total C * Area / Total Area = 0.87

Weighted P = Total P * Area / Total Area = 0.83

***RAINFALL FACTOR:***

R= 40

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# PEABODY WESTERN COAL COMPANY
# CALCULATED SEDIMENT YIELD

## STRUCTURE: A1

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

| PARAMETER DESCRIPTION | VALUE | |
|---|---|---|
| Annual Rainfall Factor ( R) | 40 | |
| Soil Erodibility Factor (K) | 0.12 | |
| Length Slope Factor (L) | 7.53 | |
| Cover Factor(C) | 0.87 | |
| Practice Factor (P) | 0.83 | |
| Gross Annual Sediment Yield | 27.10 | tons/acre/year |
| | | |
| Sediment Density | 94 | pcf |
| Gross Annual Sediment Yield | 0.0132 | acre-feet/acre/year |
| Sediment Delivery Ratio | 90% | |
| Estimated Annual Sediment Yield | 0.0119 | acre-feet/acre/year |
| | | |
| Watershed Area | 19.48 | acres |
| Watershed Annual Sediment Yield | 0.23 | acre-feet/year |
| | | |
| Number of Years | 1 | years |
| Calculated Sediment Volume | 0.23 | acre-feet |

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TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION
N9-A1 POND
November 15, 2004

PROGRAM INPUT DATA

| DESCRIPTION | VALUE |
|---|---|
| Flow Rate (cfs) | 254.48 |
| Channel Bottom Slope (ft/ft) | 0.005 |
| Manning's Roughness Coefficient (n-value) | 0.048 |
| Channel Left Side Slope (horizontal/vertical) | 3.0 |
| Channel Right Side Slope (horizontal/vertical) | 3.0 |
| Channel Bottom Width (ft) | 30.0 |

COMPUTATION RESULTS

| DESCRIPTION | VALUE |
|---|---|
| Critical Depth (ft) | 1.25 |
| Critical Slope (ft/ft) | 0.0327 |
| Flow Velocity (fps) | 6.02 |
| Froude Number | 1.0 |
| Velocity Head (ft) | 0.56 |
| Energy Head (ft) | 1.82 |
| Cross-Sectional Area of Flow (sq ft) | 42.27 |
| Top Width of Flow (ft) | 37.51 |

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# N9-A1 POND OUTFLOW CHANNEL

Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 30.00 | 3.0:1 | 3.0:1 | 25.0 | 1.00 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 254.48 cfs | |
| Depth: | 0.83 ft | 1.83 ft |
| Top Width: | 34.98 ft | 40.98 ft |
| Velocity: | 9.44 fps | |
| X-Section Area: | 26.96 sq ft | |
| Hydraulic Radius: | 0.765 | |
| Froude Number: | 1.90 | |
| Manning's n: | 0.0660 | |
| Dmin: | 5.00 in | |
| D50: | 9.00 in | |
| Dmax: | 12.00 in | |

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APPENDIX B

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

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# Peabody Western Coal
# Kayenta Mine
# N9-A1 POND DESIGN
# 10YR 24HR STORM

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SEP 2005

Gary Altsisi

# *General Information*

## *Storm Information:*

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

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## *Structure Summary:*

| | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|
| #1 | 19.480 | 19.480 | 18.56 | 1.41 |

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# *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 | 19.480 | 0.104 | 0.000 | 0.000 | 85.000 | F | 18.56 | 1.411 |
| | $\sum$ | **19.480** | | | | | | **18.56** | **1.411** |

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APPENDIX C

SEDCAD4 (Input and Output) 100-Year, 6-Hour Storm Event

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# Peabody Western Coal
# Kayenta Mine
# N9-A1 POND DESIGN
# 100YR 6HR STORM

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Gary Altsisi

# *General Information*

## *Storm Information:*

| | |
|---|---|
| Storm Type: | NRCS Type II |
| Design Storm: | 100 yr - 6 hr |
| Rainfall Depth: | 2.400 inches |

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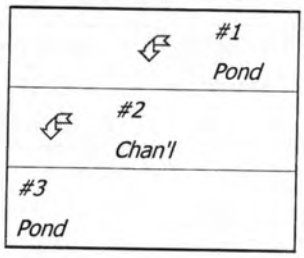
# *Structure Networking:*

| Type | Stru # | (flows into) | Stru # | Musk. K (hrs) | Musk. X | Description |
|---|---|---|---|---|---|---|
| Pond | #1 | ==> | #2 | 0.000 | 0.000 | N9-A2 POND |
| Channel | #2 | ==> | #3 | 0.000 | 0.000 | N9-A2 EMGY SPWY |
| Pond | #3 | ==> | End | 0.000 | 0.000 | N9-A1 POND |

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## *Structure Summary:*

| | | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|---|
| #1 | In | 289.360 | 289.360 | 310.40 | 25.05 |
| | Out | | | 247.59 | 25.05 |
| #2 | | 0.000 | 289.360 | 247.59 | 25.05 |
| #3 | In | 19.480 | 308.840 | 254.48 | 26.84 |
| | Out | | | 211.00 | 26.84 |

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# *Structure Detail:*

*Structure #3 (Pond)*

*N9-A1 POND*

Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,865.20 |
| Initial Pool: | 19.69 ac-ft |

## Emergency Spillway

| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,865.20 | 43.80 | 3.00:1 | 3.00:1 | 25.00 |

Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,867.30 |
| Dewater Time: | 0.36 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) |
|---|---|---|---|---|
| 6,850.00 | 0.450 | 0.000 | 0.000 | |
| 6,850.50 | 0.511 | 0.240 | 0.000 | |
| 6,851.00 | 0.576 | 0.512 | 0.000 | |
| 6,851.50 | 0.644 | 0.817 | 0.000 | |
| 6,852.00 | 0.717 | 1.157 | 0.000 | |
| 6,852.50 | 0.793 | 1.534 | 0.000 | |
| 6,853.00 | 0.874 | 1.951 | 0.000 | |
| 6,853.50 | 0.958 | 2.408 | 0.000 | |
| 6,854.00 | 1.046 | 2.909 | 0.000 | |
| 6,854.50 | 1.137 | 3.455 | 0.000 | |
| 6,855.00 | 1.233 | 4.047 | 0.000 | |
| 6,855.50 | 1.241 | 4.666 | 0.000 | |
| 6,856.00 | 1.250 | 5.288 | 0.000 | |
| 6,856.50 | 1.258 | 5.915 | 0.000 | |
| 6,857.00 | 1.267 | 6.547 | 0.000 | |
| 6,857.50 | 1.275 | 7.182 | 0.000 | |
| 6,858.00 | 1.284 | 7.822 | 0.000 | |

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| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,858.50 | 1.292 | 8.466 | 0.000 | | |
| 6,859.00 | 1.301 | 9.114 | 0.000 | | |
| 6,859.50 | 1.310 | 9.767 | 0.000 | | |
| 6,860.00 | 1.318 | 10.424 | 0.000 | | |
| 6,860.50 | 1.402 | 11.104 | 0.000 | | |
| 6,861.00 | 1.488 | 11.826 | 0.000 | | |
| 6,861.50 | 1.576 | 12.592 | 0.000 | | |
| 6,862.00 | 1.668 | 13.403 | 0.000 | | |
| 6,862.50 | 1.761 | 14.260 | 0.000 | | |
| 6,863.00 | 1.857 | 15.164 | 0.000 | | |
| 6,863.50 | 1.956 | 16.118 | 0.000 | | |
| 6,864.00 | 2.058 | 17.121 | 0.000 | | |
| 6,864.50 | 2.162 | 18.176 | 0.000 | | |
| 6,865.00 | 2.268 | 19.283 | 0.000 | | |
| 6,865.20 | 1.820 | 19.691 | 0.000 | | Spillway #1 |
| 6,865.50 | 1.877 | 20.246 | 12.413 | 4.75 | |
| 6,866.00 | 1.974 | 21.208 | 33.114 | 1.45 | |
| 6,866.50 | 2.074 | 22.220 | 86.567 | 1.60 | |
| 6,867.00 | 2.176 | 23.283 | 158.763 | 0.45 | |
| 6,867.30 | 2.240 | 23.958 | 211.004 | 0.30 | Peak Stage |
| 6,867.50 | 2.281 | 24.397 | 244.922 | | |
| 6,868.00 | 2.388 | 25.564 | 351.808 | | |
| 6,868.50 | 2.497 | 26.785 | 481.035 | | |
| 6,869.00 | 2.609 | 28.061 | 633.478 | | |
| 6,869.50 | 2.723 | 29.394 | 800.698 | | |
| 6,870.00 | 2.840 | 30.785 | 985.715 | | |

## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,850.00 | 0.000 | 0.000 |
| 6,850.50 | 0.000 | 0.000 |
| 6,851.00 | 0.000 | 0.000 |
| 6,851.50 | 0.000 | 0.000 |
| 6,852.00 | 0.000 | 0.000 |
| 6,852.50 | 0.000 | 0.000 |
| 6,853.00 | 0.000 | 0.000 |
| 6,853.50 | 0.000 | 0.000 |

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| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,854.00 | 0.000 | 0.000 |
| 6,854.50 | 0.000 | 0.000 |
| 6,855.00 | 0.000 | 0.000 |
| 6,855.50 | 0.000 | 0.000 |
| 6,856.00 | 0.000 | 0.000 |
| 6,856.50 | 0.000 | 0.000 |
| 6,857.00 | 0.000 | 0.000 |
| 6,857.50 | 0.000 | 0.000 |
| 6,858.00 | 0.000 | 0.000 |
| 6,858.50 | 0.000 | 0.000 |
| 6,859.00 | 0.000 | 0.000 |
| 6,859.50 | 0.000 | 0.000 |
| 6,860.00 | 0.000 | 0.000 |
| 6,860.50 | 0.000 | 0.000 |
| 6,861.00 | 0.000 | 0.000 |
| 6,861.50 | 0.000 | 0.000 |
| 6,862.00 | 0.000 | 0.000 |
| 6,862.50 | 0.000 | 0.000 |
| 6,863.00 | 0.000 | 0.000 |
| 6,863.50 | 0.000 | 0.000 |
| 6,864.00 | 0.000 | 0.000 |
| 6,864.50 | 0.000 | 0.000 |
| 6,865.00 | 0.000 | 0.000 |
| 6,865.20 | 0.000 | 0.000 |
| 6,865.50 | 12.413 | 12.413 |
| 6,866.00 | 33.114 | 33.114 |
| 6,866.50 | 86.567 | 86.567 |
| 6,867.00 | 158.763 | 158.763 |
| 6,867.50 | 244.922 | 244.922 |
| 6,868.00 | 351.808 | 351.808 |
| 6,868.50 | 481.035 | 481.035 |
| 6,869.00 | 633.478 | 633.478 |
| 6,869.50 | 0.000 | 800.698 |
| 6,870.00 | 0.000 | 985.715 |

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# *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 | 289.360 | 0.383 | 0.000 | 0.000 | 84.000 | F | 310.40 | 25.052 |
| | ∑ | **289.360** | | | | | | **310.40** | **25.052** |
| **#2** | ∑ | **289.360** | | | | | | **247.59** | **25.052** |
| #3 | 1 | 19.480 | 0.104 | 0.000 | 0.000 | 85.000 | F | 34.23 | 1.785 |
| | ∑ | **308.840** | | | | | | **254.48** | **26.837** |

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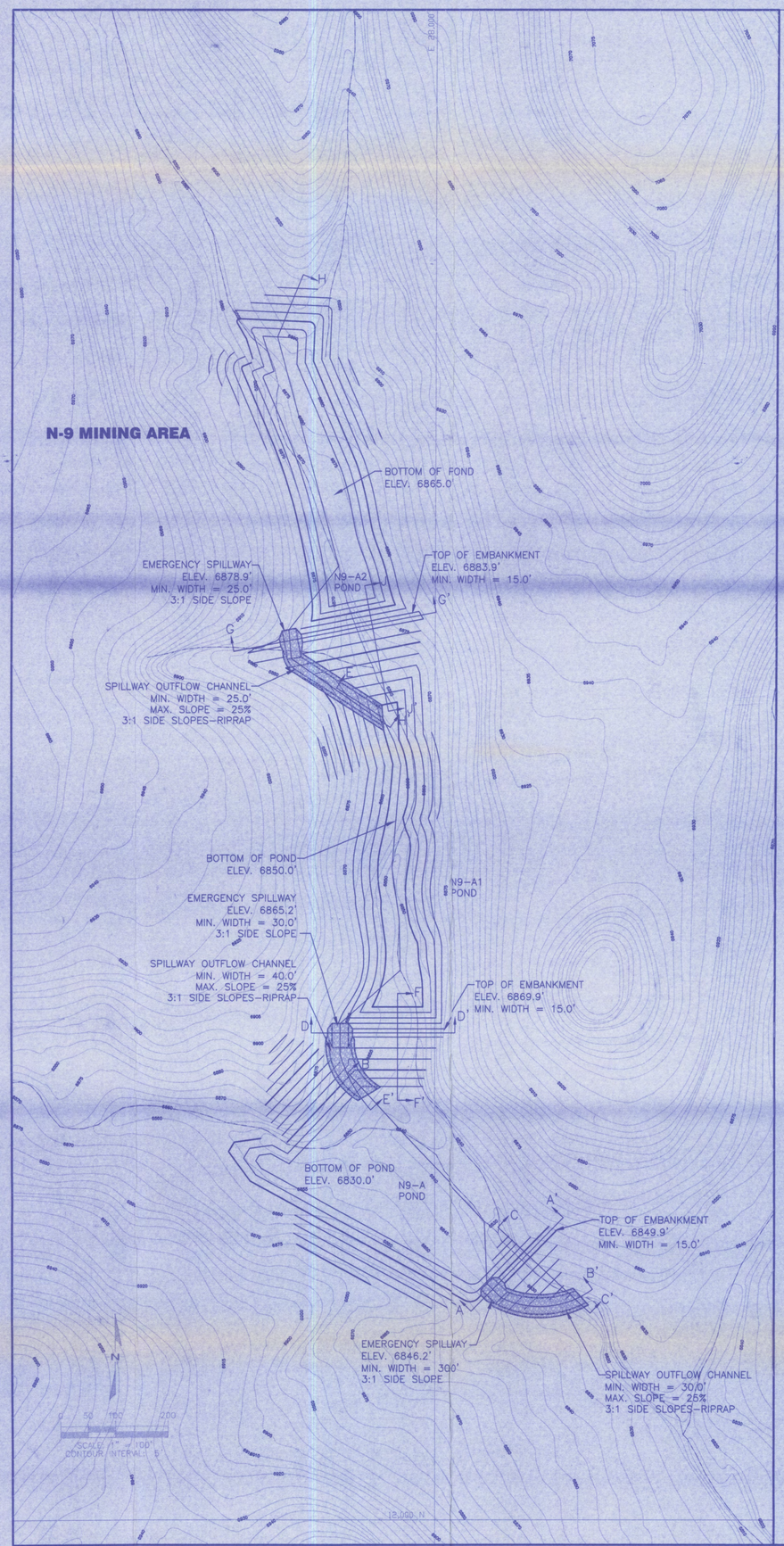



## N9-A POND STAGE CAPACITY TABLE

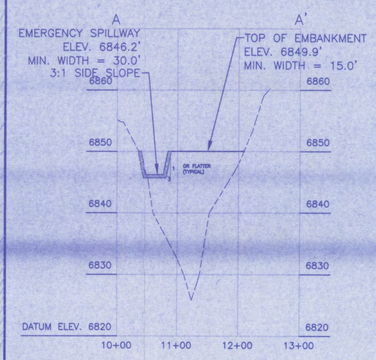
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6830.0 | 0.0 | 0.03 | 0.00 | BOTTOM OF POND |
| 6835.0 | 5.0 | 0.10 | 0.31 | INCISED ELEV. |
| 6840.0 | 10.0 | 2.02 | 5.62 | |
| 6845.0 | 15.0 | 2.43 | 16.76 | |
| 6846.2 | 16.2 | 2.54 | 19.75 | EMERGENCY SPILLWAY |
| 6849.9 | 19.9 | 2.88 | 30.05 | TOP OF EMBANKMENT |

## N9-A1 POND STAGE CAPACITY TABLE

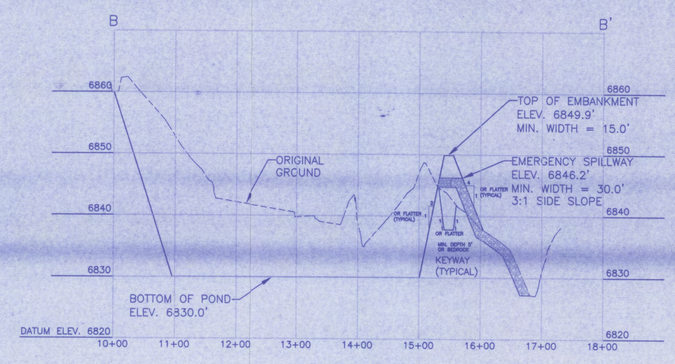
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6850.0 | 0.0 | 0.59 | 0.00 | BOTTOM OF POND |
| 6855.0 | 5.0 | 1.03 | 4.05 | INCISED ELEV. |
| 6860.0 | 10.0 | 1.52 | 10.42 | |
| 6865.0 | 15.0 | 2.03 | 19.28 | |
| 6865.2 | 15.2 | 2.05 | 19.69 | EMERGENCY SPILLWAY |
| 6869.9 | 19.9 | 2.57 | 30.78 | TOP OF EMBANKMENT |

## N9-A2 POND STAGE CAPACITY TABLE

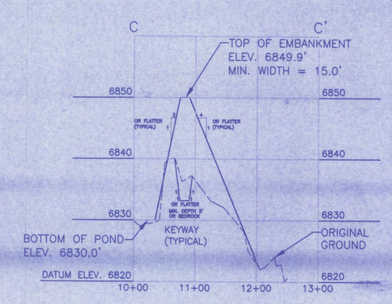
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6865.0 | 0.0 | 0.80 | 0.00 | BOTTOM OF POND |
| 6870.0 | 5.0 | 1.22 | 5.04 | INCISED ELEV. |
| 6875.0 | 10.0 | 1.68 | 12.27 | |
| 6878.9 | 13.9 | 2.11 | 19.65 | EMERGENCY SPILLWAY |
| 6880.0 | 15.0 | 2.23 | 22.04 | |
| 6883.9 | 18.9 | 2.84 | 31.94 | TOP OF EMBANKMENT |



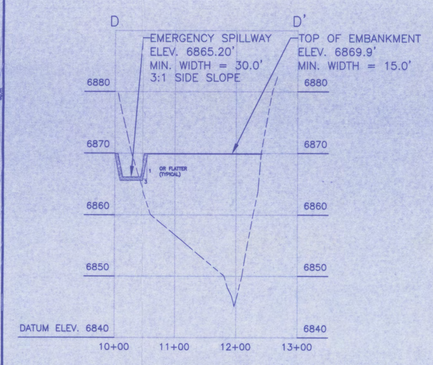

SECTION A – A'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



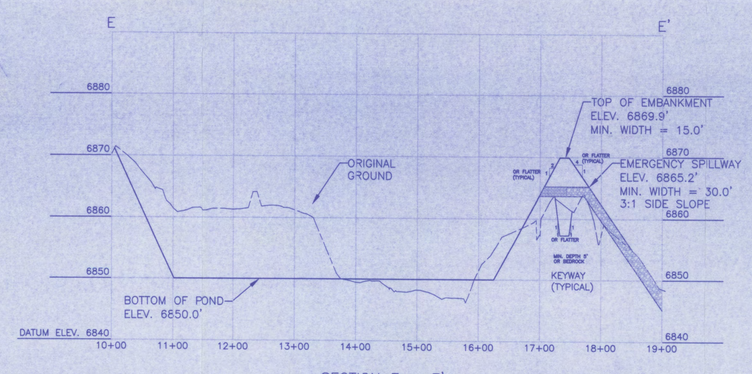

SECTION B – B'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



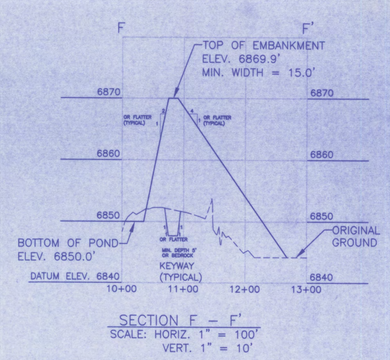

SECTION C – C'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



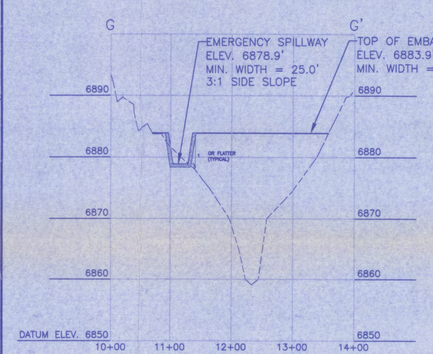

SECTION D – D'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



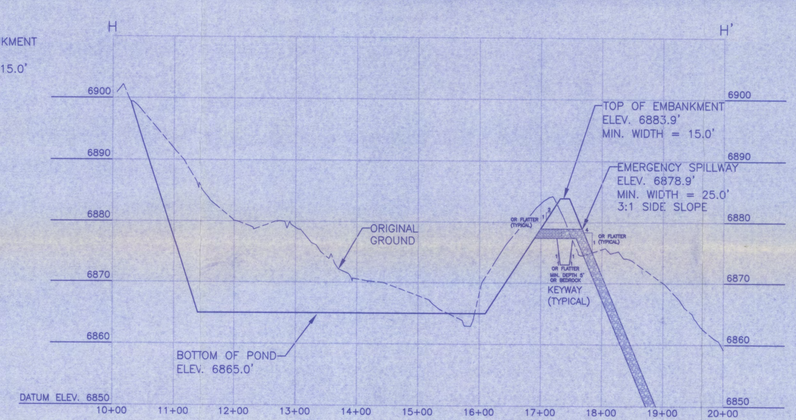

SECTION E – E'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



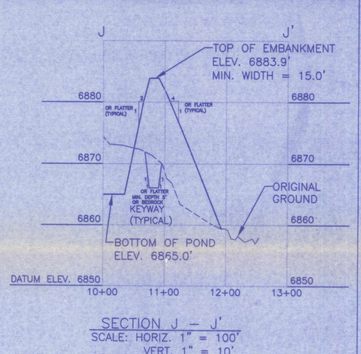

SECTION F – F'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



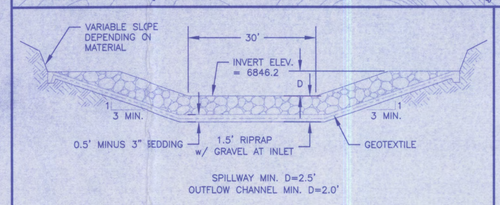

SECTION G – G'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



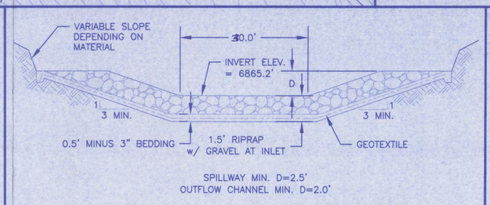

SECTION H – H'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



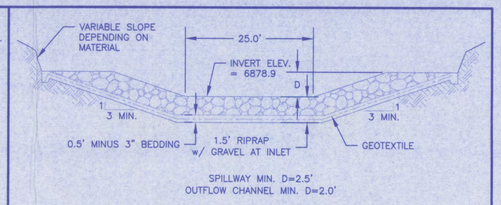

SECTION J – J'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-A POND




SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-A1 POND




SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-A2 POND

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ENGINEER'S CERTIFICATION
JAMES G. SCHLENDORF
Engineering Supervisor
Peabody Western Coal Company
ARIZONA P.E. 18782
Date: DEC 23 2004

NOTES:
1) General location, see Drawing No. 85400, Sheet K-6 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the disrtubed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.

