

DESIGN REPORT

Permanent Impoundment

N7-E

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

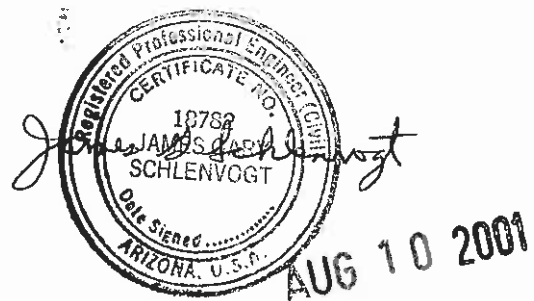


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INTRODUCTION

Pond N7-E is an existing impoundment constructed by Peabody Western Coal Company (PWCC) in 1990 in the N-7/N-8 reclamation 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.

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.

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.

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.

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.

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:

	<u>100-Year, 6-Hour</u>
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).

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

N7-E POND HYDRAULICS TABLE

	<u>Units</u>	<u>Inflow (100-yr, 6-hr storm)</u>
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.

<u>Input Parameters</u>	<u>Inlet Channel A</u>		<u>Inlet Channel B</u>
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
<u>Channel Design</u>			
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

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)	3:1 or 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:

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

Table 1

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

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

Location: Uncensored Data Censored Data

Elevation: 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	10.80	32.40	1	<	3.80	<	3.80
Conductivity UMHOS/CM	11	429.45	255.23	1014.00					
Field Salinity 0/00	10	.15	.10	.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	128.00					
Alk, Bicarb As CaCO3 MG/L	9	87.00	26.80	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	<	2.00
Barium, Dissolved UG/L	3	65.33	15.01	80.00	2	<	1.00	<	1.00
Boron, Dissolved UG/L	10	56.00	15.06	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	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	14.00	1	<	1.00	<	1.00
Chromium, Dissolved UG/L					3	<	10.00	<	10.00
Conductivity UMS/CM2	11	437.27	245.63	965.00	2	<	10.00	<	10.00
Copper, Dissolved U/G/L	1	10.00	10.00	10.00					
Fluoride MG/L	11	.50	.11	.70					
Hardness As CaCO3 MG/L	11	184.09	115.59	439.00					
Iron, Total MG/L	11	11.28	14.67	51.00					
Iron, Dissolved MG/L	11	.07	.04	.13					
Lead, Dissolved UG/L					3	<	20.00	<	20.00
Magnesium, Dissolved MG/L	11	15.58	10.99	40.40					
Manganese, Total MG/L	11	.23	.26	.94					
Manganese, Dissolved MG/L	9	.03	.02	.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

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

Location:

Elevation:

Laboratory Parameters	Uncensored Data				Censored Data			
	No of Obs	Mean	StDv	Min	Max	No of Obs	Min	Max
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			
Nitrite Nitrogen_N MG/L	6	.11	.06	.04	.22	1	.02	.02
NO3_NO2 Nitrogen_N MG/L	10	1.03	1.75	.03	5.80	5	.01	.01
Ph At 25 Deg. Cent. S.U.	11	7.35		6.80	8.30	1	.02	.02
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

Table 1. (cont.)

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			

----- 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	1/0	12/09/92-12/09/92	1482.0000 - 1482.0000	3482.0000
Total Recoverable Al	0.0000 - 5.0000	2	N7-D-P N7-E-P	1/8 6/11	09/01/99-09/01/99 09/02/93-07/10/99	17.0000 - 5.8500 - 49.9000	17.0000 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				