WOODSON
ENGINEERING AND SURVEYING, INC.
124 N. ELDEN ST.
FLAGSTAFF, AZ 86001
PHONE: (928) 774-4638 FAX: (928) 774-4646

EXHIBIT # 1
PROPOSED N9-A, A1 & A2
SEDIMENTATION POND DESIGN
KAYENTA MINE
PEABODY WESTERN COAL COMPANY
P. O. BOX 650 KAYENTA, ARIZONA 86033

| | |
|---|---|
| DESIGNED BY: GA | SCALE: AS NOTED |
| DRAWN BY: PEK | DRAWING DATE: 11-22-04 |
| CHECKED BY: JGS | PHOTO DATE: 11-84 |
| CONTOUR INTERVAL: 5 FT. | DWG FILE: POND N9-A,A1,A2.DWG |

DESIGN REPORT

Temporary Sedimentation Structure

N9-A2 (Upper)

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

SEP 2005 APPROVED

Registered Professional Engineer (Civil) CERTIFICATE NO. 18782 JAMES GARY SCHLENVOGT Date Signed ..... ARIZONA, U.S.A.

DEC 23 2004

1

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TABLE OF CONTENTS


Page

INTRODUCTION ..... 1

INSPECTION ..... 1

SITE DESCRIPTION ..... 2

LAND USE ..... 2

DESIGN ANALYSES ..... 2

GENERAL ..... 2

STABILITY ..... 2

HYDROLOGY ..... 3

HYDRAULICS ..... 4

EMERGENCY SPILLWAY AND OUTLET CHANNEL ..... 6

STORAGE CAPACITY ..... 6

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 -N9-A2, N9-A1, and N9-A Proposed Sedimentation Ponds



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## INTRODUCTION

Sedimentation Structure N9-A2 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 N9 disturbed surface mining area at the Kayenta Mine. The location of Structure N9-A2 and its watershed boundary are shown on Drawing No. 85400, (Sheet K-6), 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 N9-A2 that is in series with sedimentation structures N9-A1 & N9-A. N9-A2 is the upper pond in the series. 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 N9-A2 was inspected in October, 2004 by a Registered Professional Engineer from Woodson Engineering, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. 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.

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## SITE DESCRIPTION

### LAND USE

The N9-A2, N9-A1 and N9-A Structures have a combined watershed of 433.41 acres and are located on a tributary upstream of Yellow Water Canyon Wash at the Kayenta Mine. The 289.36-acre watershed, which contributes directly to structure N9-A2, is classified as 72% undisturbed and 28% spoil.

## DESIGN ANALYSES

### GENERAL

Structure N9-A2 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 1984 for Peabody Western Coal Company and was used in the analyses of the structure.

### STABILITY

Structure N9-A2 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 15 feet wide on top. A minimum upstream slope of 2H: 1V and a minimum downstream slope of 4H: 1V were assumed. Based on the total embankment height of approximately 19.5 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 25-foot wide, riprap-lined, trapezoidal channel.

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HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure N9-A2 will be constructed in series with proposed Structures N9-A1 and N9-A. Structure N9-A2 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. N9-A2 is the upper pond in the series and has a capacity of less than 20 acre-feet; therefore, the spillway was analyzed using the 25-year, 6-hour storm event. All structures were conservatively assumed to be full to the emergency spillway at the time of design storm event. The storage capacity of structure N9-A2 was analyzed using the 10-year, 24-hour storm event. The combined ponds in series were verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Yellow Water Canyon Wash.

The following parameters were used in the hydrologic analysis:

| | | |
|---|---|---|
| 1. | Water Course length, L | 1.318 mi. |
| 2. | Elevation Difference, H | 330 ft |
| 3. | Time of Concentration, $T_c$ | 0.383 hr |
| 4. | NRCS Curve Number | 84 |
| 5. | Rainfall Depth, 10-year, 24-hour storm<br>25-year, 6-hour storm | 2.1 in<br>1.9 in |
| 6. | Drainage Area | 289.36 acres |

Values reported represent the watershed, which drains directly to Pond N9-A2. Hydrologic input parameters for structure N9-A1 and N9-A are presented in separate design reports.

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Muskingum routing parameters were utilized to route the 25-year hydrographs between the three structures. The routing parameters are presented in Appendices B and C, and are shown on a sub-watershed basis.

HYDRAULICS

The SEDCAD4 and HYDROCALC 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).

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## N9-A2 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 | 171.66 | 198.99 |
| Volume | ac-ft | 19.66 | 16.25 |
| Storage | | | |
| Peak Stage | Msl | N/A | 6880.6 |
| Emerg. Spillway Elev. | Msl | 6878.9 | 6878.9 |
| Peak Storage | ac-ft | N/A | 23.3 |
| Storage Capacity | ac-ft | 19.65 | 19.65 |
| Outflow | | | |
| Peak Flow | Cfs | N/A | 141.5 |
| Spillway Elevation | Msl | 6878.9 | 6878.9 |
| Embankment Crest Elev. | Msl | 6883.9 | 6883.9 |
| Peak Stage | Msl | -- | 6880.6 |
| Freeboard | Ft | -- | 3.3 |
| Emergency Spillway Channel | | | |
| Flow Depth | Ft | -- | 1.7 |
| Critical Velocity | Fps | -- | 5.84 |
| Mannings "n" | -- | -- | 0.048 |
| Width | Ft | -- | 25 |
| Outflow Channel | | | |
| Slope | % | -- | 25 |
| Normal Velocity | Fps | -- | 9.03 |
| Normal Depth | Ft | -- | 0.8 |
| Mannings "n" | -- | -- | 0.067 |
| Riprap $D_{50}$ | In | -- | 9 |

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for N9-A2 will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

| | | | |
|---|---|---|---|
| Minimum Channel Depth | (Spillway) | 2.5 | ft |
| | (Outflow) | 2.0 | ft |
| Channel Width | | 25 | ft |
| Channel Length | (Spillway) | 45 | ft |
| | (Outflow) | 215 | ft |
| Sideslopes (Horizontal to Vertical) | | 3:1 | or flatter |
| Average Slope | (Spillway) | 0 | % |
| Maximum Slope | (Outflow) | 25 | % |
| Spillway Elevation | | 6878.9 | 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 1984 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-A2 is designed to contain approximately 19.65 acre-feet.

The calculations for the sediment load entering structure N9-A2 were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

| | | |
|---|---|---|
| 1. | Rainfall Factor, R | 40 |
| 2. | Soil Erodibility Factor, K | 0.14 |
| 3. | Slope Factor, LS | 8.41 |
| 4. | Cover Factor, C | 0.44 |
| 5. | Erosion Control Factor, P | 0.94 |

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The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. Structure N9-A2 does not have sufficient storage to contain the 10-year, 24-hour storm; however, the storage of all three ponds, (N9-A2, N9-A1 & N9-A), in series is adequate. The combined storage capacity was determined for all three structures in series and the results of the analysis are presented in the following table.

Combined Storage for Structures N9-A2, N9-A1 and N9-A

| | N9-A2 (UPPER) | N9-A1 (MIDDLE) | N9-A (LOWER) | COMBINED |
|---|---|---|---|---|
| Total Storage Capacity (ac-ft) | 19.65 | 19.69 | 19.75 | 59.08 |
| 10-Year, 24-Hour Storm Inflow (ac-ft) | 19.66 | 1.41 | 9.02 | 30.10 |
| Available Sediment Storage Capacity (ac-ft) | - | - | - | 28.98 |
| Sediment Inflow Rate/Year (ac-ft/yr) | 2.45 | 0.23 | 1.42 | 4.10 |
| Sediment Storage Life (yr) | - | - | - | 7.1 |

* * *

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- N9-A2, N9-A1 & N9-A Proposed Sedimentation Ponds

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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**PEABODY WESTERN COAL COMPANY**
**CALCULATED HYDROLOGIC DATA**

**PROJECT: N-9 MINING AREA**

**STRUCTURE: A2**

***TIME OF CONCENTRATION:***

| | | |
|---|---|---|
| Start Elevation (ft) = | 7190 | |
| End Elevation (ft) = | 6860 | |
| Elevation Difference, E (ft) = | 330 | |
| Watercourse Length (ft) = | 6957 | |
| Watercourse Length (mi) = | 1.318 | |
| Tc = (11.9L^3/E)^0.385 = | 0.383 | hours |

***ROUTING PARAMETERS:***

Between structure routing parameters were calculated using the SCS Upland mathod 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 | 1.931 | 125.515 |
| Pinyon Juniper | D | 83 | 203.638 | 16901.954 |
| Sagebrush | D | 79 | 2.686 | 212.194 |
| Distrubed Land | B | 86 | 81.1 | 6974.6 |
| TOTAL: | | | 289.355 | 24214.263 |

Weighted CN = Total CN * Area / Total Area = 84

Note: During Operations the open pit will collect most of the runoff from disturbed areas. The worst case is when the open pit is reclaimed and runoff from a larger area or regraded soil reports directly to the pond.

***DRAINAGE BASIN AREA:***

289.355 Acres

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**PEABODY WESTERN COAL COMPANY**
**CALCULATED SEDIMENTOLOGY DATA**

**STRUCTURE: A2**

***SOIL ERODIBILITY FACTOR:***

| Soil Type | Erodibility Factor, K | Area | K*Area |
|---|---|---|---|
| 16CE | 0.05 | 1.834 | 0.09 |
| 1AB | 0.16 | 1.042 | 0.17 |
| 2B | 0.43 | 1.955 | 0.84 |
| 3AB | 0.16 | 161.875 | 25.90 |
| 3CD | 0.16 | 17.808 | 2.85 |
| 3F | 0.02 | 23.644 | 0.47 |
| X11C | 0.46 | 0.097 | 0.04 |
| Disturbed | 0.12 | 81.1 | 9.73 |
| | TOTAL | 289.355 | 40.10 |

Weighted K = Total K * Area / Total Area = 0.14

***SLOPE FACTOR:***

| Length (ft) | | Slope (%) | m | Slope Angle (deg) | LS Factor |
|---|---|---|---|---|---|
| 1043 | 110 | 10.55% | 0.60 | 6.02 | 6.24 |
| 1126 | 186 | 16.52% | 0.60 | 9.38 | 11.59 |
| 1257 | 155 | 12.33% | 0.60 | 7.03 | 8.61 |
| 2374 | 254 | 10.70% | 0.60 | 6.11 | 10.44 |
| 3168 | 221 | 6.98% | 0.50 | 3.99 | 5.16 |

Average LS = 8.41

The LS Factor was calculated by:
LS=(Slope Length/72.6)^m*(10.8sin(slope angle)+.03) for slopes < 9%
LS=(Slope Length/72.6)^m*(16.8sin(slope angle)-0.5) for slopes > 9%

Where:

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

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# STRUCTURE: A2

***Cover and Practice Factors:***

| Cover Type | Cover (%) | Canopy (%) | Area (acres) | Cover Factor, C | C * Area | Practive Factor, P | P * Area |
|---|---|---|---|---|---|---|---|
| Pinyon Juniper | 40% | 25% | 205.569 | 0.22 | 45.23 | 1.00 | 205.569 |
| Sagebrush, Grass | 40% | 25% | 2.686 | 0.2 | 0.54 | 1.00 | 2.686 |
| Saltbrush | 40% | 25% | 0 | 0.2 | 0.00 | 1.00 | 0 |
| Disturbed | 0% | 0% | 81.1 | 1 | 81.10 | 0.80 | 64.88 |
| TOTAL: | | | 289.355 | | 126.86 | | 273.14 |

Weighted C = Total C * Area / Total Area = 0.44

Weighted P = Total P * Area / Total Area = 0.94

***RAINFALL FACTOR:***

R= 40

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# PEABODY WESTERN COAL COMPANY
# CALCULATED SEDIMENT YIELD

## STRUCTURE: A2

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

| PARAMETER DESCRIPTION | VALUE | |
|---|---|---|
| Annual Rainfall Factor ( R) | 40.00 | |
| Soil Erodibility Factor (K) | 0.14 | |
| Length Slope Factor (L) | 8.41 | |
| Cover Factor(C) | 0.44 | |
| Practice Factor (P) | 0.94 | |
| Gross Annual Sediment Yield | 19.29 | tons/acre/year |
| | | |
| Sediment Density | 94.00 | pcf |
| Gross Annual Sediment Yield | 0.0094 | acre-feet/acre/year |
| Sediment Delivery Ratio | 90% | |
| Estimated Annual Sediment Yield | 0.0085 | acre-feet/acre/year |
| | | |
| Watershed Area | 289.36 | acres |
| Watershed Annual Sediment Yield | 2.45 | acre-feet/year |
| | | |
| Number of Years | 1.00 | years |
| Calculated Sediment Volume | 2.45 | acre-feet |

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TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION
N9-A2 POND
November 12, 2004

PROGRAM INPUT DATA

| DESCRIPTION | VALUE |
|---|---|
| Flow Rate (cfs) | 198.99 |
| Channel Bottom Slope (ft/ft) | 0.005 |
| Manning's Roughness Coefficient (n-value) | 0.048 |
| Channel Left Side Slope (horizontal/vertical) | 3.0 |
| Channel Right Side Slope (horizontal/vertical) | 3.0 |
| Channel Bottom Width (ft) | 25.0 |

COMPUTATION RESULTS

| DESCRIPTION | VALUE |
|---|---|
| Critical Depth (ft) | 1.19 |
| Critical Slope (ft/ft) | 0.0335 |
| Flow Velocity (fps) | 5.84 |
| Froude Number | 1.0 |
| Velocity Head (ft) | 0.53 |
| Energy Head (ft) | 1.72 |
| Cross-Sectional Area of Flow (sq ft) | 34.08 |
| Top Width of Flow (ft) | 32.15 |

HYDROCALC Hydraulics for Windows, Version 1.2 Copyright (c) 1996
Dodson & Associates, Inc., 5629 FM 1960 West, Suite 314, Houston, TX 77069
Phone:(281)440-3787, Fax:(281)440-4742, Email:software@dodson-hydro.com
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# N9-A2 POND OUTFLOW CHANNEL

## Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 25.00 | 3.0:1 | 3.0:1 | 25.0 | 1.00 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 198.99 cfs | |
| Depth: | 0.80 ft | 1.80 ft |
| Top Width: | 29.82 ft | 35.82 ft |
| Velocity: | 9.03 fps | |
| X-Section Area: | 22.03 sq ft | |
| Hydraulic Radius: | 0.732 | |
| Froude Number: | 1.85 | |
| Manning's n: | 0.0670 | |
| Dmin: | 5.00 in | |
| D50: | 9.00 in | |
| Dmax: | 12.00 in | |

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APPENDIX B

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

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# Peabody Western Coal
# Kayenta Mine
# N9-A2 POND DESIGN
# 10YR 24HR STORM

Gary Altsisi

SEP 2005
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# *General Information*

## *Storm Information:*

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

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## *Structure Summary:*

| | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|
| #1 | 289.360 | 289.360 | 171.66 | 19.66 |

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# *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 | 289.360 | 0.383 | 0.000 | 0.000 | 84.000 | F | 171.66 | 19.664 |
| | $\sum$ | **289.360** | | | | | | **171.66** | **19.664** |

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APPENDIX C

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

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# Peabody Western Coal

# Kayenta Mine

# N9-A2 POND DESIGN

# 25YR 6HR STORM

Gary Altsisi

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# *General Information*

## *Storm Information:*

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

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## *Structure Networking:*

| Type | Stru # | (flows into) | Stru # | Musk. K (hrs) | Musk. X | Description |
|---|---|---|---|---|---|---|
| Pond | #1 | ==> | End | 0.000 | 0.000 | N9-A2 |

*#1*
*Pond*

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## *Structure Summary:*

| | | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|---|
| #1 | In | 289.360 | 289.360 | 198.99 | 16.25 |
| | Out | | | 141.46 | 16.25 |

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# *Structure Detail:*

*Structure #1 (Pond)*

*N9-A2*

Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,878.90 |
| Initial Pool: | 19.65 ac-ft |

Emergency Spillway

| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,878.90 | 45.00 | 3.00:1 | 3.00:1 | 25.00 |

Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,880.58 |
| Dewater Time: | 0.29 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) |
|---|---|---|---|---|
| 6,865.00 | 0.750 | 0.000 | 0.000 | |
| 6,865.50 | 0.798 | 0.387 | 0.000 | |
| 6,866.00 | 0.847 | 0.798 | 0.000 | |
| 6,866.50 | 0.897 | 1.234 | 0.000 | |
| 6,867.00 | 0.949 | 1.695 | 0.000 | |
| 6,867.50 | 1.002 | 2.183 | 0.000 | |
| 6,868.00 | 1.057 | 2.698 | 0.000 | |
| 6,868.50 | 1.113 | 3.240 | 0.000 | |
| 6,869.00 | 1.171 | 3.811 | 0.000 | |
| 6,869.50 | 1.230 | 4.411 | 0.000 | |
| 6,870.00 | 1.291 | 5.042 | 0.000 | |
| 6,870.50 | 1.321 | 5.695 | 0.000 | |
| 6,871.00 | 1.351 | 6.363 | 0.000 | |
| 6,871.50 | 1.382 | 7.046 | 0.000 | |
| 6,872.00 | 1.413 | 7.744 | 0.000 | |
| 6,872.50 | 1.444 | 8.458 | 0.000 | |
| 6,873.00 | 1.475 | 9.188 | 0.000 | |

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| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,873.50 | 1.507 | 9.934 | 0.000 | | |
| 6,874.00 | 1.540 | 10.696 | 0.000 | | |
| 6,874.50 | 1.572 | 11.474 | 0.000 | | |
| 6,875.00 | 1.605 | 12.268 | 0.000 | | |
| 6,875.50 | 1.676 | 13.088 | 0.000 | | |
| 6,876.00 | 1.748 | 13.944 | 0.000 | | |
| 6,876.50 | 1.821 | 14.836 | 0.000 | | |
| 6,877.00 | 1.896 | 15.766 | 0.000 | | |
| 6,877.50 | 1.973 | 16.733 | 0.000 | | |
| 6,878.00 | 2.051 | 17.739 | 0.000 | | |
| 6,878.50 | 2.131 | 18.784 | 0.000 | | |
| 6,878.90 | 2.195 | 19.649 | 0.000 | | Spillway #1 |
| 6,879.00 | 2.191 | 19.869 | 5.563 | 3.35 | |
| 6,879.50 | 2.170 | 20.959 | 33.351 | 2.05 | |
| 6,880.00 | 2.149 | 22.039 | 61.138 | 0.90 | |
| 6,880.50 | 2.244 | 23.137 | 128.257 | 0.55 | |
| 6,880.58 | 2.262 | 23.328 | 141.457 | 0.10 | Peak Stage |
| 6,881.00 | 2.342 | 24.283 | 207.526 | | |
| 6,881.50 | 2.442 | 25.479 | 304.805 | | |
| 6,882.00 | 2.543 | 26.725 | 425.209 | | |
| 6,882.50 | 2.647 | 28.023 | 567.183 | | |
| 6,883.00 | 2.753 | 29.373 | 730.520 | | |
| 6,883.50 | 2.861 | 30.776 | 906.004 | | |
| 6,883.90 | 2.948 | 31.938 | 1,063.874 | | |

## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,865.00 | 0.000 | 0.000 |
| 6,865.50 | 0.000 | 0.000 |
| 6,866.00 | 0.000 | 0.000 |
| 6,866.50 | 0.000 | 0.000 |
| 6,867.00 | 0.000 | 0.000 |
| 6,867.50 | 0.000 | 0.000 |
| 6,868.00 | 0.000 | 0.000 |
| 6,868.50 | 0.000 | 0.000 |
| 6,869.00 | 0.000 | 0.000 |
| 6,869.50 | 0.000 | 0.000 |

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| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,870.00 | 0.000 | 0.000 |
| 6,870.50 | 0.000 | 0.000 |
| 6,871.00 | 0.000 | 0.000 |
| 6,871.50 | 0.000 | 0.000 |
| 6,872.00 | 0.000 | 0.000 |
| 6,872.50 | 0.000 | 0.000 |
| 6,873.00 | 0.000 | 0.000 |
| 6,873.50 | 0.000 | 0.000 |
| 6,874.00 | 0.000 | 0.000 |
| 6,874.50 | 0.000 | 0.000 |
| 6,875.00 | 0.000 | 0.000 |
| 6,875.50 | 0.000 | 0.000 |
| 6,876.00 | 0.000 | 0.000 |
| 6,876.50 | 0.000 | 0.000 |
| 6,877.00 | 0.000 | 0.000 |
| 6,877.50 | 0.000 | 0.000 |
| 6,878.00 | 0.000 | 0.000 |
| 6,878.50 | 0.000 | 0.000 |
| 6,878.90 | 0.000 | 0.000 |
| 6,879.00 | 5.563 | 5.563 |
| 6,879.50 | 33.351 | 33.351 |
| 6,880.00 | 61.138 | 61.138 |
| 6,880.50 | 128.257 | 128.257 |
| 6,881.00 | 207.526 | 207.526 |
| 6,881.50 | 304.805 | 304.805 |
| 6,882.00 | 425.209 | 425.209 |
| 6,882.50 | 567.183 | 567.183 |
| 6,883.00 | 730.520 | 730.520 |
| 6,883.50 | 906.004 | 906.004 |
| 6,883.90 | 1,063.874 | 1,063.874 |

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# *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 | 289.360 | 0.383 | 0.000 | 0.000 | 84.000 | F | 198.99 | 16.251 |
| | $\Sigma$ | **289.360** | | | | | | **198.99** | **16.251** |

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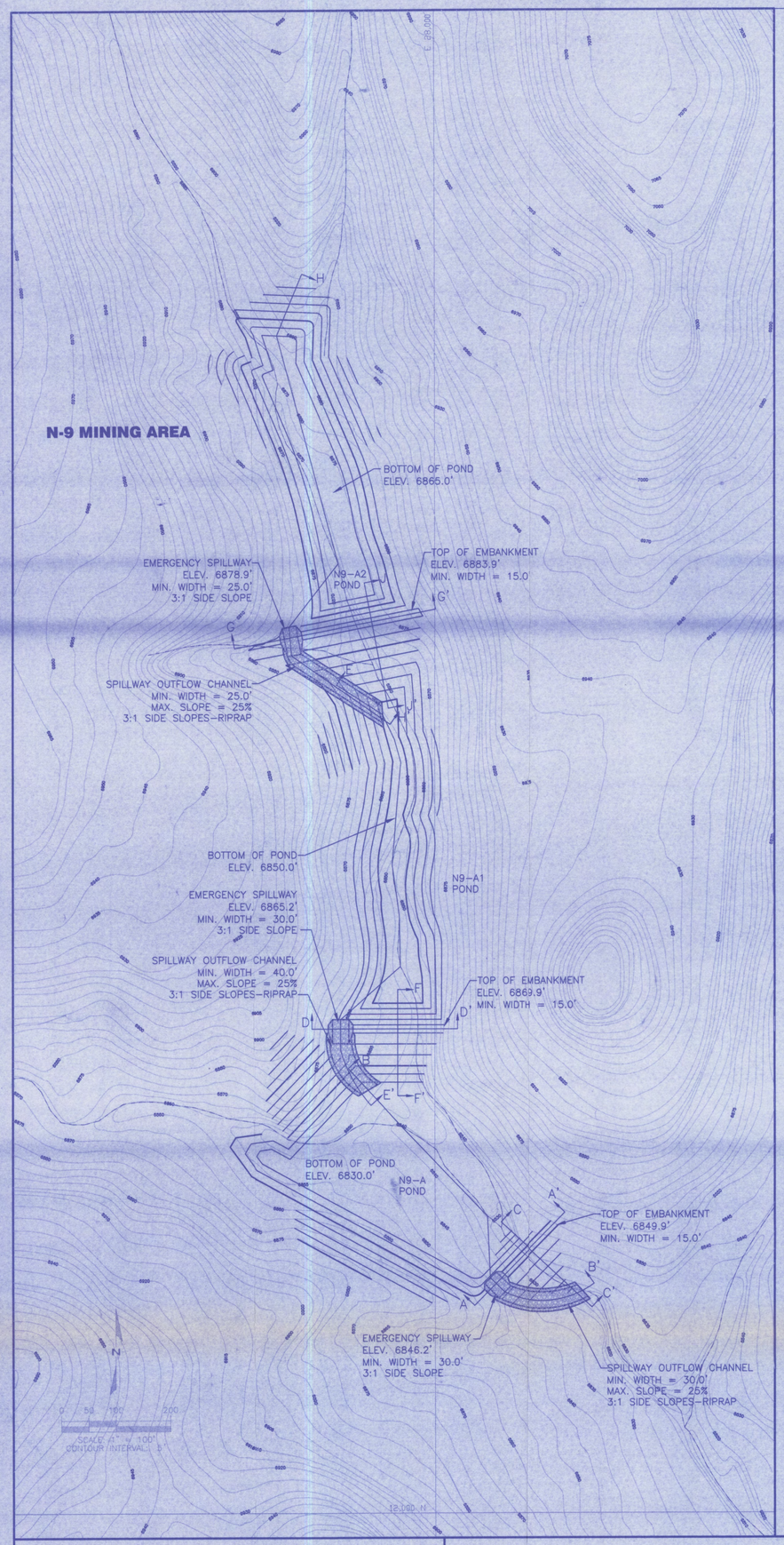



## N9-A POND STAGE CAPACITY TABLE

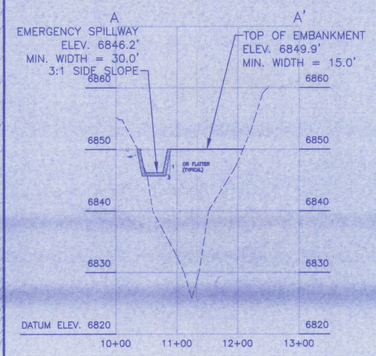
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6830.0 | 0.0 | 0.03 | 0.00 | BOTTOM OF POND |
| 6835.0 | 5.0 | 0.10 | 0.31 | INCISED ELEV. |
| 6840.0 | 10.0 | 2.02 | 5.62 | |
| 6845.0 | 15.0 | 2.43 | 16.76 | |
| 6846.2 | 16.2 | 2.54 | 19.75 | EMERGENCY SPILLWAY |
| 6849.9 | 19.9 | 2.88 | 30.05 | TOP OF EMBANKMENT |

## N9-A1 POND STAGE CAPACITY TABLE

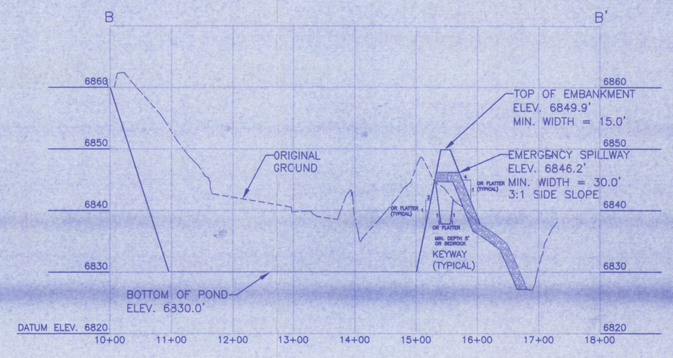
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6850.0 | 0.0 | 0.59 | 0.00 | BOTTOM OF POND |
| 6855.0 | 5.0 | 1.03 | 4.05 | INCISED ELEV. |
| 6860.0 | 10.0 | 1.52 | 10.42 | |
| 6865.0 | 15.0 | 2.03 | 19.28 | |
| 6865.2 | 15.2 | 2.05 | 19.69 | EMERGENCY SPILLWAY |
| 6869.9 | 19.9 | 2.57 | 30.78 | TOP OF EMBANKMENT |

## N9-A2 POND STAGE CAPACITY TABLE

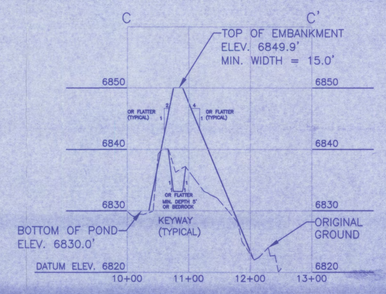
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6865.0 | 0.0 | 0.80 | 0.00 | BOTTOM OF POND |
| 6870.0 | 5.0 | 1.22 | 5.04 | INCISED ELEV. |
| 6875.0 | 10.0 | 1.68 | 12.27 | |
| 6878.9 | 13.9 | 2.11 | 19.65 | EMERGENCY SPILLWAY |
| 6880.0 | 15.0 | 2.23 | 22.04 | |
| 6883.9 | 18.9 | 2.84 | 31.94 | TOP OF EMBANKMENT |




SECTION A – A'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION B – B'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION C – C'
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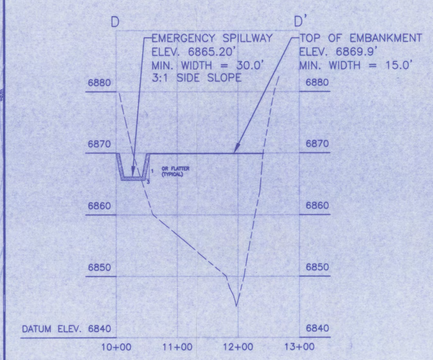


SECTION D – D'
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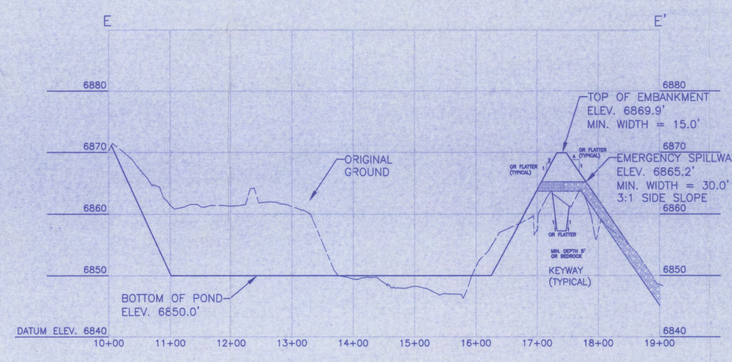
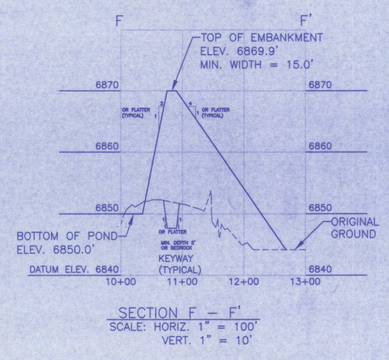
VERT. 1" = 10'




SECTION E – E'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION F – F'
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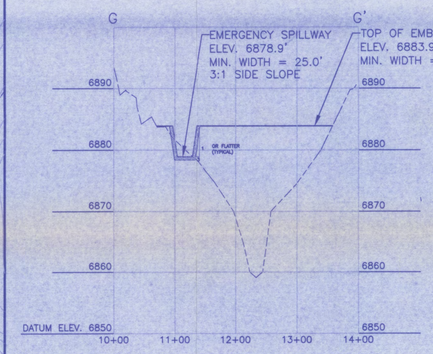
VERT. 1" = 10'




SECTION G – G'
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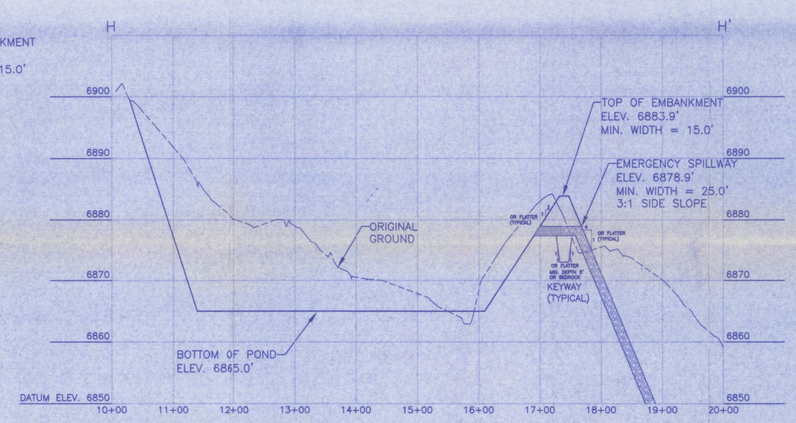
VERT. 1" = 10'




SECTION H – H'
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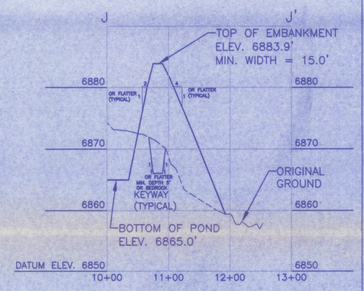
VERT. 1" = 10'




SECTION J – J'
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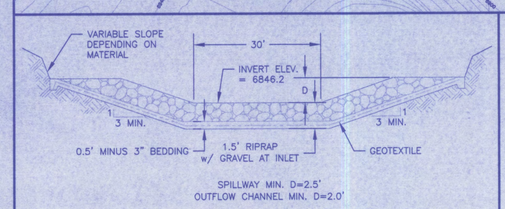
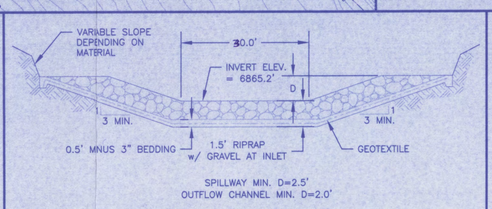
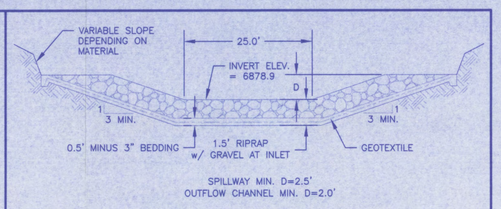
VERT. 1" = 10'




SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-A POND




SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-A1 POND




SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-A2 POND

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ENGINEER'S CERTIFICATION

GAMBLE G. SCHUENVOGT
Engineering Supervisor
Peabody Western Coal Company

ARIZONA P.E. 18788

Date: DEC 23 2004

NOTES:
1) General location, see Drawing No. 85400, Sheet K-6 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the distrubed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.


WOODSON
ENGINEERING AND SURVEYING, INC.
124 N. ELDEN ST.
FLAGSTAFF, AZ 86001
PHONE: (928) 774-4636 FAX: (928) 774-4646


EXHIBIT # 1
PROPOSED N9-A, A1 & A2
SEDIMENTATION POND DESIGN

KAYENTA MINE
PEABODY WESTERN COAL COMPANY
P. O. BOX 650 KAYENTA, ARIZONA 86033

| | |
|---|---|
| DESIGNED BY: GA | SCALE: AS NOTED |
| DRAWN BY: PEK | DRAWING DATE: 11-22-04 |
| CHECKED BY: JGS | PHOTO DATE: 11-84 |
| CONTOUR INTERVAL: 5 FT. | DWG FILE: POND N9-A,A1,A2.DWG |

DESIGN REPORT

Temporary Sedimentation Structure

N9-B (Lower)

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

SEP 2005 APPROVED

Registered Professional Engineer (Civil) CERTIFICATE NO. 18782 JAMES DEAN SCHLENVOGT Date Signed ARIZONA, U.S.A.

James D. Schlenvogt

DEC 23 2004

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TABLE OF CONTENTS


Page

INTRODUCTION ..... 1

INSPECTION ..... 1

SITE DESCRIPTION ..... 2

LAND USE ..... 2

DESIGN ANALYSES ..... 2

GENERAL ..... 2

STABILITY ..... 2

HYDROLOGY ..... 3

HYDRAULICS ..... 4

EMERGENCY SPILLWAY AND OUTLET CHANNEL ..... 6

STORAGE CAPACITY ..... 6

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) 100-Year, 6-Hour Storm Event
EXHIBIT #1 -N9-B2, N9-B1, and N9-B Proposed Sedimentation Ponds



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## INTRODUCTION

Sedimentation Structure N9-B will be an earthen embankment, designed and constructed by Peabody Western Coal Company (PWCC) as a temporary sedimentation structure to control runoff and sediment from portions of the N9 disturbed surface mining area at the Kayenta Mine. The location of Structure N9-B and its watershed boundary are shown on Drawing No. 85400, (Sheet K-6), 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 N9-B that is in series with sedimentation structures N9-B1 & N9-B2. N9-B is the lower pond in the series. 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 N9-B was inspected in October, 2004 by a Registered Professional Engineer from Woodson Engineering, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. 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.

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## SITE DESCRIPTION

### LAND USE

The N9-B, N9-B1 and N9-B2 Structures have a combined watershed of 433.57 acres and are located on a tributary upstream of Yellow Water Canyon Wash at the Kayenta Mine. The 74.34-acre watershed, which contributes directly to structure N9-B, is classified as 100% spoil.

## DESIGN ANALYSES

### GENERAL

Structure N9-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 1983 for Peabody Western Coal Company and was used in the analyses of the structure.

### STABILITY

Structure N9-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 15 feet wide on top. A minimum upstream slope of 2H: 1V and minimum downstream slope of 4H: 1V were assumed. Based on the total embankment height of approximately 17.4 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 35-foot wide, riprap-lined, trapezoidal channel.

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HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure N9-B will be constructed in series with proposed Structures N9-B1 and N9-B2. Structure N9-B is the lower pond in the series and 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 three structures have a combined capacity greater than 20 acre-feet; therefore, the spillway was analyzed using the 100-year, 6-hour storm event in lieu of the 25-year, 6-hour storm. The structure was conservatively assumed to be full to the emergency spillway at the time of 100-year storm event. The storage capacity of structure N9-B was analyzed using the 10-year, 24-hour storm event. The combined ponds in series were verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Yellow Water Canyon Wash.

The following parameters were used in the hydrologic analysis:

| | | |
|---|---|---|
| 1. | Water Course length, L | 0.067 mi. |
| 2. | Elevation Difference, H | 12 ft |
| 3. | Time of Concentration, $T_c$ | 0.044 hr |
| 4. | NRCS Curve Number | 86 |
| 5. | Rainfall Depth, 10-year, 24-hour storm<br>100-year, 6-hour storm | 2.1 in<br>2.4 in |
| 6. | Drainage Area | 74.34 acres |

Values reported represent the watershed, which drains directly to Pond N9-B. Hydrologic input parameters for structure N9-B1 and N9-B2 are presented in separate design reports.

Muskingum routing parameters were utilized to route the 100-year hydrographs between the three structures. The routing parameters are presented in Appendices B and C, and are shown on a sub-watershed basis.

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HYDRAULICS

The SEDCAD4 and HYDROCALC 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).