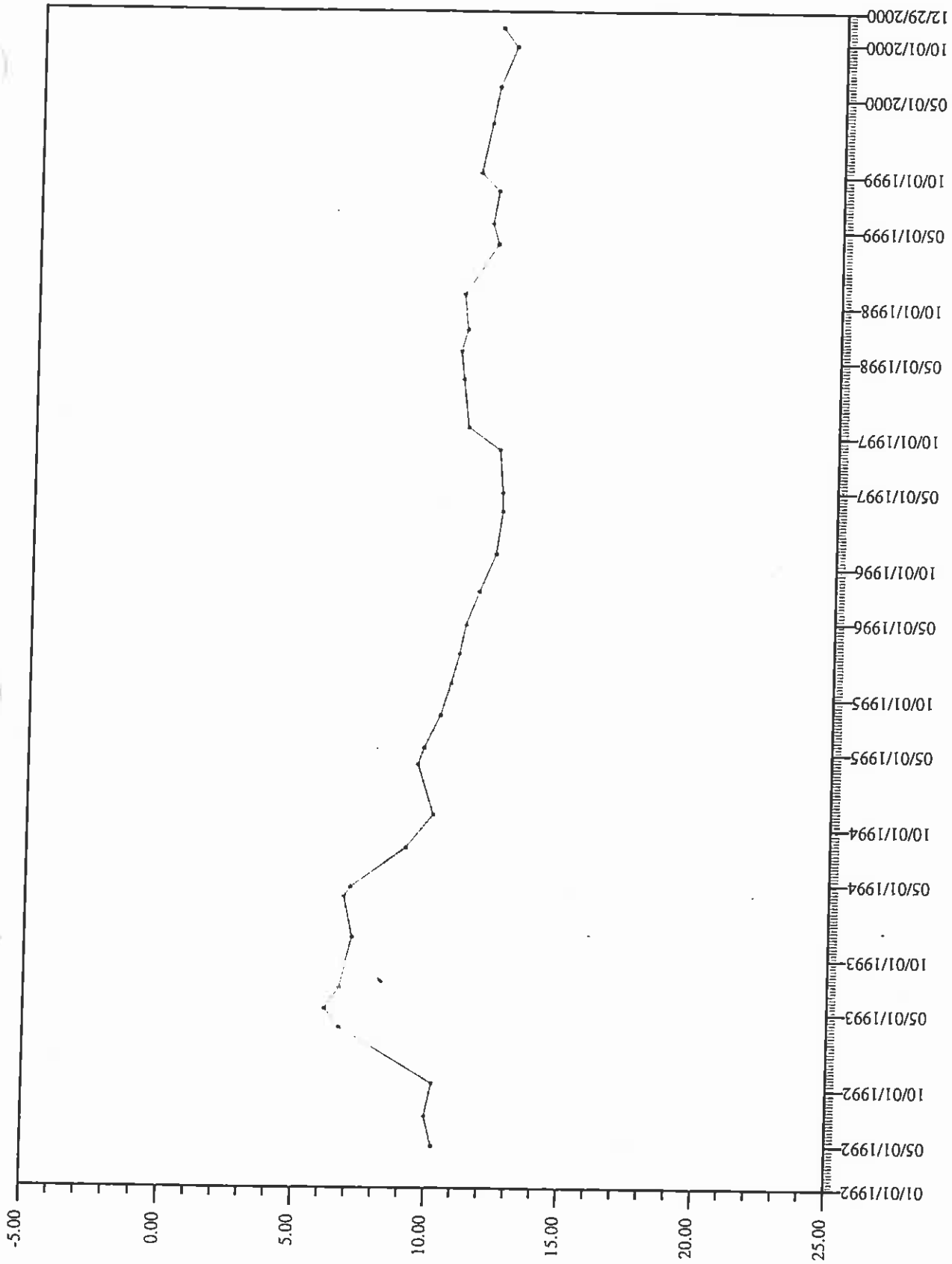
Table 2. (cont.)

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.

ALUV180

WATER LEVEL HYDROGRAPH



ALUV181

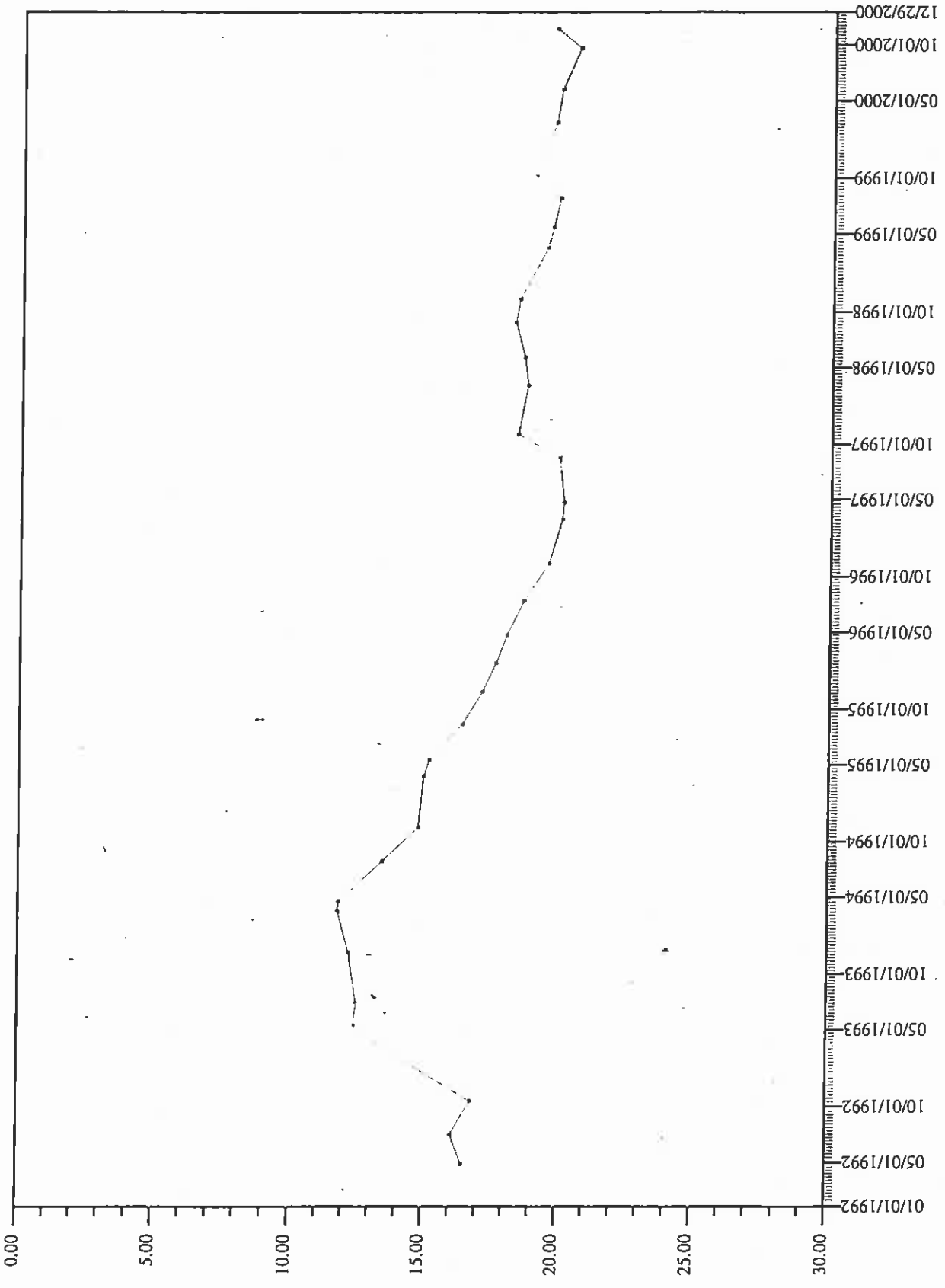
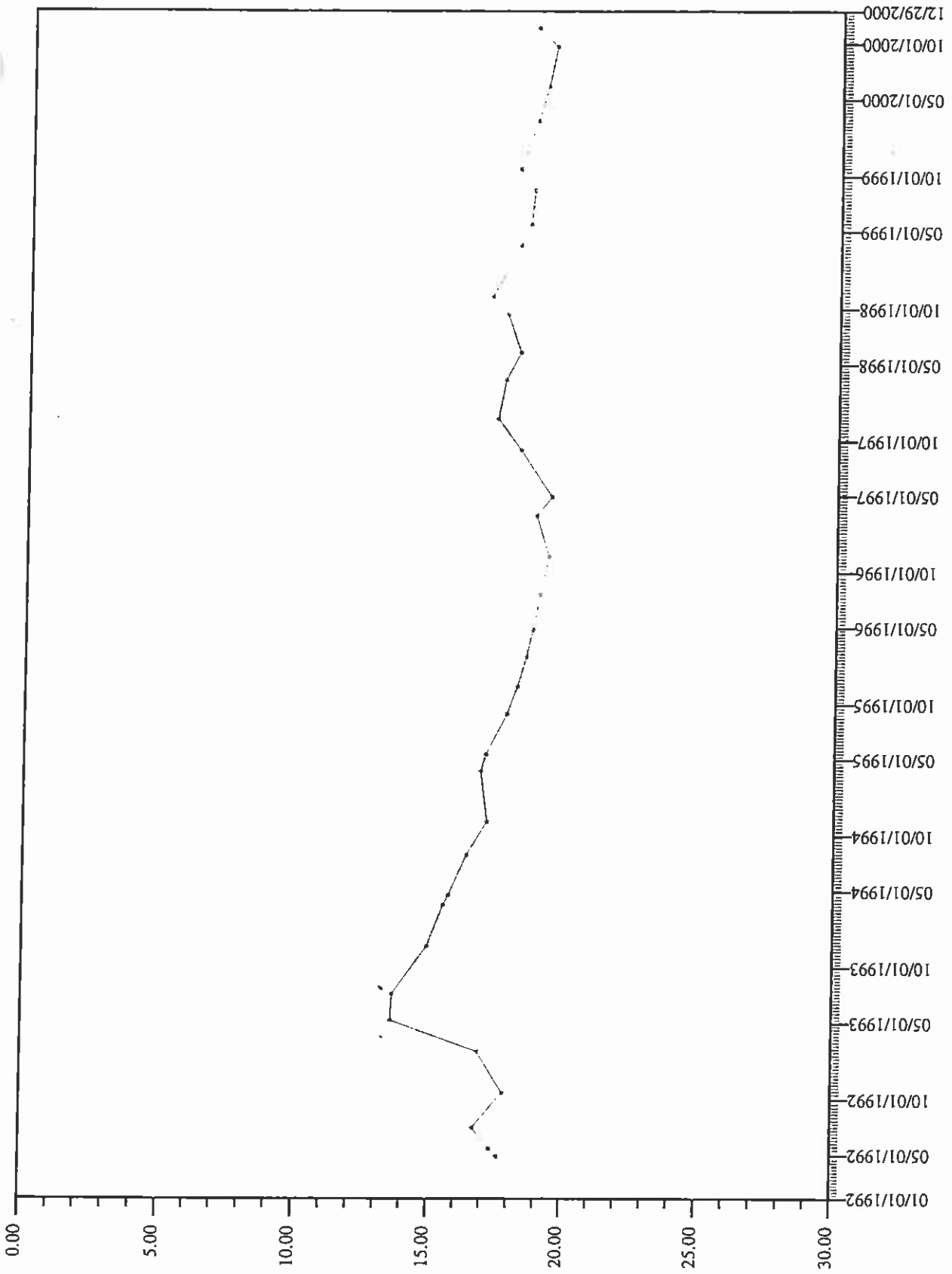