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## N9-B SEDIMENTATION POND HYDRAULICS TABLE

| | Units | 10-Yr, 24-Hr Storm | 100-Yr, 6-Hr Storm |
|---|---|---|---|
| Initial Reservoir Volume Condition | | Empty | Full to emergency spillway |
| Inflow | | | |
| Peak Flow | cfs | 74.61 | 313.28 |
| Volume | ac-ft | 5.73 | 37.97 |
| Storage | | | |
| Peak Stage | msl | N/A | 6694.5 |
| Emerg. Spillway Elev. | msl | 6692.4 | 6692.4 |
| Peak Storage | ac-ft | N/A | 24.2 |
| Storage Capacity | ac-ft | 19.56 | 19.56 |
| Outflow | | | |
| Peak Flow | cfs | N/A | 286.7 |
| Spillway Elevation | msl | 6692.4 | 6692.4 |
| Embankment Crest Elev. | msl | 6697.4 | 6697.4 |
| Peak Stage | msl | -- | 6694.5 |
| Freeboard | ft | -- | 2.9 |
| Emergency Spillway Channel | | | |
| Flow Depth | ft | -- | 2.1 |
| Critical Velocity | fps | -- | 6.2 |
| Mannings "n" | -- | -- | 0.048 |
| Width | ft | -- | 35 |
| Outflow Channel | | | |
| Slope | % | -- | 25 |
| Normal Velocity | fps | -- | 9.8 |
| Normal Depth | ft | -- | 0.9 |
| Mannings "n" | -- | -- | 0.065 |
| Riprap $D_{50}$ | in | -- | 9 |

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for N9-B will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

| | | | |
|---|---|---|---|
| Minimum Channel Depth | (Spillway) | 2.5 | ft |
| | (Outflow) | 2.0 | ft |
| Channel Width | | 35 | ft |
| Channel Length | (Spillway) | 45 | ft |
| | (Outflow) | 156 | ft |
| Sideslopes (Horizontal to Vertical) | | 3:1 | or flatter |
| Average Slope | (Spillway) | 0 | % |
| Maximum Slope | (Outflow) | 25 | % |
| Spillway Elevation | | 6692.4 | 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 1983 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-B is designed to contain approximately 19.56 acre-feet.

The calculations for the sediment load entering structure N9-B were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

| | | |
|---|---|---|
| 1. | Rainfall Factor, R | 40 |
| 2. | Soil Erodibility Factor, K | 0.12 |
| 3. | Slope Factor, LS | 5.44 |
| 4. | Cover Factor, C | 1.0 |
| 5. | Erosion Control Factor, P | 0.8 |

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The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. Structure N9-B has sufficient storage capacity to contain the 10-year, 24-hour storm and has additional capacity to store excess runoff from the N9-B1 and N9-B2 watersheds. The combined storage capacity was determined for all three structures in series and the results of the analysis are presented in the following table.

Combined Storage for Structures N9-B2, N9-B1 and N9-B

| | N9-B2 (Upper) | N9-B1 (Middle) | N9-B (Lower) | COMBINED |
|---|---|---|---|---|
| Total Storage Capacity (ac-ft) | 19.55 | 19.58 | 19.56 | 58.69 |
| 10-Year, 24-Hour Storm Inflow(ac-ft) | 8.80 | 15.34 | 5.73 | 29.86 |
| Available Sediment Storage Capacity | - | - | - | 28.83 |
| Sediment Inflow Rate/Year (ac-ft/yr) | 1.37 | 1.77 | 0.68 | 3.82 |
| Sediment Storage Life (yr) | - | - | - | 7.5 |

* * *

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) 100-Year, 6-Hour Storm Event

Exhibit #1- N9-B2, N9-B1and N9-B Proposed Sedimentation Ponds

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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**PEABODY WESTERN COAL COMPANY**
**CALCULATED HYDROLOGIC DATA**

**PROJECT: N-9 MINING AREA**

**STRUCTURE: B**

***TIME OF CONCENTRATION:***

| | | |
|---|---|---|
| Start Elevation (ft) = | 6695 | |
| End Elevation (ft) = | 6683 | |
| Elevation Difference, E (ft) = | 12 | |
| Watercourse Length (ft) = | 352 | |
| Watercourse Length (mi) = | 0.067 | |
| Tc = (11.9L^3/E)^0.385 = | 0.044 | hours |

***ROUTING PARAMETERS:***

Between structure routing parameters were calculated using the SCS Upland mathod 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 | D | 83 | 0.058 | 4.814 |
| Saltbrush | D | 79 | 0.009 | 0.711 |
| Distrubed Land | B | 86 | 74.27 | 6387.22 |
| TOTAL: | | | 74.337 | 6392.745 |

Weighted CN = Total CN * Area / Total Area = 86

Note: During Operations the open pit will collect most of the runoff from disturbed areas. The worst case is when the open pit is reclaimed and runoff from a larger area or regraded soil reports directly to the pond.

***DRAINAGE BASIN AREA:*** 74.337 Acres

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# PEABODY WESTERN COAL COMPANY
# CALCULATED SEDIMENTOLOGY DATA

## STRUCTURE: B

***SOIL ERODIBILITY FACTOR:***

| Soil Type | Erodibility Factor, K | Area | K*Area |
|---|---|---|---|
| 3F | 0.02 | 0.067 | 0.00 |
| Disturbed | 0.12 | 74.27 | 8.91 |
| | TOTAL | 74.337 | 8.91 |

Weighted K = Total K * Area / Total Area = 0.12

***SLOPE FACTOR:***

| Length (ft) | | Slope (%) | m | Slope Angle (deg) | LS Factor |
|---|---|---|---|---|---|
| 391 | 50 | 12.79% | 0.60 | 7.29 | 4.48 |
| 302 | 65 | 21.52% | 0.60 | 12.15 | 7.14 |
| 312 | 60 | 19.23% | 0.60 | 10.89 | 6.41 |
| 412 | 45 | 10.92% | 0.60 | 6.23 | 3.75 |

Average LS = 5.45

The LS Factor was calculated by:
LS=(Slope Length/72.6)^m*(10.8sin(slope angle)+.03) for slopes < 9%
LS=(Slope Length/72.6)^m*(16.8sin(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 |

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# STRUCTURE: B

***Cover and Practice Factors:***

| Cover Type | Cover (%) | Canopy (%) | Area (acres) | Cover Factor, C | C * Area | Practive Factor, P | P * Area |
|---|---|---|---|---|---|---|---|
| Pinyon Juniper | 40% | 25% | 0.058 | 0.22 | 0.01 | 1.00 | 0.058 |
| Sagebrush, Grass | 40% | 25% | 0 | 0.2 | 0.00 | 1.00 | 0 |
| Saltbrush | 40% | 25% | 0.009 | 0.2 | 0.00 | 1.00 | 0.009 |
| Disturbed | 0% | 0% | 74.27 | 1 | 74.27 | 0.80 | 59.416 |
| TOTAL: | | | 74.337 | | 74.28 | | 59.48 |

Weighted C = Total C * Area / Total Area = 1.00

Weighted P = Total P * Area / Total Area = 0.80

***RAINFALL FACTOR:***

R= 40

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# PEABODY WESTERN COAL COMPANY
# CALCULATED SEDIMENT YIELD

## STRUCTURE: B

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

| PARAMETER DESCRIPTION | VALUE |
|---|---|
| Annual Rainfall Factor ( R) | 40.00 |
| Soil Erodibility Factor (K) | 0.12 |
| Length Slope Factor (L) | 5.45 |
| Cover Factor(C) | 1.00 |
| Practice Factor (P) | 0.80 |
| Gross Annual Sediment Yield | 20.89 tons/acre/year |
| | |
| Sediment Density | 94.00 pcf |
| Gross Annual Sediment Yield | 0.0102 acre-feet/acre/year |
| Sediment Delivery Ratio | 90% |
| Estimated Annual Sediment Yield | 0.0092 acre-feet/acre/year |
| | |
| Watershed Area | 74.34 acres |
| Watershed Annual Sediment Yield | 0.68 acre-feet/year |
| | |
| Number of Years | 1.00 years |
| Calculated Sediment Volume | 0.68 acre-feet |

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TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION
N9-B POND
November 16, 2004

PROGRAM INPUT DATA

| DESCRIPTION | VALUE |
|---|---|
| Flow Rate (cfs) | 313.28 |
| Channel Bottom Slope (ft/ft) | 0.005 |
| Manning's Roughness Coefficient (n-value) | 0.048 |
| Channel Left Side Slope (horizontal/vertical) | 3.0 |
| Channel Right Side Slope (horizontal/vertical) | 3.0 |
| Channel Bottom Width (ft) | 35.0 |

COMPUTATION RESULTS

| DESCRIPTION | VALUE |
|---|---|
| Critical Depth (ft) | 1.3 |
| Critical Slope (ft/ft) | 0.0321 |
| Flow Velocity (fps) | 6.17 |
| Froude Number | 1.0 |
| Velocity Head (ft) | 0.59 |
| Energy Head (ft) | 1.9 |
| Cross-Sectional Area of Flow (sq ft) | 50.74 |
| Top Width of Flow (ft) | 42.82 |

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# N9-B POND OUTFLOW CHANNEL

## Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 35.00 | 3.0:1 | 3.0:1 | 25.0 | 4.15 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 313.28 cfs | |
| Depth: | 0.85 ft | 5.00 ft |
| Top Width: | 40.10 ft | 65.00 ft |
| Velocity: | 9.80 fps | |
| X-Section Area: | 31.95 sq ft | |
| Hydraulic Radius: | 0.791 | |
| Froude Number: | 1.94 | |
| Manning's n: | 0.0650 | |
| Dmin: | 5.00 in | |
| D50: | 9.00 in | |
| Dmax: | 12.00 in | |

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APPENDIX B

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

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# Peabody Western Coal
# Kayenta Mine
# N9-B POND DESIGN
# 10YR 24HR STORM

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Gary Altsisi

# *General Information*

## *Storm Information:*

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

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## *Structure Summary:*

| | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|
| #1 | 74.340 | 74.340 | 74.61 | 5.73 |

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# *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 | 74.340 | 0.044 | 0.000 | 0.000 | 86.000 | F | 74.61 | 5.733 |
| | $\sum$ | **74.340** | | | | | | **74.61** | **5.733** |

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APPENDIX C

SEDCAD4 (Input and Output) 100-Year, 6-Hour Storm Event

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# Peabody Western Coal
# Kayenta Mine
# N9-B POND DESIGN
# 100YR 6HR STORM

Gary Altsisi

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# *General Information*

## *Storm Information:*

| | |
|---|---|
| Storm Type: | NRCS Type II |
| Design Storm: | 100 yr - 6 hr |
| Rainfall Depth: | 2.400 inches |

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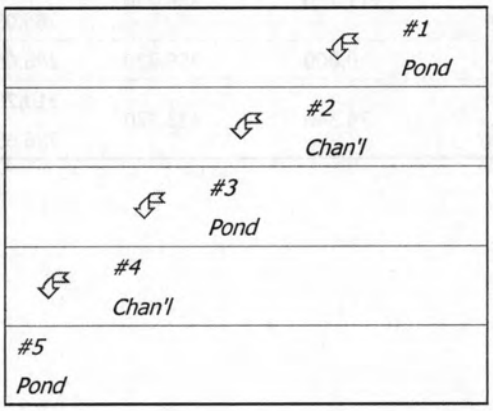
# *Structure Networking:*

| Type | Stru # | (flows into) | Stru # | Musk. K (hrs) | Musk. X | Description |
|---|---|---|---|---|---|---|
| Pond | #1 | ==> | #2 | 0.000 | 0.000 | N9-B2 POND |
| Channel | #2 | ==> | #3 | 0.000 | 0.000 | N9-B2 SPILLWAY |
| Pond | #3 | ==> | #4 | 0.000 | 0.000 | N9-B1 POND |
| Channel | #4 | ==> | #5 | 0.000 | 0.000 | N9-B1 SPILLWAY |
| Pond | #5 | ==> | End | 0.000 | 0.000 | N9-B POND |

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## *Structure Summary:*

| | | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|---|
| #1 | In | 147.510 | 147.510 | 155.58 | 11.37 |
| | Out | | | 101.19 | 11.38 |
| #2 | | 0.000 | 147.510 | 101.19 | 11.37 |
| #3 | In | 211.720 | 359.230 | 323.66 | 30.77 |
| | Out | | | 286.05 | 30.77 |
| #4 | | 0.000 | 359.230 | 286.05 | 30.77 |
| #5 | In | 74.340 | 433.570 | 313.28 | 37.97 |
| | Out | | | 286.65 | 37.97 |

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# *Structure Detail:*

*Structure #1 (Pond)*

*N9-B2 POND*

Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,776.80 |
| Initial Pool: | 19.55 ac-ft |

Emergency Spillway

| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,776.80 | 34.20 | 3.00:1 | 3.00:1 | 20.00 |

Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,778.32 |
| Dewater Time: | 0.36 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) |
|---|---|---|---|---|
| 6,760.00 | 0.475 | 0.000 | 0.000 | |
| 6,760.50 | 0.514 | 0.247 | 0.000 | |
| 6,761.00 | 0.554 | 0.514 | 0.000 | |
| 6,761.50 | 0.596 | 0.802 | 0.000 | |
| 6,762.00 | 0.640 | 1.111 | 0.000 | |
| 6,762.50 | 0.685 | 1.442 | 0.000 | |
| 6,763.00 | 0.731 | 1.796 | 0.000 | |
| 6,763.50 | 0.779 | 2.173 | 0.000 | |
| 6,764.00 | 0.829 | 2.575 | 0.000 | |
| 6,764.50 | 0.880 | 3.002 | 0.000 | |
| 6,765.00 | 0.932 | 3.455 | 0.000 | |
| 6,765.50 | 0.959 | 3.928 | 0.000 | |
| 6,766.00 | 0.985 | 4.414 | 0.000 | |
| 6,766.50 | 1.012 | 4.913 | 0.000 | |
| 6,767.00 | 1.039 | 5.426 | 0.000 | |
| 6,767.50 | 1.067 | 5.953 | 0.000 | |
| 6,768.00 | 1.095 | 6.493 | 0.000 | |

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| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,768.50 | 1.124 | 7.048 | 0.000 | | |
| 6,769.00 | 1.152 | 7.617 | 0.000 | | |
| 6,769.50 | 1.181 | 8.200 | 0.000 | | |
| 6,770.00 | 1.211 | 8.798 | 0.000 | | |
| 6,770.50 | 1.264 | 9.417 | 0.000 | | |
| 6,771.00 | 1.318 | 10.062 | 0.000 | | |
| 6,771.50 | 1.374 | 10.735 | 0.000 | | |
| 6,772.00 | 1.430 | 11.437 | 0.000 | | |
| 6,772.50 | 1.488 | 12.166 | 0.000 | | |
| 6,773.00 | 1.547 | 12.925 | 0.000 | | |
| 6,773.50 | 1.607 | 13.713 | 0.000 | | |
| 6,774.00 | 1.668 | 14.532 | 0.000 | | |
| 6,774.50 | 1.731 | 15.382 | 0.000 | | |
| 6,775.00 | 1.794 | 16.263 | 0.000 | | |
| 6,775.50 | 1.812 | 17.164 | 0.000 | | |
| 6,776.00 | 1.829 | 18.075 | 0.000 | | |
| 6,776.50 | 1.847 | 18.994 | 0.000 | | |
| 6,776.80 | 1.858 | 19.549 | 0.000 | | Spillway #1 |
| 6,777.00 | 1.890 | 19.924 | 6.305 | 5.15 | |
| 6,777.50 | 1.971 | 20.890 | 22.053 | 2.20 | |
| 6,778.00 | 2.054 | 21.896 | 63.313 | 0.95 | |
| 6,778.32 | 2.110 | 22.573 | 101.195 | 0.40 | Peak Stage |
| 6,778.50 | 2.139 | 22.944 | 121.954 | | |
| 6,779.00 | 2.226 | 24.036 | 193.061 | | |
| 6,779.50 | 2.314 | 25.170 | 282.223 | | |
| 6,780.00 | 2.404 | 26.350 | 391.648 | | |

## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,760.00 | 0.000 | 0.000 |
| 6,760.50 | 0.000 | 0.000 |
| 6,761.00 | 0.000 | 0.000 |
| 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 |

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| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 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 | 0.000 | 0.000 |
| 6,770.50 | 0.000 | 0.000 |
| 6,771.00 | 0.000 | 0.000 |
| 6,771.50 | 0.000 | 0.000 |
| 6,772.00 | 0.000 | 0.000 |
| 6,772.50 | 0.000 | 0.000 |
| 6,773.00 | 0.000 | 0.000 |
| 6,773.50 | 0.000 | 0.000 |
| 6,774.00 | 0.000 | 0.000 |
| 6,774.50 | 0.000 | 0.000 |
| 6,775.00 | 0.000 | 0.000 |
| 6,775.50 | 0.000 | 0.000 |
| 6,776.00 | 0.000 | 0.000 |
| 6,776.50 | 0.000 | 0.000 |
| 6,776.80 | 0.000 | 0.000 |
| 6,777.00 | 6.305 | 6.305 |
| 6,777.50 | 22.053 | 22.053 |
| 6,778.00 | 0.000 | 63.313 |
| 6,778.50 | 0.000 | 121.954 |
| 6,779.00 | 0.000 | 193.061 |
| 6,779.50 | 0.000 | 282.223 |
| 6,780.00 | 0.000 | 391.648 |

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*Structure #2 (Riprap Channel)*

*N9-B2 SPILLWAY*

Trapezoidal Riprap Channel Inputs:

Material: Riprap

| Bottom Width (ft)} | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 20.00 | 3.0:1 | 3.0:1 | 25.0 | 2.62 | | |

Riprap Channel Results:

PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 101.19 cfs | |
| Depth: | 0.57 ft | 3.19 ft |
| Top Width: | 23.45 ft | 39.17 ft |
| Velocity: | 8.11 fps | |
| X-Section Area: | 12.48 sq ft | |
| Hydraulic Radius: | 0.528 | |
| Froude Number: | 1.96 | |
| Manning's n: | 0.0600 | |
| Dmin: | 3.00 in | |
| D50: | 6.00 in | |
| Dmax: | 9.00 in | |

*Structure #3 (Pond)*

*N9-B1 POND*

Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,703.60 |
| Initial Pool: | 19.58 ac-ft |

Emergency Spillway

| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,703.60 | 45.00 | 3.00:1 | 3.00:1 | 35.00 |

Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,705.72 |
| Dewater Time: | 0.38 days |

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

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Elevation-Capacity-Discharge Table

| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,690.00 | 1.000 | 0.000 | 0.000 | | |
| 6,690.50 | 1.032 | 0.508 | 0.000 | | |
| 6,691.00 | 1.064 | 1.032 | 0.000 | | |
| 6,691.50 | 1.097 | 1.572 | 0.000 | | |
| 6,692.00 | 1.130 | 2.129 | 0.000 | | |
| 6,692.50 | 1.164 | 2.702 | 0.000 | | |
| 6,693.00 | 1.198 | 3.293 | 0.000 | | |
| 6,693.50 | 1.233 | 3.900 | 0.000 | | |
| 6,694.00 | 1.268 | 4.525 | 0.000 | | |
| 6,694.50 | 1.304 | 5.168 | 0.000 | | |
| 6,695.00 | 1.340 | 5.829 | 0.000 | | |
| 6,695.50 | 1.367 | 6.506 | 0.000 | | |
| 6,696.00 | 1.394 | 7.196 | 0.000 | | |
| 6,696.50 | 1.421 | 7.900 | 0.000 | | |
| 6,697.00 | 1.449 | 8.617 | 0.000 | | |
| 6,697.50 | 1.476 | 9.348 | 0.000 | | |
| 6,698.00 | 1.504 | 10.093 | 0.000 | | |
| 6,698.50 | 1.533 | 10.853 | 0.000 | | |
| 6,699.00 | 1.561 | 11.626 | 0.000 | | |
| 6,699.50 | 1.590 | 12.414 | 0.000 | | |
| 6,700.00 | 1.619 | 13.216 | 0.000 | | |
| 6,700.50 | 1.660 | 14.036 | 0.000 | | |
| 6,701.00 | 1.701 | 14.876 | 0.000 | | |
| 6,701.50 | 1.742 | 15.737 | 0.000 | | |
| 6,702.00 | 1.784 | 16.618 | 0.000 | | |
| 6,702.50 | 1.826 | 17.521 | 0.000 | | |
| 6,703.00 | 1.869 | 18.444 | 0.000 | | |
| 6,703.50 | 1.912 | 19.390 | 0.000 | | |
| 6,703.60 | 1.921 | 19.582 | 0.000 | | Spillway #1 |
| 6,704.00 | 1.935 | 20.353 | 25.197 | 5.95 | |
| 6,704.50 | 1.952 | 21.324 | 56.700 | 1.90 | |
| 6,705.00 | 1.969 | 22.304 | 136.422 | 0.75 | |
| 6,705.50 | 2.086 | 23.318 | 235.292 | 0.35 | |
| 6,705.72 | 2.138 | 23.780 | 286.048 | 0.15 | Peak Stage |
| 6,706.00 | 2.206 | 24.391 | 353.166 | | |
| 6,706.50 | 2.329 | 25.524 | 498.252 | | |
| 6,707.00 | 2.456 | 26.720 | 669.401 | | |
| 6,707.50 | 2.586 | 27.981 | 868.331 | | |
| 6,708.00 | 2.719 | 29.307 | 1,081.005 | | |
| 6,708.50 | 2.856 | 30.701 | 1,318.253 | | |
| 6,708.60 | 2.884 | 30.988 | 1,368.679 | | |