Figure 2

ALUVI182



WATER LEVEL HYDROGRAPH

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

**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 (m) = 1.447

$T_c = (11.9L^3/E)^{0.385} = \underline{\underline{0.442 \text{ hours}}}$

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

**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

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

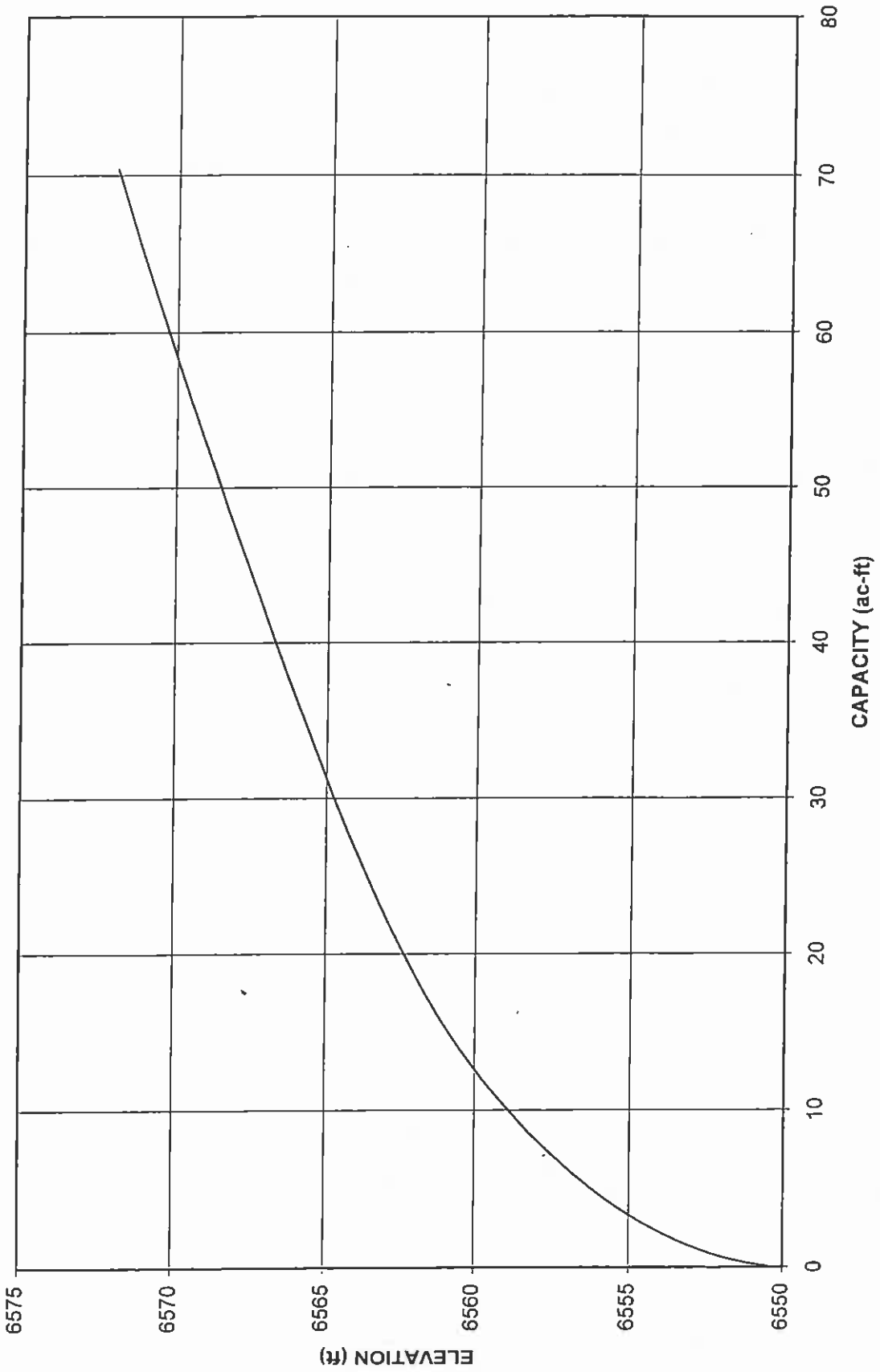
PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: N7E POND