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## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,690.00 | 0.000 | 0.000 |
| 6,690.50 | 0.000 | 0.000 |
| 6,691.00 | 0.000 | 0.000 |
| 6,691.50 | 0.000 | 0.000 |
| 6,692.00 | 0.000 | 0.000 |
| 6,692.50 | 0.000 | 0.000 |
| 6,693.00 | 0.000 | 0.000 |
| 6,693.50 | 0.000 | 0.000 |
| 6,694.00 | 0.000 | 0.000 |
| 6,694.50 | 0.000 | 0.000 |
| 6,695.00 | 0.000 | 0.000 |
| 6,695.50 | 0.000 | 0.000 |
| 6,696.00 | 0.000 | 0.000 |
| 6,696.50 | 0.000 | 0.000 |
| 6,697.00 | 0.000 | 0.000 |
| 6,697.50 | 0.000 | 0.000 |
| 6,698.00 | 0.000 | 0.000 |
| 6,698.50 | 0.000 | 0.000 |
| 6,699.00 | 0.000 | 0.000 |
| 6,699.50 | 0.000 | 0.000 |
| 6,700.00 | 0.000 | 0.000 |
| 6,700.50 | 0.000 | 0.000 |
| 6,701.00 | 0.000 | 0.000 |
| 6,701.50 | 0.000 | 0.000 |
| 6,702.00 | 0.000 | 0.000 |
| 6,702.50 | 0.000 | 0.000 |
| 6,703.00 | 0.000 | 0.000 |
| 6,703.50 | 0.000 | 0.000 |
| 6,703.60 | 0.000 | 0.000 |
| 6,704.00 | 25.197 | 25.197 |
| 6,704.50 | 56.700 | 56.700 |
| 6,705.00 | 136.422 | 136.422 |
| 6,705.50 | 235.292 | 235.292 |
| 6,706.00 | 353.166 | 353.166 |
| 6,706.50 | 498.252 | 498.252 |
| 6,707.00 | 669.401 | 669.401 |
| 6,707.50 | 868.331 | 868.331 |
| 6,708.00 | 0.000 | 1,081.005 |

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| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,708.50 | 0.000 | 1,318.253 |
| 6,708.60 | 0.000 | 1,368.679 |

*Structure #4 (Riprap Channel)*

*N9-B1 SPILLWAY*

Trapezoidal Riprap Channel Inputs:

Material: Riprap

| Bottom Width (ft)} | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 35.00 | 3.0:1 | 3.0:1 | 25.0 | 4.19 | | |

Riprap Channel Results:

PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 286.05 cfs | |
| Depth: | 0.81 ft | 5.00 ft |
| Top Width: | 39.88 ft | 65.02 ft |
| Velocity: | 9.39 fps | |
| X-Section Area: | 30.46 sq ft | |
| Hydraulic Radius: | 0.759 | |
| Froude Number: | 1.89 | |
| Manning's n: | 0.0660 | |
| Dmin: | 5.00 in | |
| D50: | 9.00 in | |
| Dmax: | 12.00 in | |

*Structure #5 (Pond)*

*N9-B POND*

Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,692.40 |
| Initial Pool: | 19.56 ac-ft |

Emergency Spillway

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| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,692.40 | 45.00 | 3.00:1 | 3.00:1 | 35.00 |

Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,694.53 |
| Dewater Time: | 0.40 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) | |
|---|---|---|---|---|---|
| 6,680.00 | 1.000 | 0.000 | 0.000 | | |
| 6,680.50 | 1.059 | 0.515 | 0.000 | | |
| 6,681.00 | 1.120 | 1.060 | 0.000 | | |
| 6,681.50 | 1.183 | 1.635 | 0.000 | | |
| 6,682.00 | 1.247 | 2.243 | 0.000 | | |
| 6,682.50 | 1.313 | 2.883 | 0.000 | | |
| 6,683.00 | 1.381 | 3.557 | 0.000 | | |
| 6,683.50 | 1.451 | 4.265 | 0.000 | | |
| 6,684.00 | 1.522 | 5.008 | 0.000 | | |
| 6,684.50 | 1.595 | 5.787 | 0.000 | | |
| 6,685.00 | 1.669 | 6.603 | 0.000 | | |
| 6,685.50 | 1.667 | 7.437 | 0.000 | | |
| 6,686.00 | 1.664 | 8.270 | 0.000 | | |
| 6,686.50 | 1.661 | 9.101 | 0.000 | | |
| 6,687.00 | 1.659 | 9.931 | 0.000 | | |
| 6,687.50 | 1.656 | 10.760 | 0.000 | | |
| 6,688.00 | 1.653 | 11.587 | 0.000 | | |
| 6,688.50 | 1.650 | 12.413 | 0.000 | | |
| 6,689.00 | 1.648 | 13.237 | 0.000 | | |
| 6,689.50 | 1.645 | 14.060 | 0.000 | | |
| 6,690.00 | 1.642 | 14.882 | 0.000 | | |
| 6,690.50 | 1.765 | 15.734 | 0.000 | | |
| 6,691.00 | 1.892 | 16.648 | 0.000 | | |
| 6,691.50 | 2.024 | 17.626 | 0.000 | | |
| 6,692.00 | 2.160 | 18.672 | 0.000 | | |
| 6,692.40 | 2.272 | 19.558 | 0.000 | | Spillway #1 |
| 6,692.50 | 2.265 | 19.785 | 7.649 | 5.20 | |
| 6,693.00 | 2.232 | 20.909 | 45.856 | 1.75 | |
| 6,693.50 | 2.199 | 22.017 | 84.064 | 1.50 | |

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| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,694.00 | 2.167 | 23.108 | 174.574 | 0.60 | |
| 6,694.50 | 2.135 | 24.184 | 279.950 | 0.40 | |
| 6,694.53 | 2.133 | 24.239 | 286.654 | 0.05 | Peak Stage |
| 6,695.00 | 2.103 | 25.243 | 407.605 | | |
| 6,695.50 | 2.263 | 26.334 | 563.656 | | |
| 6,696.00 | 2.429 | 27.507 | 745.489 | | |
| 6,696.50 | 2.600 | 28.764 | 952.365 | | |
| 6,697.00 | 2.778 | 30.108 | 1,172.390 | | |
| 6,697.40 | 2.924 | 31.248 | 1,368.679 | | |

## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,680.00 | 0.000 | 0.000 |
| 6,680.50 | 0.000 | 0.000 |
| 6,681.00 | 0.000 | 0.000 |
| 6,681.50 | 0.000 | 0.000 |
| 6,682.00 | 0.000 | 0.000 |
| 6,682.50 | 0.000 | 0.000 |
| 6,683.00 | 0.000 | 0.000 |
| 6,683.50 | 0.000 | 0.000 |
| 6,684.00 | 0.000 | 0.000 |
| 6,684.50 | 0.000 | 0.000 |
| 6,685.00 | 0.000 | 0.000 |
| 6,685.50 | 0.000 | 0.000 |
| 6,686.00 | 0.000 | 0.000 |
| 6,686.50 | 0.000 | 0.000 |
| 6,687.00 | 0.000 | 0.000 |
| 6,687.50 | 0.000 | 0.000 |
| 6,688.00 | 0.000 | 0.000 |
| 6,688.50 | 0.000 | 0.000 |
| 6,689.00 | 0.000 | 0.000 |
| 6,689.50 | 0.000 | 0.000 |
| 6,690.00 | 0.000 | 0.000 |
| 6,690.50 | 0.000 | 0.000 |
| 6,691.00 | 0.000 | 0.000 |
| 6,691.50 | 0.000 | 0.000 |
| 6,692.00 | 0.000 | 0.000 |

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| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,692.40 | 0.000 | 0.000 |
| 6,692.50 | 7.649 | 7.649 |
| 6,693.00 | 45.856 | 45.856 |
| 6,693.50 | 84.064 | 84.064 |
| 6,694.00 | 174.574 | 174.574 |
| 6,694.50 | 279.950 | 279.950 |
| 6,695.00 | 407.605 | 407.605 |
| 6,695.50 | 563.656 | 563.656 |
| 6,696.00 | 745.489 | 745.489 |
| 6,696.50 | 952.365 | 952.365 |
| 6,697.00 | 1,172.390 | 1,172.390 |
| 6,697.40 | 1,368.679 | 1,368.679 |

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# *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 | 147.510 | 0.289 | 0.000 | 0.000 | 82.000 | F | 155.58 | 11.374 |
| | ∑ | **147.510** | | | | | | **155.58** | **11.374** |
| **#2** | ∑ | **147.510** | | | | | | **101.19** | **11.374** |
| #3 | 1 | 211.720 | 0.438 | 0.000 | 0.000 | 85.000 | F | 228.17 | 19.396 |
| | ∑ | **359.230** | | | | | | **323.66** | **30.770** |
| **#4** | ∑ | **359.230** | | | | | | **286.05** | **30.770** |
| #5 | 1 | 74.340 | 0.044 | 0.000 | 0.000 | 86.000 | F | 135.99 | 7.200 |
| | ∑ | **433.570** | | | | | | **313.28** | **37.970** |

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# Peabody Western Coal

# Kayenta Mine

# N9-B POND TEMPORARY DIVERSION DESIGN

# 100YR 6HR STORM

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Gary Altsisi

# General Information

## Storm Information:

| | |
|---|---|
| Storm Type: | NRCS Type II |
| Design Storm: | 100 yr - 6 hr |
| Rainfall Depth: | 2.400 inches |

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## *Structure Summary:*

| | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|
| #1 | 23.590 | 23.590 | 24.44 | 2.28 |

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## 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 | 23.590 | 0.453 | 0.453 | 0.272 | 86.000 | F | 26.50 | 2.285 |
| | $\sum$ | **23.590** | | | | | | **24.44** | **2.285** |

## Subwatershed Time of Concentration Details:

| Stru # | SWS # | Land Flow Condition | Slope (%) | Vert. Dist. (ft) | Horiz. Dist. (ft) | Velocity (fps) | Time (hrs) |
|---|---|---|---|---|---|---|---|
| #1 | 1 | 5. Nearly bare and untilled, and alluvial valley fans | 4.09 | 135.00 | 3,300.00 | 2.020 | 0.453 |
| **#1** | **1** | **Time of Concentration:** | | | | | **0.453** |

## Subwatershed Muskingum Routing Details:

| Stru # | SWS # | Land Flow Condition | Slope (%) | Vert. Dist. (ft) | Horiz. Dist. (ft) | Velocity (fps) | Time (hrs) |
|---|---|---|---|---|---|---|---|
| #1 | 1 | 5. Nearly bare and untilled, and alluvial valley fans | 4.09 | 135.00 | 3,300.00 | 2.020 | 0.453 |
| **#1** | **1** | **Muskingum K:** | | | | | **0.453** |

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# N9-B POND TEMPORARY DIVERSION

Material: Shales and hardpans

*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 | 1.5 | 0.0250 | 1.00 | | | 6.0 |

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 24.44 cfs | |
| Depth: | 1.26 ft | 2.26 ft |
| Top Width: | 7.53 ft | 13.53 ft |
| Velocity: | 5.17 fps | |
| X-Section Area: | 4.73 sq ft | |
| Hydraulic Radius: | 0.596 | |
| Froude Number: | 1.15 | |

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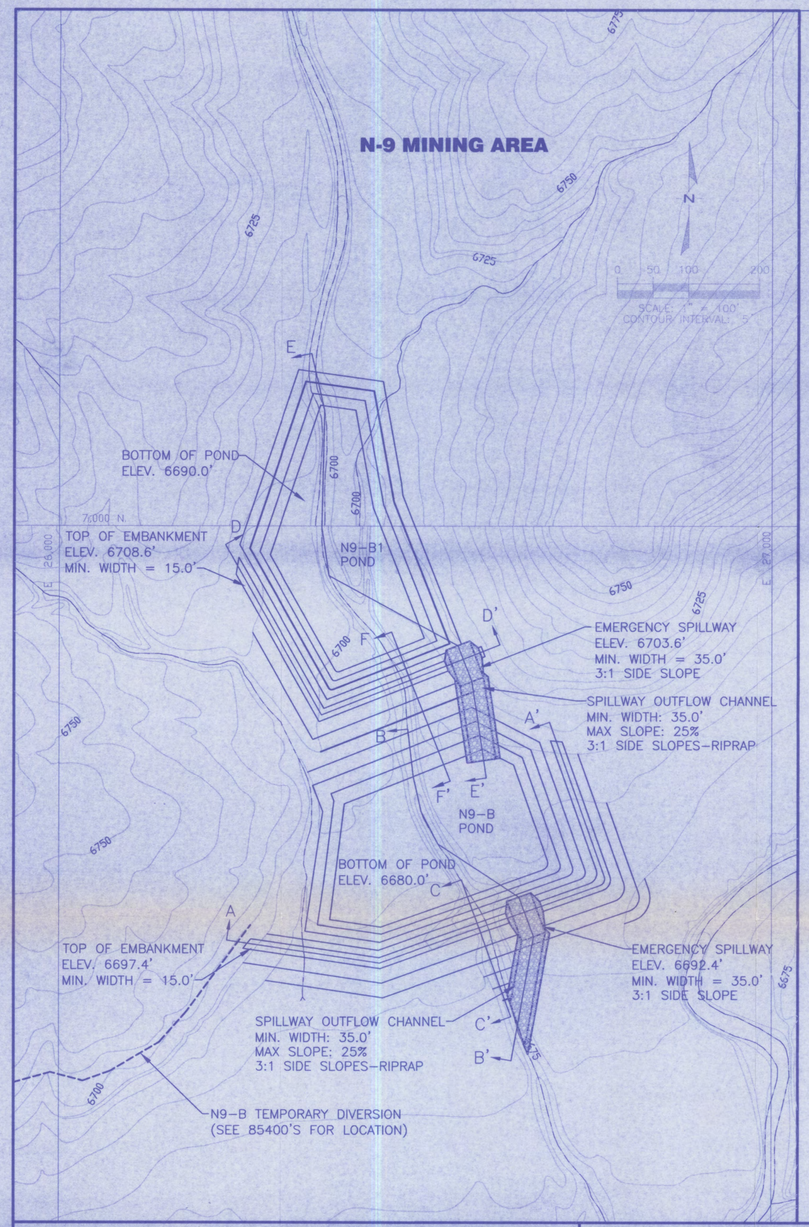
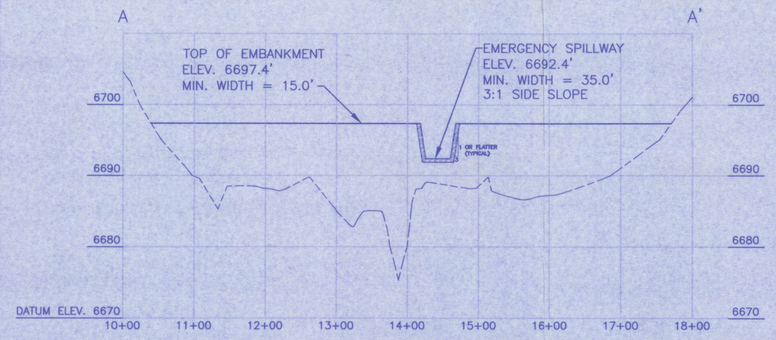
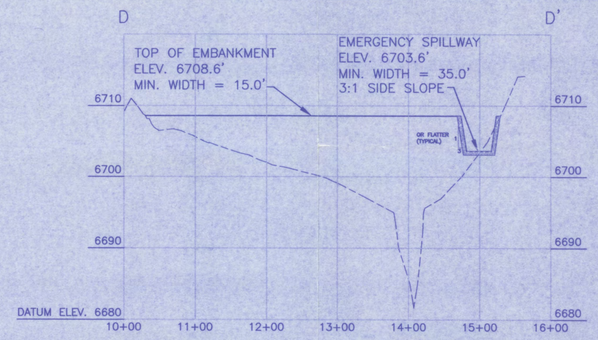
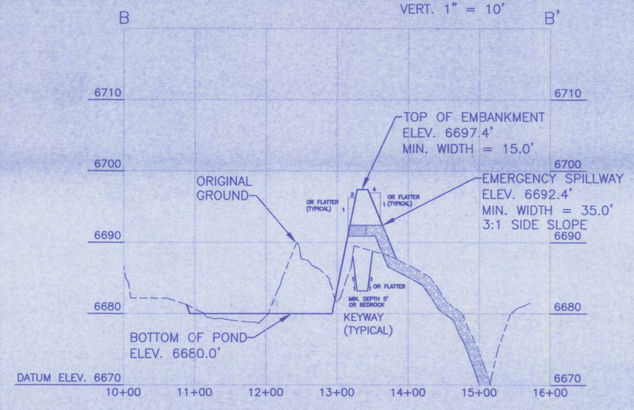


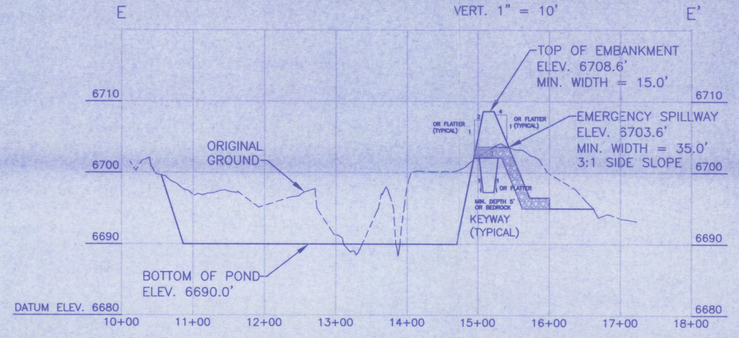

SECTION A – A'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



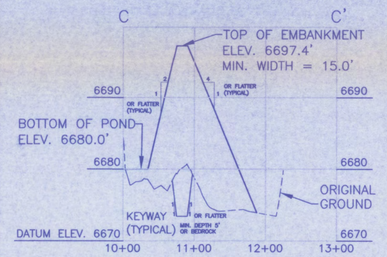

SECTION D – D'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



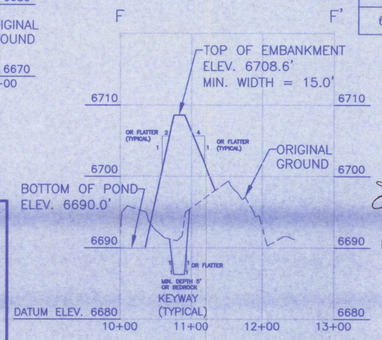

SECTION B – B'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION E – E'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION C – C'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION F – F'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'

N9-B POND STAGE CAPACITY TABLE

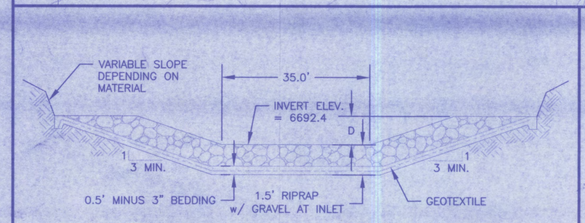
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6680.0 | 0.0 | 1.16 | 0.00 | BOTTOM OF POND |
| 6685.0 | 5.0 | 1.48 | 6.60 | INCISED ELEV. |
| 6690.0 | 10.0 | 1.83 | 14.88 | |
| 6692.4 | 12.4 | 2.06 | 19.56 | EMERGENCY SPILLWAY |
| 6695.0 | 15.0 | 2.31 | 25.24 | |
| 6697.4 | 17.4 | 2.69 | 31.25 | TOP OF EMBANKMENT |

N9-B1 POND STAGE CAPACITY TABLE

| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6690.0 | 0.0 | 1.02 | 0.00 | BOTTOM OF POND |
| 6695.0 | 5.0 | 1.31 | 5.83 | INCISED ELEV. |
| 6700.0 | 10.0 | 1.64 | 13.22 | |
| 6703.6 | 13.6 | 1.90 | 19.58 | EMERGENCY SPILLWAY |
| 6705.0 | 15.0 | 2.00 | 22.30 | |
| 6708.6 | 18.6 | 2.83 | 30.99 | TOP OF EMBANKMENT |

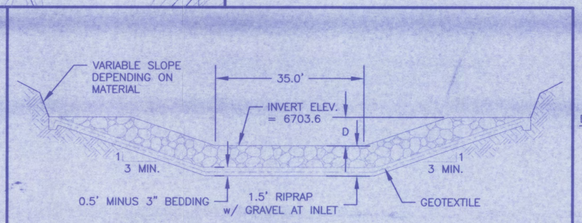
ENGINEER'S CERTIFICATION

ARIZONA P.E. 18782
Date: DEC 23 2004



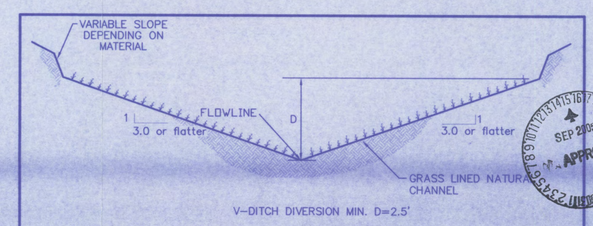

SPILLWAY MIN. D=2.5'
OUTFLOW CHANNEL MIN. D=2.0

SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-B POND




SPILLWAY MIN. D=2.5'
OUTFLOW CHANNEL MIN. D=2.0'

SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-B1 POND




V-DITCH DIVERSION MIN. D=2.5'

TYPICAL CROSS-SECTION OF TEMPORARY DIVERSION
NOT TO SCALE
N9-B POND

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NOTES:
1) General location, see Drawing No. 85400, Sheet K-6 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the distrubed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.