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

<u>PARAMETER DESCRIPTION</u>	<u>VALUE</u>
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

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	

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	

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	

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	

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	

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	

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	ft ²
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.		

APPENDIX B

Water Persistence Calculations

PEABODY WESTERN COAL CO
N7E PERMANENT IMPOUNDMENT POND WATER

	January	February	March	April	May	June	July	August	September	October
Average Precipitation (inch)	0.95	0.86	0.89	0.58	0.45	0.48	1.49	1.49	0.95	1.0
Area (acres)	246.9	246.9	246.9	246.9	246.9	246.9	246.9	246.9	246.9	246
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	2.9
Run-Off (inches)	0.04	0.02	0.03	0.00	0.00	0.00	0.21	0.21	0.04	0.0
Run-Off (ac-ft)	0.77	0.44	0.54	0.00	0.00	0.00	4.23	4.23	0.77	1.4
Starting Pond Volume (ac-ft)	0	0.68	0.92	1.09	0.62	0.21	0.00	2.98	5.73	5.3
Pond Volume + Runoff (ac-ft)	0.77	1.12	1.46	1.09	0.62	0.21	4.23	7.21	6.50	6.7
Water Elevation (ft)	6552	6552.5	6553	6552.5	6551.5	6551	6555.5	6557.5	6557	655
Water Surface Area (acres)	0.55	0.66	0.77	0.66	0.43	0.32	1.36	1.86	1.73	1.7
Evaporation Rate (inches/month)	0.87	2.63	4.68	7.38	10.54	10.77	9.85	8.49	7.08	4.6
Evaporation (ac-ft)	0.04	0.14	0.30	0.41	0.38	0.29	1.12	1.31	1.02	0.6
Infiltration Rate (Inches/month)	1.054	0.952	1.054	1.02	1.054	1.02	1.054	1.054	1.02	1.0
Infiltration (ac-ft)	0.05	0.05	0.07	0.08	0.04	0.03	0.12	0.16	0.15	0.1
Total Water Loss (ac-ft)	0.09	0.20	0.37	0.46	0.42	0.31	1.24	1.48	1.17	0.8
Total Water Change (ac-ft)	0.68	0.24	0.17	-0.46	-0.42	-0.31	2.98	2.75	-0.40	0.6
Ending Pond Volume	0.68	0.92	1.09	0.82	0.21	0.00	2.98	5.73	5.33	5.9

Notes:

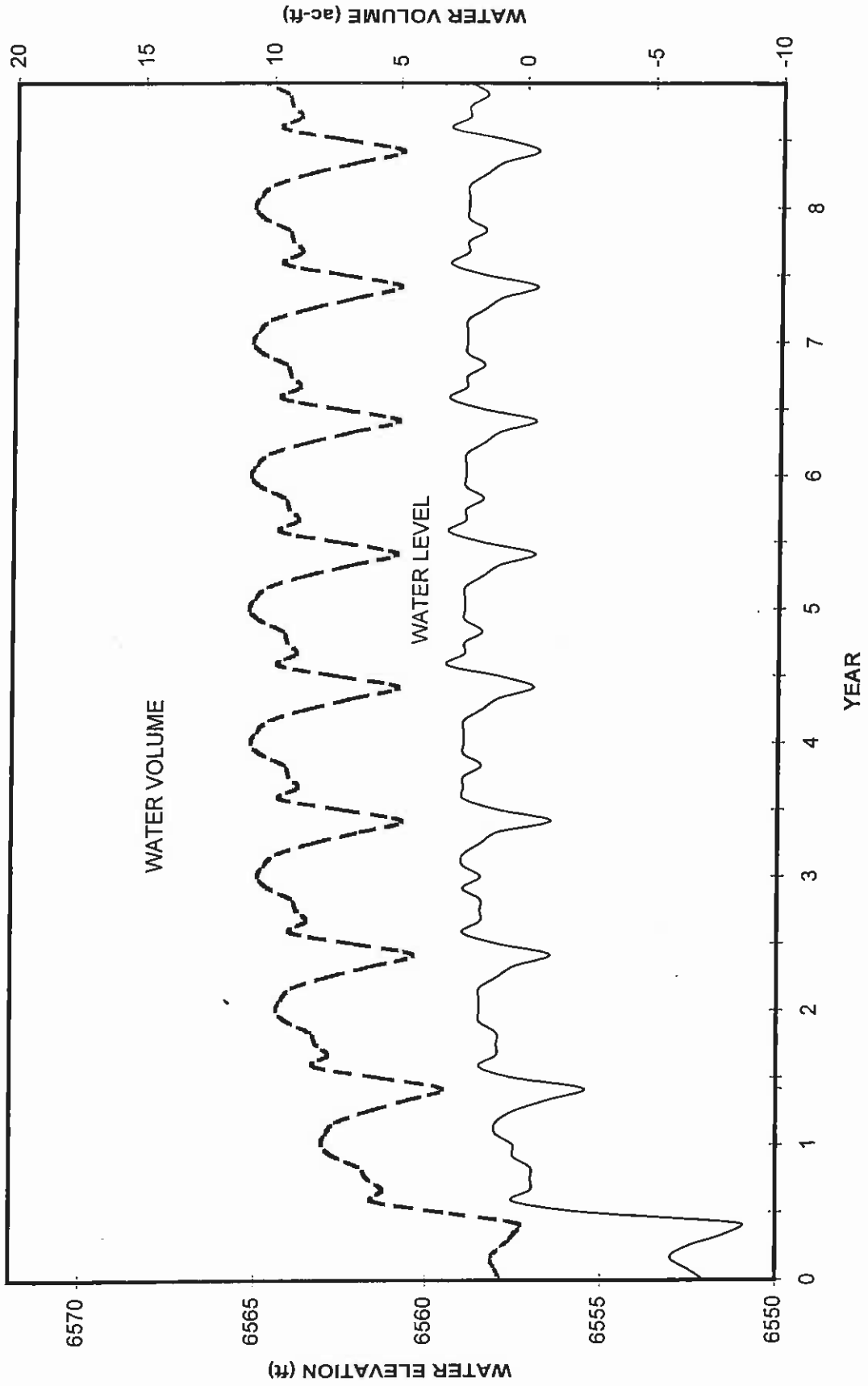
1) Run-off volumes based on SCS Runoff Curve Number method: $Q = (P-0.2S)^2 / (P+0.8S)$

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 P

N7E PERMANENT IMPOUNDMENT
WATER PERSISTENCE EVALUATION



APPENDIX C

SEDCAD4 (Input and Output)

PEABODY WESTERN
KAYENTA MINE
POND N7E

100 year, 6 hour

DJK

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

Phone: 303 763-5140

General Information

Storm Information:

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

Structure Networking:

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



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

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	

SEDCAD 4 for Windows

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Civil Software Design

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	

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

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
Σ		246.900						207.12	17.937

PEABODY WESTERN
KAYENTA MINE
POND N7E

10 year, 24 hour

DJK

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

Phone: 303 763-5140

General Information

Storm Information:

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

Structure 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

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

Structure Detail:

Structure #1 (Null)

Runoff to Pond N7E