WOODSON
ENGINEERING AND SURVEYING, INC.
124 N. ELDEN ST.
FLAGSTAFF, AZ 86001
PHONE: (928) 774-4636 FAX: (928) 774-4646


EXHIBIT # 1
PROPOSED N9-B & B1
SEDIMENTATION POND DESIGN

KAYENTA MINE
PEABODY WESTERN COAL COMPANY
P. O. BOX 650 KAYENTA, ARIZONA 86033

| | |
|---|---|
| DESIGNED BY: GA | SCALE: AS NOTED |
| DRAWN BY: PEK | DRAWING DATE: 11-22-04 |
| CHECKED BY: JGS | PHOTO DATE: 05-83 |
| CONTOUR INTERVAL: 5 FT. | DWG FILE: POND N9-B,B1.DWG |

DESIGN REPORT

Temporary Sedimentation Structure

N9-B1 (Middle)

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

SEP 2005 APPROVED

Registered Professional Engineer (Civil) CERTIFICATE NO. 18782 JAMES GARY SCHLENVOGT Date Signed ARIZONA, U.S.A.

DEC 23 2004

10

TABLE OF CONTENTS


Page

INTRODUCTION ..... 1

INSPECTION ..... 1

SITE DESCRIPTION ..... 2

LAND USE ..... 2

DESIGN ANALYSES ..... 2

GENERAL ..... 2

STABILITY ..... 2

HYDROLOGY ..... 3

HYDRAULICS ..... 4

EMERGENCY SPILLWAY AND OUTLET CHANNEL ..... 6

STORAGE CAPACITY ..... 6

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) 100-Year, 6-Hour Storm Event
EXHIBIT #1 -N9-B2, N9-B1, and N9-B Proposed Sedimentation Ponds



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## INTRODUCTION

Sedimentation Structure N9-B1 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 N9 disturbed surface mining area at the Kayenta Mine. The location of Structure N9-B1 and its watershed boundary are shown on Drawing No. 85400 (Sheet K-6) 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 N9-B1 that is in series with sedimentation structures N9-B2 & N9-B. N9-B1 is the middle pond in the series. 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 N9-B1 was inspected in October, 2004 by a Registered Professional Engineer from Woodson Engineering, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. 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.

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## SITE DESCRIPTION

### LAND USE

The N9-B1, N9-B2 and N9-B Structures have a combined watershed of 433.57 acres and are located on a tributary upstream of Yellow Water Canyon Wash at the Kayenta Mine. The 211.72-acre watershed, which contributes directly to structure N9-B1 is classified as 19% undisturbed and 81% Spoil.

## DESIGN ANALYSES

### GENERAL

Structure N9-B1 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 1983 for Peabody Western Coal Company and was used in the analyses of the structure.

### STABILITY

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Structure N9-B1 (MIDDLE) 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 15 feet wide on top. A minimum upstream slope of 2H: 1V and minimum downstream slope of 4H: 1V were assumed. Based on the total embankment height of approximately 18.6 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 35-foot wide, riprap-lined, trapezoidal channel.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure N9-B1 will be constructed in series with proposed Structures N9-B2 and N9-B. Structure N9-B1 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 combined capacity of N9-B1 and N9-B2 exceeds 20 acre-feet; therefore, the spillway was analyzed using the 100-year, 6-hour storm event in lieu of the 25-year, 6-hour storm. All structures were conservatively assumed to be full to the emergency spillway at the time of 100-year storm event. The storage capacity of structure N9-B1 was analyzed using the 10-year, 24-hour storm event. The combined ponds in series were verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Yellow Water Canyon Wash.

The following parameters were used in the hydrologic analysis:

| | | |
|---|---|---|
| 1. | Water Course length, L | 1.559 mi. |
| 2. | Elevation Difference, H | 385 ft |
| 3. | Time of Concentration, $T_c$ | 0.438 hr |
| 4. | NRCS Curve Number | 85 |
| 5. | Rainfall Depth, 10-year, 24-hour storm | 2.1 in |
| | 100-year, 6-hour storm | 2.4 in |
| 6. | Drainage Area | 211.72 acres |

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Values reported represent the watershed, which drains directly to Pond N9-B1. Hydrologic input parameters for structure N9-B2 and N9-B are presented in separate design reports.

Muskingum routing parameters were utilized to route the 100-year hydrographs between the three structures. The routing parameters are presented in Appendices B and C, and are shown on a sub-watershed basis.

HYDRAULICS

The SEDCAD4 and HYDROCALC 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).

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## N9-B1 SEDIMENTATION POND HYDRAULICS TABLE

| | Units | 10-Yr, 24-Hr Storm | 100-Yr, 6-Hr Storm |
|---|---|---|---|
| Initial Reservoir Volume Condition | | Empty | Full to emergency spillway |
| Inflow | | | |
| Peak Flow | cfs | 128.56 | 323.66 |
| Volume | ac-ft | 15.33 | 30.77 |
| Storage | | | |
| Peak Stage | msl | N/A | 6705.7 |
| Emerg. Spillway Elev. | msl | 6703.6 | 6703.6 |
| Peak Storage | ac-ft | N/A | 23.78 |
| Storage Capacity | ac-ft | 19.58 | 19.58 |
| Outflow | | | |
| Peak Flow | cfs | N/A | 286.1 |
| Spillway Elevation | msl | 6703.6 | 6703.6 |
| Embankment Crest Elev. | msl | 6708.6 | 6708.6 |
| Peak Stage | msl | -- | 6705.7 |
| Freeboard | ft | -- | 2.9 |
| Emergency Spillway Channel | | | |
| Flow Depth | ft | -- | 2.1 |
| Critical Velocity | fps | -- | 6.2 |
| Mannings "n" | -- | -- | 0.048 |
| Width | ft | -- | 35 |
| Outflow Channel | | | |
| Slope | % | -- | 25 |
| Normal Velocity | fps | -- | 9.92 |
| Normal Depth | ft | -- | 0.9 |
| Mannings "n" | -- | -- | 0.065 |
| Riprap $D_{50}$ | In | -- | 9 |

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for N9-B1 will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

| | | | |
|---|---|---|---|
| Minimum Channel Depth | (Spillway) | 3.0 | ft |
| | (Outflow) | 2.0 | |
| Channel Width | | 35 | ft |
| Channel Length | (Spillway) | 45 | ft |
| | (Outflow) | 127 | ft |
| Sideslopes (Horizontal to Vertical) | | 3:1 | or flatter |
| Average Slope | (Spillway) | 0 | % |
| Maximum Slope | (Outflow) | 25 | % |
| Spillway Elevation | | 6703.6 | ft |

The riprapped-lined channel will extend a minimum of 15 feet beyond the toe of the embankment as shown on Exhibit 1.

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 1983 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-B1 is designed to contain approximately 19.58 acre-feet.

The calculations for the sediment load entering structure N9-B1 were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

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| | | |
|---|---|---|
| 1. | Rainfall Factor, R | 40 |
| 2. | Soil Erodibility Factor, K | 0.11 |
| 3. | Slope Factor, LS | 5.82 |
| 4. | Cover Factor, C | 0.85 |
| 5. | Erosion Control Factor, P | 0.84 |

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and

the remaining storage volume available for storing sediment. Structure N9-B1, combined with Structures N9-B2 and N9-B has adequate storage capacity to contain the 10-year, 24-hour storm and reasonable sediment storage capacity. The combined storage capacity was determined for all three structures in series and the results of the analysis are presented in the following table.

Combined Storage for Structures N9-B2, N9-B1 and N9-B

| | N9-B2 (UPPER) | N9-B1 (MIDDLE) | N9-B (LOWER) | COMBINED |
|---|---|---|---|---|
| Total Storage Capacity (ac-ft) | 19.55 | 19.58 | 19.56 | 58.69 |
| 10-Year, 24-Hour Storm Inflow(ac-ft) | 8.80 | 15.34 | 5.73 | 29.86 |
| Available Sediment Storage Capacity | - | - | - | 28.83 |
| Sediment Inflow Rate/Year (ac-ft/yr) | 1.37 | 1.77 | 0.68 | 3.82 |
| Sediment Storage Life (yr) | - | - | - | 7.5 |

* * *

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) 100-Year, 6-Hour Storm Event

Exhibit #1- N9-B2, N9-B1 and N9-B Proposed Sedimentation Ponds

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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**PEABODY WESTERN COAL COMPANY**
**CALCULATED HYDROLOGIC DATA**

**PROJECT: N-9 MINING AREA**

**STRUCTURE: B1**

***TIME OF CONCENTRATION:***

| | | |
|---|---|---|
| Start Elevation (ft) = | 7080 | |
| End Elevation (ft) = | 6695 | |
| Elevation Difference, E (ft) = | 385 | |
| Watercourse Length (ft) = | 8233 | |
| Watercourse Length (mi) = | 1.559 | |
| Tc = (11.9L^3/E)^0.385 = | 0.438 | hours |

***ROUTING PARAMETERS:***

Between structure routing parameters were calculated using the SCS Upland mathod 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 | 1.664 | 108.16 |
| Pinyon Juniper | D | 83 | 38.019 | 3155.577 |
| Saltbrush | D | 79 | 1.14 | 90.06 |
| Distrubed Land | B | 86 | 170.9 | 14697.4 |
| TOTAL: | | | 211.723 | 18051.197 |

Weighted CN = Total CN * Area / Total Area = 85

Note: During Operations the open pit will collect most of the runoff from disturbed areas. The worst case is when the open pit is reclaimed and runoff from a larger area or regraded soil reports directly to the pond.

***DRAINAGE BASIN AREA:***

211.723 Acres

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**PEABODY WESTERN COAL COMPANY**
**CALCULATED SEDIMENTOLOGY DATA**

**STRUCTURE: B1**

***SOIL ERODIBILITY FACTOR:***

| Soil Type | Erodibility Factor, K | Area | K*Area |
|---|---|---|---|
| 12AB | 0.43 | 0.362 | 0.16 |
| 16CE | 0.05 | 1.302 | 0.07 |
| 1AB | 0.16 | 4.074 | 0.65 |
| 3CD | 0.16 | 7.077 | 1.13 |
| 3DE | 0.15 | 0.148 | 0.02 |
| 3F | 0.02 | 17.699 | 0.35 |
| 7CD | 0.14 | 10.161 | 1.42 |
| Disturbed | 0.12 | 170.9 | 20.51 |
| | TOTAL | 211.723 | 24.31 |

Weighted K = Total K * Area / Total Area = 0.11

***SLOPE FACTOR:***

| Length (ft) | | Slope (%) | m | Slope Angle (deg) | LS Factor |
|---|---|---|---|---|---|
| 895 | 94 | 10.50% | 0.60 | 6 | 5.67 |
| 1064 | 166 | 15.60% | 0.60 | 8.87 | 10.47 |
| 1146 | 101 | 8.81% | 0.50 | 5.04 | 3.89 |
| 1312 | 114 | 8.69% | 0.50 | 4.97 | 4.11 |
| 2320 | 184 | 7.93% | 0.50 | 4.53 | 4.99 |

Average LS = 5.82

The LS Factor was calculated by:
LS=(Slope Length/72.6)^m*(10.8sin(slope angle)+.03) for slopes < 9%
LS=(Slope Length/72.6)^m*(16.8sin(slope angle)-0.5) for slopes > 9%

Where:

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

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# STRUCTURE: B1

***Cover and Practice Factors:***

| Cover Type | Cover (%) | Canopy ( %) | Area (acres) | Cover Factor, C | C * Area | Practive Factor, P | P * Area |
|---|---|---|---|---|---|---|---|
| Pinyon Junip | 40% | 25% | 39.683 | 0.22 | 8.73 | 1.00 | 39.683 |
| Sagebrush, C | 40% | 25% | 0 | 0.2 | 0.00 | 1.00 | 0 |
| Saltbrush | 40% | 25% | 1.14 | 0.2 | 0.23 | 1.00 | 1.14 |
| Disturbed | 0% | 0% | 170.9 | 1 | 170.90 | 0.80 | 136.72 |
| TOTAL: | | | 211.723 | | 179.86 | | 177.54 |

Weighted C = Total C * Area / Total Area = 0.85

Weighted P = Total P * Area / Total Area = 0.84

***RAINFALL FACTOR:***

R= 40

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# PEABODY WESTERN COAL COMPANY
# CALCULATED SEDIMENT YIELD

## STRUCTURE: B1

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

| PARAMETER DESCRIPTION | VALUE |
|---|---|
| Annual Rainfall Factor ( R) | 40.00 |
| Soil Erodibility Factor (K) | 0.11 |
| Length Slope Factor (L) | 5.82 |
| Cover Factor(C) | 0.85 |
| Practice Factor (P) | 0.84 |
| Gross Annual Sediment Yield | 19.06 tons/acre/year |
| | |
| Sediment Density | 94.00 pcf |
| Gross Annual Sediment Yield | 0.0093 acre-feet/acre/year |
| Sediment Delivery Ratio | 90% |
| Estimated Annual Sediment Yield | 0.0084 acre-feet/acre/year |
| | |
| Watershed Area | 211.72 acres |
| Watershed Annual Sediment Yield | 1.77 acre-feet/year |
| | |
| Number of Years | 1.00 years |
| Calculated Sediment Volume | 1.77 acre-feet |

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TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION
N9-B1 POND
November 16, 2004

PROGRAM INPUT DATA

| DESCRIPTION | VALUE |
|---|---|
| Flow Rate (cfs) | 323.66 |
| Channel Bottom Slope (ft/ft) | 0.005 |
| Manning's Roughness Coefficient (n-value) | 0.048 |
| Channel Left Side Slope (horizontal/vertical) | 3.0 |
| Channel Right Side Slope (horizontal/vertical) | 3.0 |
| Channel Bottom Width (ft) | 35.0 |

COMPUTATION RESULTS

| DESCRIPTION | VALUE |
|---|---|
| Critical Depth (ft) | 1.33 |
| Critical Slope (ft/ft) | 0.032 |
| Flow Velocity (fps) | 6.23 |
| Froude Number | 1.0 |
| Velocity Head (ft) | 0.6 |
| Energy Head (ft) | 1.94 |
| Cross-Sectional Area of Flow (sq ft) | 51.92 |
| Top Width of Flow (ft) | 42.99 |

HYDROCALC Hydraulics for Windows, Version 1.2 Copyright (c) 1996
Dodson & Associates, Inc., 5629 FM 1960 West, Suite 314, Houston, TX 77069
Phone:(281)440-3787, Fax:(281)440-4742, Email:software@dodson-hydro.com
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# N9-B1 POND OUTFLOW CHANNEL

## Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 35.00 | 3.0:1 | 3.0:1 | 25.0 | 1.00 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 323.66 cfs | |
| Depth: | 0.87 ft | 1.87 ft |
| Top Width: | 40.20 ft | 46.20 ft |
| Velocity: | 9.92 fps | |
| X-Section Area: | 32.62 sq ft | |
| Hydraulic Radius: | 0.806 | |
| Froude Number: | 1.94 | |
| Manning's n: | 0.0650 | |
| Dmin: | 5.00 in | |
| D50: | 9.00 in | |
| Dmax: | 12.00 in | |

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APPENDIX B

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

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Copyright 1998 Pamela L Schwab


# Peabody Western Coal
# Kayenta Mine
# N9-B1 POND DESIGN
# 10YR 24HR STORM

APPROVED
SEP 2005

Gary Altsisi

# *General Information*

## *Storm Information:*

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

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## *Structure Summary:*

| | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|
| #1 | 211.720 | 211.720 | 128.56 | 15.33 |

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# *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 | 211.720 | 0.438 | 0.000 | 0.000 | 85.000 | F | 128.56 | 15.335 |
| | $\sum$ | **211.720** | | | | | | **128.56** | **15.335** |

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APPENDIX C

SEDCAD4 (Input and Output) 100-Year, 6-Hour Storm Event

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# Peabody Western Coal
# Kayenta Mine
# N9-B1 POND DESIGN
# 100YR 6HR STORM

SEP 2005
APPROVED

Gary Altsisi

# *General Information*

## *Storm Information:*

| | |
|---|---|
| Storm Type: | NRCS Type II |
| Design Storm: | 100 yr - 6 hr |
| Rainfall Depth: | 2.400 inches |

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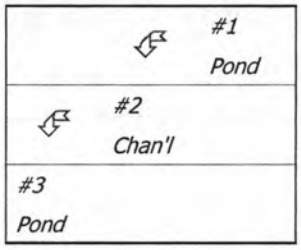
# *Structure Networking:*

| Type | Stru # | (flows into) | Stru # | Musk. K (hrs) | Musk. X | Description |
|---|---|---|---|---|---|---|
| Pond | #1 | ==> | #2 | 0.000 | 0.000 | N9-B2 POND |
| Channel | #2 | ==> | #3 | 0.000 | 0.000 | N9-B2 SPILLWAY |
| Pond | #3 | ==> | End | 0.000 | 0.000 | N9-B1 POND |

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# Structure Summary:

| | | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|---|
| #1 | In | 147.510 | 147.510 | 155.58 | 11.37 |
| | Out | | | 101.19 | 11.38 |
| #2 | | 0.000 | 147.510 | 101.19 | 11.37 |
| #3 | In | 211.720 | 359.230 | 323.66 | 30.77 |
| | Out | | | 286.05 | 30.77 |

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# *Structure Detail:*

*Structure #3 (Pond)*

*N9-B1 POND*

Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,703.60 |
| Initial Pool: | 19.58 ac-ft |

Emergency Spillway

| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,703.60 | 45.00 | 3.00:1 | 3.00:1 | 35.00 |

Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,705.72 |
| Dewater Time: | 0.38 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) |
|---|---|---|---|---|
| 6,690.00 | 1.000 | 0.000 | 0.000 | |
| 6,690.50 | 1.032 | 0.508 | 0.000 | |
| 6,691.00 | 1.064 | 1.032 | 0.000 | |
| 6,691.50 | 1.097 | 1.572 | 0.000 | |
| 6,692.00 | 1.130 | 2.129 | 0.000 | |
| 6,692.50 | 1.164 | 2.702 | 0.000 | |
| 6,693.00 | 1.198 | 3.293 | 0.000 | |
| 6,693.50 | 1.233 | 3.900 | 0.000 | |
| 6,694.00 | 1.268 | 4.525 | 0.000 | |
| 6,694.50 | 1.304 | 5.168 | 0.000 | |
| 6,695.00 | 1.340 | 5.829 | 0.000 | |
| 6,695.50 | 1.367 | 6.506 | 0.000 | |
| 6,696.00 | 1.394 | 7.196 | 0.000 | |
| 6,696.50 | 1.421 | 7.900 | 0.000 | |
| 6,697.00 | 1.449 | 8.617 | 0.000 | |
| 6,697.50 | 1.476 | 9.348 | 0.000 | |
| 6,698.00 | 1.504 | 10.093 | 0.000 | |

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| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,698.50 | 1.533 | 10.853 | 0.000 | | |
| 6,699.00 | 1.561 | 11.626 | 0.000 | | |
| 6,699.50 | 1.590 | 12.414 | 0.000 | | |
| 6,700.00 | 1.619 | 13.216 | 0.000 | | |
| 6,700.50 | 1.660 | 14.036 | 0.000 | | |
| 6,701.00 | 1.701 | 14.876 | 0.000 | | |
| 6,701.50 | 1.742 | 15.737 | 0.000 | | |
| 6,702.00 | 1.784 | 16.618 | 0.000 | | |
| 6,702.50 | 1.826 | 17.521 | 0.000 | | |
| 6,703.00 | 1.869 | 18.444 | 0.000 | | |
| 6,703.50 | 1.912 | 19.390 | 0.000 | | |
| 6,703.60 | 1.921 | 19.582 | 0.000 | | Spillway #1 |
| 6,704.00 | 1.935 | 20.353 | 25.197 | 5.95 | |
| 6,704.50 | 1.952 | 21.324 | 56.700 | 1.90 | |
| 6,705.00 | 1.969 | 22.304 | 136.422 | 0.75 | |
| 6,705.50 | 2.086 | 23.318 | 235.292 | 0.35 | |
| 6,705.72 | 2.138 | 23.780 | 286.048 | 0.15 | Peak Stage |
| 6,706.00 | 2.206 | 24.391 | 353.166 | | |
| 6,706.50 | 2.329 | 25.524 | 498.252 | | |
| 6,707.00 | 2.456 | 26.720 | 669.401 | | |
| 6,707.50 | 2.586 | 27.981 | 868.331 | | |
| 6,708.00 | 2.719 | 29.307 | 1,081.005 | | |
| 6,708.50 | 2.856 | 30.701 | 1,318.253 | | |
| 6,708.60 | 2.884 | 30.988 | 1,368.679 | | |

## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,690.00 | 0.000 | 0.000 |
| 6,690.50 | 0.000 | 0.000 |
| 6,691.00 | 0.000 | 0.000 |
| 6,691.50 | 0.000 | 0.000 |
| 6,692.00 | 0.000 | 0.000 |
| 6,692.50 | 0.000 | 0.000 |
| 6,693.00 | 0.000 | 0.000 |
| 6,693.50 | 0.000 | 0.000 |
| 6,694.00 | 0.000 | 0.000 |
| 6,694.50 | 0.000 | 0.000 |

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| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,695.00 | 0.000 | 0.000 |
| 6,695.50 | 0.000 | 0.000 |
| 6,696.00 | 0.000 | 0.000 |
| 6,696.50 | 0.000 | 0.000 |
| 6,697.00 | 0.000 | 0.000 |
| 6,697.50 | 0.000 | 0.000 |
| 6,698.00 | 0.000 | 0.000 |
| 6,698.50 | 0.000 | 0.000 |
| 6,699.00 | 0.000 | 0.000 |
| 6,699.50 | 0.000 | 0.000 |
| 6,700.00 | 0.000 | 0.000 |
| 6,700.50 | 0.000 | 0.000 |
| 6,701.00 | 0.000 | 0.000 |
| 6,701.50 | 0.000 | 0.000 |
| 6,702.00 | 0.000 | 0.000 |
| 6,702.50 | 0.000 | 0.000 |
| 6,703.00 | 0.000 | 0.000 |
| 6,703.50 | 0.000 | 0.000 |
| 6,703.60 | 0.000 | 0.000 |
| 6,704.00 | 25.197 | 25.197 |
| 6,704.50 | 56.700 | 56.700 |
| 6,705.00 | 136.422 | 136.422 |
| 6,705.50 | 235.292 | 235.292 |
| 6,706.00 | 353.166 | 353.166 |
| 6,706.50 | 498.252 | 498.252 |
| 6,707.00 | 669.401 | 669.401 |
| 6,707.50 | 868.331 | 868.331 |
| 6,708.00 | 1,081.005 | 1,081.005 |
| 6,708.50 | 1,318.253 | 1,318.253 |
| 6,708.60 | 1,368.679 | 1,368.679 |

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# *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) |
|---|---|---|---|---|---|---|---|---|---|
| #3 | 1 | 211.720 | 0.438 | 0.000 | 0.000 | 85.000 | F | 228.17 | 19.396 |
| | $\sum$ | **359.230** | | | | | | **323.66** | **30.770** |

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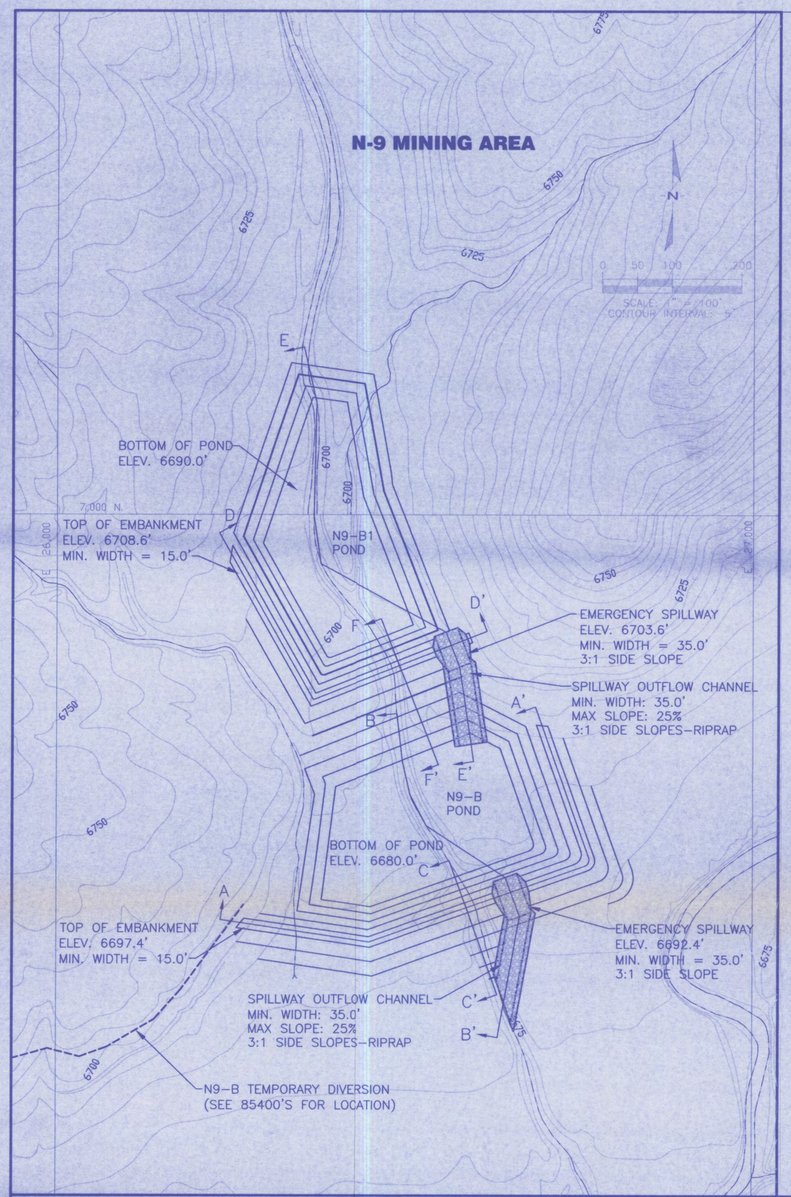
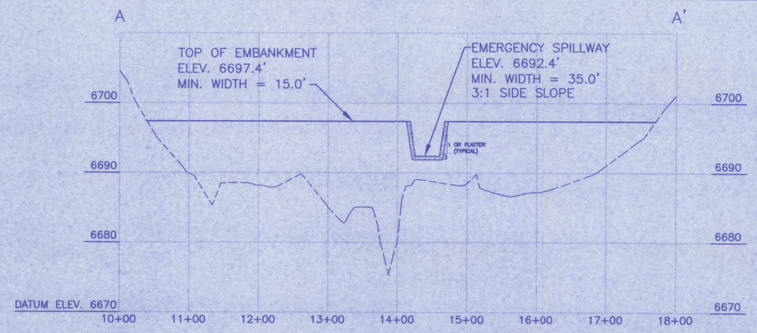
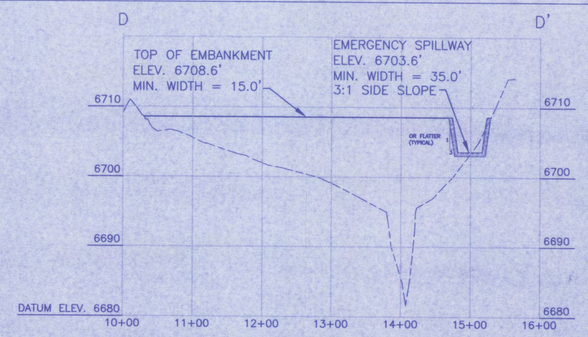
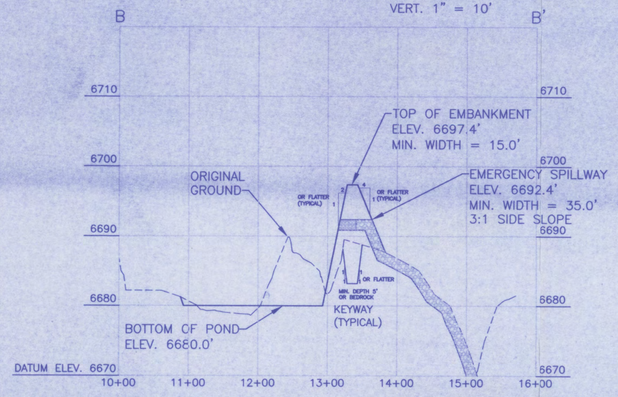


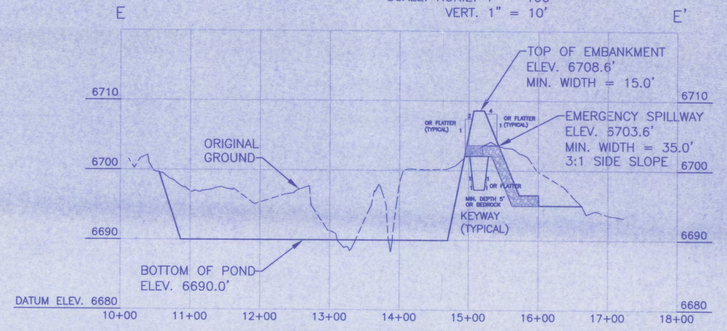

SECTION A – A'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



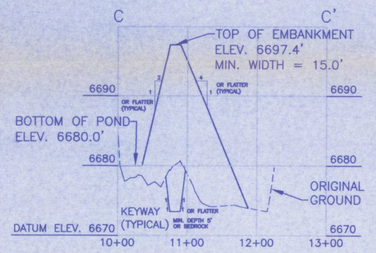

SECTION D – D'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



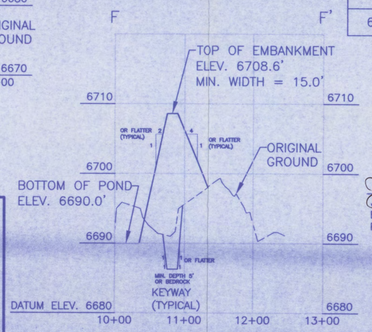

SECTION B – B'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION E – E'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION C – C'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



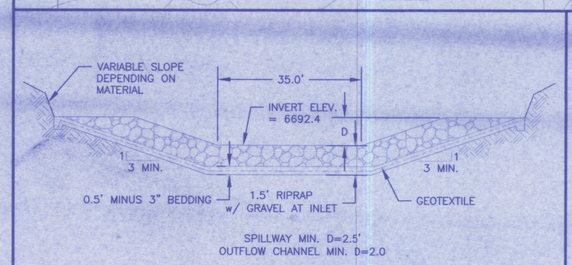

SECTION F – F'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'

N9-B POND STAGE CAPACITY TABLE

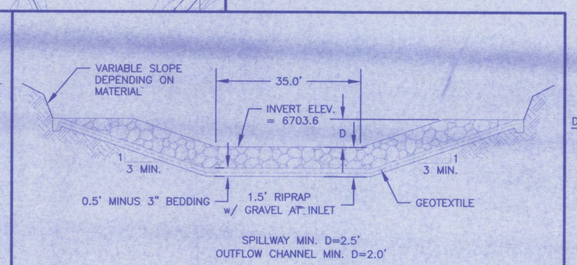
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6680.0 | 0.0 | 1.16 | 0.00 | BOTTOM OF POND |
| 6685.0 | 5.0 | 1.48 | 6.60 | INCISED ELEV. |
| 6690.0 | 10.0 | 1.83 | 14.88 | |
| 6692.4 | 12.4 | 2.06 | 19.56 | EMERGENCY SPILLWAY |
| 6695.0 | 15.0 | 2.31 | 25.24 | |
| 6697.4 | 17.4 | 2.69 | 31.25 | TOP OF EMBANKMENT |

N9-B1 POND STAGE CAPACITY TABLE

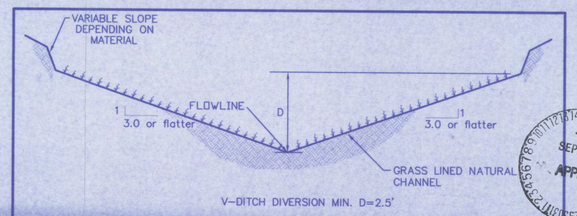
| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6690.0 | 0.0 | 1.02 | 0.00 | BOTTOM OF POND |
| 6695.0 | 5.0 | 1.31 | 5.83 | INCISED ELEV. |
| 6700.0 | 10.0 | 1.64 | 13.22 | |
| 6703.6 | 13.6 | 1.90 | 19.58 | EMERGENCY SPILLWAY |
| 6705.0 | 15.0 | 2.00 | 22.30 | |
| 6708.6 | 18.6 | 2.83 | 30.99 | TOP OF EMBANKMENT |




SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-B POND




SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-B1 POND




TYPICAL CROSS-SECTION OF TEMPORARY DIVERSION
NOT TO SCALE
N9-B POND

ENGINEER'S CERTIFICATION

JAMES SCHOLDENVOGT
Engineering Supervisor
Peabody Western Coal Company

ARIZONA P.E. 18782
Date: DEC 23 2004

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**WOODSON**
ENGINEERING AND SURVEYING, INC.
124 N. ELDEN ST.
FLAGSTAFF, AZ 86001
PHONE: (928) 774-4636 FAX: (928) 774-4646

NOTES:
1) General location, see Drawing No. 85400, Sheet K-6 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the distrubed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.

EXHIBIT # 1
PROPOSED N9-B & B1
SEDIMENTATION POND DESIGN
KAYENTA MINE
PEABODY WESTERN COAL COMPANY
P. O. BOX 650 KAYENTA, ARIZONA 86033

| | |
|---|---|
| DESIGNED BY: GA | SCALE: AS NOTED |
| DRAWN BY: PEK | DRAWING DATE: 11-22-04 |
| CHECKED BY: JGS | PHOTO DATE: 05-83 |
| CONTOUR INTERVAL: 5 FT. | DWG FILE: POND N9-B,B1.DWG |

DESIGN REPORT

Temporary Sedimentation Structure

N9-B2 (Upper)

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

SEP 2005 APPROVED

Registered Professional Engineer (Civil) CERTIFICATE NO. 18789 JAMES GARY SCHLENVOGT Date Signed ..... ARIZONA

DEC 23 2004

10

TABLE OF CONTENTS


| | Page |
|---|---|
| INTRODUCTION | 1 |
| INSPECTION | 1 |
| SITE DESCRIPTION | 2 |
| LAND USE | 2 |
| DESIGN ANALYSES | 2 |
| GENERAL | 2 |
| STABILITY | 2 |
| HYDROLOGY | 3 |
| HYDRAULICS | 4 |
| EMERGENCY SPILLWAY AND OUTLET CHANNEL | 6 |
| STORAGE CAPACITY | 6 |

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 -N9-B2, N9-B1, and N9-B Proposed Sedimentation Ponds


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## INTRODUCTION

Sedimentation Structure N9-B2 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 N9 disturbed surface mining area at the Kayenta Mine. The location of Structure N9-B2 and its watershed boundary are shown on Drawing No. 85400, (Sheet K-6), 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 N9-B2 that is in series with sedimentation structures N9-B1 & N9-B. N9-B2 is the upper pond in the series. 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 N9-B2 was inspected in October, 2004 by a Registered Professional Engineer from Woodson Engineering, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. 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.

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## SITE DESCRIPTION

### LAND USE

The N9-B2, N9-B1 and N9-B Structures have a combined watershed of 433.57 acres and are located on a tributary upstream of Yellow Water Canyon Wash at the Kayenta Mine. The 147.51-acre watershed, which contributes directly to structure N9-B2, is classified as 61% undisturbed and 39% spoil.

## DESIGN ANALYSES

### GENERAL

Structure N9-B2 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 1983 for Peabody Western Coal Company and was used in the analyses of the structure.

### STABILITY

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Structure N9-B2 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 15 feet wide on top. A minimum upstream slope of 2H: 1V and a minimum downstream slope of 4H: 1V were assumed. Based on the total embankment height of approximately 19.5 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 20-foot wide, riprap-lined, trapezoidal channel.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure N9-B2 will be constructed in series with proposed Structures N9-B1 and N9-B. Structure N9-B2 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. N9-B2 is the upper pond in the series and has a capacity of less than 20 acre-feet; therefore, the spillway was analyzed using the 25-year, 6-hour storm event. All structures were conservatively assumed to be full to the emergency spillway at the time of design storm event. The storage capacity of structure N9-B2 was analyzed using the 10-year, 24-hour storm event. The combined ponds in series were verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Yellow Water Canyon Wash.

The following parameters were used in the hydrologic analysis:

| | | |
|---|---|---|
| 1. | Water Course length, L | 1.033 mi. |
| 2. | Elevation Difference, H | 330 ft |
| 3. | Time of Concentration, $T_c$ | 0.289 hr |
| 4. | NRCS Curve Number | 82 |
| 5. | Rainfall Depth, 10-year, 24-hour storm<br>25-year, 6-hour storm | 2.1 in<br>1.9 in |
| 6. | Drainage Area | 147.51 acres |

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Values reported represent the watershed, which drains directly to Pond N9-B2. Hydrologic input parameters for structure N9-B1 and N9-B are presented in separate design reports.

Muskingum routing parameters were utilized to route the 25-year hydrographs between the three structures. The routing parameters are presented in Appendices B and C, and are shown on a sub-watershed basis.

HYDRAULICS

The SEDCAD4 and HYDROCALC 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).

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## N9-B2 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 | 83.63 | 96.58 |
| Volume | ac-ft | 8.80 | 7.18 |
| Storage | | | |
| Peak Stage | Msl | N/A | 6777.2 |
| Emerg. Spillway Elev. | Msl | 6776.8 | 6776.8 |
| Peak Storage | ac-ft | N/A | 21.6 |
| Storage Capacity | ac-ft | 19.55 | 19.55 |
| Outflow | | | |
| Peak Flow | Cfs | N/A | 51.3 |
| Spillway Elevation | Msl | 6776.8 | 6776.8 |
| Embankment Crest Elev. | Msl | 6779.9 | 6779.9 |
| Peak Stage | Msl | -- | 6777.9 |
| Freeboard | Ft | -- | 2.0 |
| Emergency Spillway Channel | | | |
| Flow Depth | Ft | -- | 1.1 |
| Critical Velocity | Fps | -- | 4.98 |
| Mannings "n" | -- | -- | 0.048 |
| Width | Ft | -- | 20 |
| Outflow Channel | | | |
| Slope | % | -- | 25 |
| Normal Velocity | Fps | -- | 7.9 |
| Normal Depth | Ft | -- | 0.6 |
| Mannings "n" | -- | -- | 0.061 |
| Riprap D[illegible] | In | -- | 6 |

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for N9-B2 will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

| | | | |
|---|---|---|---|
| Minimum Channel Depth | (Spillway) | 2.0 | ft |
| | (Outflow) | 2.0 | ft |
| Channel Width | | 20 | ft |
| Channel Length | (Spillway) | 34.2 | ft |
| | (Outflow) | 207 | ft |
| Sideslopes (Horizontal to Vertical) | | 3:1 | or flatter |
| Average Slope | (Spillway) | 0 | % |
| Maximum Slope | (Outflow) | 25 | % |
| Spillway Elevation | | 6776.8 | 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 1983 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-B2 is designed to contain approximately 19.55 acre-feet.

The calculations for the sediment load entering structure N9-B2 were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

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| | | |
|---|---|---|
| 1. | Rainfall Factor, R | 40 |
| 2. | Soil Erodibility Factor, K | 0.11 |
| 3. | Slope Factor, LS | 9.85 |
| 4. | Cover Factor, C | 0.52 |
| 5. | Erosion Control Factor, P | 0.92 |

the remaining storage volume available for storing sediment. Structure N9-B2 does not have sufficient storage to contain the 10-year, 24-hour storm; however, the storage of all three ponds, (N9-B2, N9-B1 & N9-B), in series is adequate. The combined storage capacity was determined for all three structures in series and the results of the analysis are presented in the following table.

Combined Storage for Structures N9-B2, N9-B1 and N9-B

| | N9-B2 (UPPER) | N9-B1 (MIDDLE) | N9-B (LOWER) | COMBINED |
|---|---|---|---|---|
| Total Storage Capacity (ac-ft) | 19.55 | 19.58 | 19.56 | 58.69 |
| 10-Year, 24-Hour Storm Inflow (ac-ft) | 8.80 | 15.34 | 5.73 | 29.86 |
| Available Sediment Storage Capacity (ac-ft) | - | - | - | 28.83 |
| Sediment Inflow Rate/Year (ac-ft/yr) | 1.37 | 1.77 | 0.68 | 3.82 |
| Sediment Storage Life (yr) | - | - | - | 7.5 |

* * *

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- N9-B2, N9-B1 & N9-B Proposed Sedimentation Ponds

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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**PEABODY WESTERN COAL COMPANY**
**CALCULATED HYDROLOGIC DATA**

**PROJECT: N-9 MINING AREA**

**STRUCTURE: B2**

***TIME OF CONCENTRATION:***

| | | |
|---|---|---|
| Start Elevation (ft) = | 7090 | |
| End Elevation (ft) = | 6760 | |
| Elevation Difference, E (ft) = | 330 | |
| Watercourse Length (ft) = | 5455 | |
| Watercourse Length (mi) = | 1.033 | |
| Tc = (11.9L^3/E)^0.385 = | 0.289 | hours |

***ROUTING PARAMETERS:***

Between structure routing parameters were calculated using the SCS Upland mathod 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 | 13.963 | 907.595 |
| Pinyon Juniper | D | 83 | 73.69 | 6116.27 |
| Saltbrush | D | 79 | 0.691 | 54.589 |
| Sagebrush | B | 60 | 1.345 | 80.7 |
| Sagebrush | D | 79 | 0.782 | 61.778 |
| Distrubed Land | B | 86 | 57.04 | 4905.44 |
| TOTAL: | | | 147.511 | 12126.372 |

Weighted CN = Total CN * Area / Total Area = 82

Note: During Operations the open pit will collect most of the runoff from disturbed areas. The worst case is when the open pit is reclaimed and runoff from a larger area or regraded soil reports directly to the pond.

***DRAINAGE BASIN AREA:*** 147.511 Acres

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# PEABODY WESTERN COAL COMPANY
# CALCULATED SEDIMENTOLOGY DATA

## STRUCTURE: B2

***SOIL ERODIBILITY FACTOR:***

| Soil Type | Erodibility Factor, K | Area | K*Area |
|---|---|---|---|
| 12AB | 0.43 | 3.472 | 1.49 |
| 16CE | 0.05 | 2.796 | 0.14 |
| 16F | 0.05 | 9.04 | 0.45 |
| 1AB | 0.16 | 4.818 | 0.77 |
| 3CD | 0.16 | 30.697 | 4.91 |
| 3DE | 0.15 | 5.262 | 0.79 |
| 3F | 0.02 | 31.563 | 0.63 |
| 7CD | 0.14 | 2.823 | 0.40 |
| Disturbed | 0.12 | 57.04 | 6.84 |
| | TOTAL | 147.511 | 16.43 |

Weighted K = Total K * Area / Total Area = 0.11

***SLOPE FACTOR:***

| Length (ft) | | Slope (%) | m | Slope Angle (deg) | LS Factor |
|---|---|---|---|---|---|
| 721 | 123 | 17.06% | 0.60 | 9.68 | 9.22 |
| 815 | 120 | 14.72% | 0.60 | 8.38 | 8.31 |
| 1000 | 181 | 18.10% | 0.60 | 10.26 | 12.02 |

Average LS = 9.85

The LS Factor was calculated by:
LS=(Slope Length/72.6)^m*(10.8sin(slope angle)+.03) for slopes < 9%
LS=(Slope Length/72.6)^m*(16.8sin(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

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# STRUCTURE: B2

***Cover and Practice Factors:***

| Cover Type | Cover (%) | Canopy ( %) | Area (acres) | Cover Factor, C | C * Area | Practive Factor, P | P * Area |
|---|---|---|---|---|---|---|---|
| Pinyon Juniper | 40% | 25% | 87.653 | 0.22 | 19.28 | 1.00 | 87.653 |
| Sagebrush, Grass | 40% | 25% | 2.127 | 0.2 | 0.43 | 1.00 | 2.127 |
| Saltbrush | 40% | 25% | 0.691 | 0.2 | 0.14 | 1.00 | 0.691 |
| Disturbed | 0% | 0% | 57.04 | 1 | 57.04 | 0.80 | 45.632 |
| TOTAL: | | | 147.511 | | 76.89 | | 136.10 |

Weighted C = Total C * Area / Total Area = 0.52

Weighted P = Total P * Area / Total Area = 0.92

***RAINFALL FACTOR:***

R= 40

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# CALCULATED SEDIMENT YIELD

## STRUCTURE: B2

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

| PARAMETER DESCRIPTION | VALUE |
|---|---|
| Annual Rainfall Factor ( R) | 40.00 |
| Soil Erodibility Factor (K) | 0.11 |
| Length Slope Factor (L) | 9.85 |
| Cover Factor(C) | 0.52 |
| Practice Factor (P) | 0.92 |
| Gross Annual Sediment Yield | 21.11 tons/acre/year |
| | |
| Sediment Density | 94.00 pcf |
| Gross Annual Sediment Yield | 0.0103 acre-feet/acre/year |
| Sediment Delivery Ratio | 90% |
| Estimated Annual Sediment Yield | 0.0093 acre-feet/acre/year |
| | |
| Watershed Area | 147.51 acres |
| Watershed Annual Sediment Yield | 1.37 acre-feet/year |
| | |
| Number of Years | 1.00 years |
| Calculated Sediment Volume | 1.37 acre-feet |

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TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION
N9-B2 POND
November 16, 2004

PROGRAM INPUT DATA

| DESCRIPTION | VALUE |
|---|---|
| Flow Rate (cfs) | 96.58 |
| Channel Bottom Slope (ft/ft) | 0.005 |
| Manning's Roughness Coefficient (n-value) | 0.048 |
| Channel Left Side Slope (horizontal/vertical) | 3.0 |
| Channel Right Side Slope (horizontal/vertical) | 3.0 |
| Channel Bottom Width (ft) | 20.0 |

COMPUTATION RESULTS

| DESCRIPTION | VALUE |
|---|---|
| Critical Depth (ft) | 0.86 |
| Critical Slope (ft/ft) | 0.0372 |
| Flow Velocity (fps) | 4.98 |
| Froude Number | 1.0 |
| Velocity Head (ft) | 0.39 |
| Energy Head (ft) | 1.24 |
| Cross-Sectional Area of Flow (sq ft) | 19.39 |
| Top Width of Flow (ft) | 25.15 |

HYDROCALC Hydraulics for Windows, Version 1.2 Copyright (c) 1996
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# N9-B2 POND OUTFLOW CHANNEL

Material: Riprap

*Trapezoidal Channel*

| Bottom Width (ft) | Left Sideslope Ratio | Right Sideslope Ratio | Slope (%) | Freeboard Depth (ft) | Freeboard % of Depth | Freeboard Mult. x (VxD) |
|---|---|---|---|---|---|---|
| 20.00 | 3.0:1 | 3.0:1 | 25.0 | 1.00 | | |

## PADER Method - Steep Slope Design

| | w/o Freeboard | w/ Freeboard |
|---|---|---|
| Design Discharge: | 96.58 cfs | |
| Depth: | 0.56 ft | 1.56 ft |
| Top Width: | 23.39 ft | 29.39 ft |
| Velocity: | 7.89 fps | |
| X-Section Area: | 12.24 sq ft | |
| Hydraulic Radius: | 0.519 | |
| Froude Number: | 1.92 | |
| Manning's n: | 0.0610 | |
| Dmin: | 3.00 in | |
| D50: | 6.00 in | |
| Dmax: | 9.00 in | |

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APPENDIX B

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

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# Peabody Western Coal
# Kayenta Mine
# N9-B2 POND DESIGN
# 10YR 24HR STORM

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# *General Information*

## *Storm Information:*

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

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## *Structure Summary:*

| | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|
| #1 | 147.510 | 147.510 | 83.63 | 8.79 |

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# *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 | 147.510 | 0.289 | 0.000 | 0.000 | 82.000 | F | 83.63 | 8.795 |
| | $\sum$ | **147.510** | | | | | | **83.63** | **8.795** |

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APPENDIX C

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

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# Peabody Western Coal
# Kayenta Mine
# N9-B2 POND DESIGN
# 25YR 6HR STORM

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# *General Information*

## *Storm Information:*

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

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## *Structure Summary:*

| | | Immediate Contributing Area (ac) | Total Contributing Area (ac) | Peak Discharge (cfs) | Total Runoff Volume (ac-ft) |
|---|---|---|---|---|---|
| #1 | In | 147.510 | 147.510 | 96.58 | 7.18 |
| | Out | | | 51.30 | 7.18 |

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# *Structure Detail:*

*Structure #1 (Pond)*

*N9-B2 POND*

Pond Inputs:

| | |
|---|---|
| Initial Pool Elev: | 6,776.80 |
| Initial Pool: | 19.55 ac-ft |

## Emergency Spillway

| Spillway Elev | Crest Length (ft) | Left Sideslope | Right Sideslope | Bottom Width (ft) |
|---|---|---|---|---|
| 6,776.80 | 34.20 | 3.00:1 | 3.00:1 | 20.00 |

Pond Results:

| | |
|---|---|
| Peak Elevation: | 6,777.85 |
| Dewater Time: | 0.35 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) |
|---|---|---|---|---|
| 6,760.00 | 0.475 | 0.000 | 0.000 | |
| 6,760.50 | 0.514 | 0.247 | 0.000 | |
| 6,761.00 | 0.554 | 0.514 | 0.000 | |
| 6,761.50 | 0.596 | 0.802 | 0.000 | |
| 6,762.00 | 0.640 | 1.111 | 0.000 | |
| 6,762.50 | 0.685 | 1.442 | 0.000 | |
| 6,763.00 | 0.731 | 1.796 | 0.000 | |
| 6,763.50 | 0.779 | 2.173 | 0.000 | |
| 6,764.00 | 0.829 | 2.575 | 0.000 | |
| 6,764.50 | 0.880 | 3.002 | 0.000 | |
| 6,765.00 | 0.932 | 3.455 | 0.000 | |
| 6,765.50 | 0.959 | 3.928 | 0.000 | |
| 6,766.00 | 0.985 | 4.414 | 0.000 | |
| 6,766.50 | 1.012 | 4.913 | 0.000 | |
| 6,767.00 | 1.039 | 5.426 | 0.000 | |
| 6,767.50 | 1.067 | 5.953 | 0.000 | |
| 6,768.00 | 1.095 | 6.493 | 0.000 | |

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| Elevation | Area (ac) | Capacity (ac-ft) | Discharge (cfs) | Dewater Time (hrs) | |
|---|---|---|---|---|---|
| 6,768.50 | 1.124 | 7.048 | 0.000 | | |
| 6,769.00 | 1.152 | 7.617 | 0.000 | | |
| 6,769.50 | 1.181 | 8.200 | 0.000 | | |
| 6,770.00 | 1.211 | 8.798 | 0.000 | | |
| 6,770.50 | 1.264 | 9.417 | 0.000 | | |
| 6,771.00 | 1.318 | 10.062 | 0.000 | | |
| 6,771.50 | 1.374 | 10.735 | 0.000 | | |
| 6,772.00 | 1.430 | 11.437 | 0.000 | | |
| 6,772.50 | 1.488 | 12.166 | 0.000 | | |
| 6,773.00 | 1.547 | 12.925 | 0.000 | | |
| 6,773.50 | 1.607 | 13.713 | 0.000 | | |
| 6,774.00 | 1.668 | 14.532 | 0.000 | | |
| 6,774.50 | 1.731 | 15.382 | 0.000 | | |
| 6,775.00 | 1.794 | 16.263 | 0.000 | | |
| 6,775.50 | 1.812 | 17.164 | 0.000 | | |
| 6,776.00 | 1.829 | 18.075 | 0.000 | | |
| 6,776.50 | 1.847 | 18.994 | 0.000 | | |
| 6,776.80 | 1.858 | 19.549 | 0.000 | | Spillway #1 |
| 6,777.00 | 1.890 | 19.924 | 6.305 | 5.15 | |
| 6,777.50 | 1.971 | 20.890 | 22.053 | 2.40 | |
| 6,777.85 | 2.030 | 21.603 | 51.302 | 0.80 | Peak Stage |
| 6,778.00 | 2.054 | 21.896 | 63.313 | | |
| 6,778.50 | 2.139 | 22.944 | 121.954 | | |
| 6,779.00 | 2.226 | 24.036 | 193.061 | | |
| 6,779.50 | 2.314 | 25.170 | 282.223 | | |
| 6,780.00 | 2.404 | 26.350 | 391.648 | | |

## Detailed Discharge Table

| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 6,760.00 | 0.000 | 0.000 |
| 6,760.50 | 0.000 | 0.000 |
| 6,761.00 | 0.000 | 0.000 |
| 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 |

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| Elevation | Emergency Spillway (cfs) | Combined Total Discharge (cfs) |
|---|---|---|
| 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 | 0.000 | 0.000 |
| 6,770.50 | 0.000 | 0.000 |
| 6,771.00 | 0.000 | 0.000 |
| 6,771.50 | 0.000 | 0.000 |
| 6,772.00 | 0.000 | 0.000 |
| 6,772.50 | 0.000 | 0.000 |
| 6,773.00 | 0.000 | 0.000 |
| 6,773.50 | 0.000 | 0.000 |
| 6,774.00 | 0.000 | 0.000 |
| 6,774.50 | 0.000 | 0.000 |
| 6,775.00 | 0.000 | 0.000 |
| 6,775.50 | 0.000 | 0.000 |
| 6,776.00 | 0.000 | 0.000 |
| 6,776.50 | 0.000 | 0.000 |
| 6,776.80 | 0.000 | 0.000 |
| 6,777.00 | 6.305 | 6.305 |
| 6,777.50 | 22.053 | 22.053 |
| 6,778.00 | 63.313 | 63.313 |
| 6,778.50 | 121.954 | 121.954 |
| 6,779.00 | 193.061 | 193.061 |
| 6,779.50 | 282.223 | 282.223 |
| 6,780.00 | 391.648 | 391.648 |

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# *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 | 147.510 | 0.289 | 0.000 | 0.000 | 82.000 | F | 96.58 | 7.176 |
| | $\sum$ | **147.510** | | | | | | **96.58** | **7.176** |

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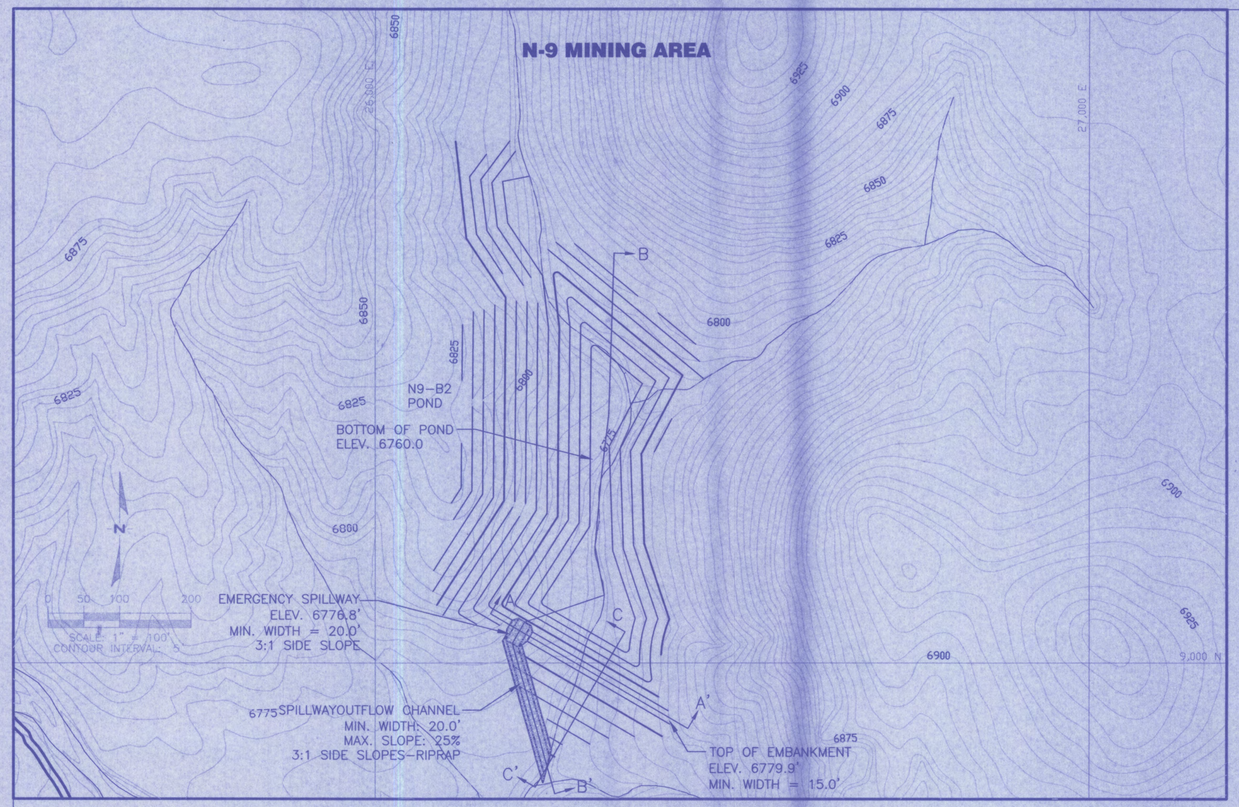
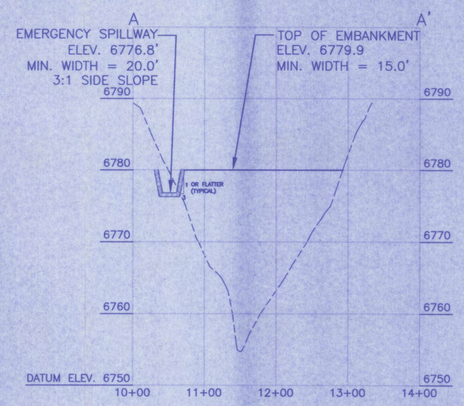
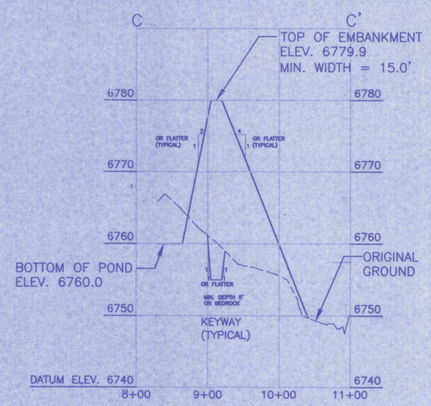
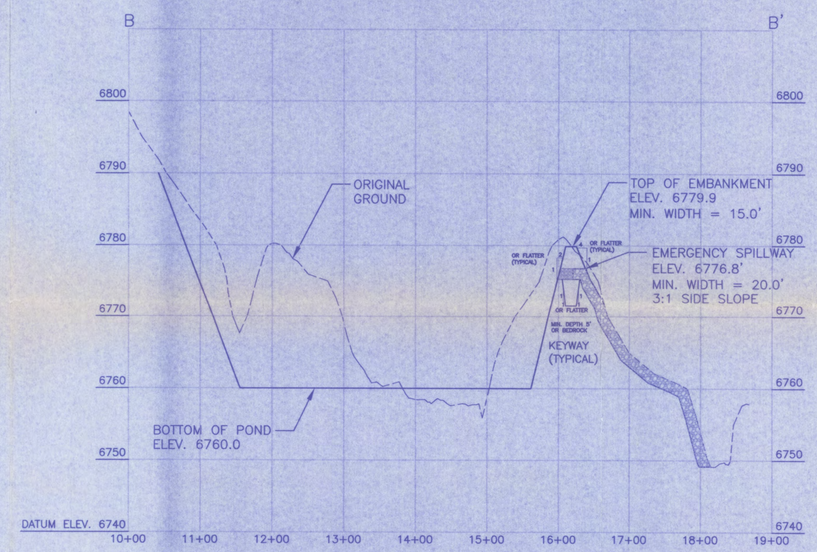


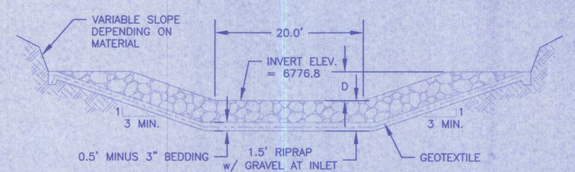

SECTION A – A'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION C – C'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SECTION B – B'
SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'




SPILLWAY MIN. D=2.0'
OUTFLOW CHANNEL MIN. D=2.0'

SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N9-B2 POND

N9-B2 POND STAGE CAPACITY TABLE

| ELEVATION (ft-msl) | STAGE (ft) | AREA (acres) | TOTAL CAPACITY (ac-ft) | DESCRIPTION |
|---|---|---|---|---|
| 6760.0 | 0.0 | 0.51 | 0.00 | BOTTOM OF POND |
| 6765.0 | 5.0 | 0.87 | 3.46 | INCISED ELEV. |
| 6770.0 | 10.0 | 1.27 | 8.80 | |
| 6775.0 | 15.0 | 1.72 | 16.26 | |
| 6776.8 | 16.8 | 1.93 | 19.55 | EMERGENCY SPILLWAY |
| 6779.9 | 19.9 | 2.32 | 26.35 | TOP OF EMBANKMENT |

ENGINEER'S CERTIFICATION

JAMES G. GLENDENINGT
Engineering Supervisor
Peabody Western Coal Company

ARIZONA P.E. 18782

Date: DEC 23 2004

SEP 2005
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NOTES:
1) General location, see Drawing No. 85400, Sheet K-6 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the distrubed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.


WOODSON
ENGINEERING AND SURVEYING, INC.
124 N. ELDEN ST.
FLAGSTAFF, AZ. 86001
PHONE: (928) 774-4636 FAX: (928) 774-4646


EXHIBIT # 1
PROPOSED N9-B2
SEDIMENTATION POND DESIGN

KAYENTA MINE
PEABODY WESTERN COAL COMPANY
P. O. BOX 650 KAYENTA, ARIZONA 86033

| | |
|---|---|
| DESIGNED BY: GA | SCALE: AS NOTED |
| DRAWN BY: PEK | DRAWING DATE: 11-22-04 |
| CHECKED BY: JGS | PHOTO DATE: 05-83 |
| CONTOUR INTERVAL: 5 FT. | DWG FILE: POND N9-B2.DWG |