DESIGN REPORT

Temporary Sedimentation Structure

N11-J (Lower)

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

DEC 2004 APPROVED

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

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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 -N11-J2, N11-J1, and N11-J Proposed Sedimentation Ponds

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INTRODUCTION

Sedimentation Structure N11-J 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 N11 Extension disturbed surface mining area at the Kayenta Mine. The location of Structure N11-J and its watershed boundary are shown on Drawing No. 85400, (Sheet L-8), 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 N11-J that is in series with sedimentation structures N11-J1 & N11-J2. N11-J 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 N11-J was inspected in December, 2003 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

The N11-J, N11-J1 and N11-J2 Structures have a combined watershed of 595.6 acres and are located on a tributary upstream of Moenkopi Wash at the Kayenta Mine. The 51.8-acre watershed, which contributes directly to structure N11-J, is classified as 100% undisturbed.

DESIGN ANALYSES

GENERAL

Structure N11-J was designed under the supervision of a Registered Professional Engineer from Peabody Western Coal Company. The design was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of Interior, Office of Surface Mining (OSM) and included a review of available project files. The most current information contained in the Peabody Western Coal Company files includes topographic maps developed from aerial photography flown in 1999 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure N11-J 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 23 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 40-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 N11-J will be constructed in series with proposed Structures N11-J1 and N11-J2. Structure N11-J 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 N11-J 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 Moenkopi Wash.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.405 mi.
2.	Elevation Difference, H	295 ft
3.	Time of Concentration, T_c	0.102 hr
4.	NRCS Curve Number	78
5.	Rainfall Depth, 10-year, 24-hour storm 100-year, 6-hour storm	2.1 in 2.4 in
6.	Drainage Area	51.8 acres

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Values reported represent the watershed, which drains directly to Pond N11-J. Hydrologic input parameters for structure N11-J1 and N11-J2 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 Flow Master computer programs were used to evaluate inflow to the sedimentation structure, outflow from the structure and the resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following table (supporting calculations are presented in Appendices A, B, and C).

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N11-J 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	32.4	375.9
Volume	ac-ft	2.33	46.9
Storage			
Peak Stage	msl	N/A	6667.0
Emerg. Spillway Elev.	msl	6664.8	6664.8
Peak Storage	ac-ft	N/A	20.5
Storage Capacity	ac-ft	16.7	16.7
Outflow			
Peak Flow	cfs	N/A	354.5
Spillway Elevation	msl	6664.8	6664.8
Embankment Crest Elev.	msl	6668.5	6668.5
Peak Stage	msl	--	6667.0
Freeboard	ft	--	1.5
Emergency Spillway Channel			
Flow Depth	ft	--	2.2
Critical Velocity	fps	--	6.2
Mannings "n"	--	--	0.03
Width	ft	--	40
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 N11-J will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway)	3.2	ft
	(Outflow)	1.9	ft
Channel Width		40	ft
Channel Length	(Spillway)	46	ft
	(Outflow)	150	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6664.8	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 1999 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N11-J is designed to contain approximately 16.7 acre-feet.

The calculations for the sediment load entering structure N11-J were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

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1.	Rainfall Factor, R	40
	Soil Erodibility Factor, K	0.19
	Slope Factor, LS	6.72
4.	Cover Factor, C	0.22
5.	Erosion Control Factor, P	1.0

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 N11-J has sufficient storage capacity to contain the 10-year, 24-hour storm and has additional capacity to store excess runoff from the N11-J1 and N11-J2 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 N11-J2, N11-J1 and N11-J

	N11-J2 (Upper)	N11-J1 (Middle)	N11-J (Lower)	COMBINED
Total Storage Capacity (ac-ft)	19.85	19.82	16.66	56.33
10-Year, 24-Hour Storm Inflow(ac-ft)	31.24	2.77	2.33	36.34
Available Sediment Storage Capacity	-	-	-	19.99
Sediment Inflow Rate/Year (ac-ft/yr)	5.57	0.26	0.25	6.08
Sediment Storage Life (yr)	-	-	-	3.3

* * *

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- N11-J2, N11-J1and N11-J Proposed Sedimentation Ponds

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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CALCULATED HYDROLOGIC DATA

PROJECT: N11/N6 AREA

STRUCTURE: N11-J (Lower) Pond

TIME OF CONCENTRATION:

Start Elevation (ft) =	6945
End Elevation (ft) =	6650
Elevation Difference, E (ft) =	295
Watercourse Length (ft) =	2136
Watercourse Length, L (mi) =	0.405
Tc = (11.9L^3/E)^0.385 =	0.102 hours

ROUTING PARAMETERS:

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

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Pinyon Juniper	B	65	10.5	682.5
Pinyon Juniper	D	83	37.7	3129.1
Sagebrush	B	60	3.6	216
TOTAL:			51.8	4027.6

Weighted CN = Total CN*Area/ Total Area = 78

Note: During operations the open pit will collect most of the runoff from disturbed areas. The worst case is when the final pit is reclaimed and runoff from a large area of regraded spoil reports directly to the pond.

DRAINAGE BASIN AREA:

51.8 Acres

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CALCULATED SEDIMENTOLOGY DATA

STRUCTURE: N11-J (Lower) Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
1AB	0.16	1.9	0.30
3CD	0.16	8.5	1.36
3DE	0.15	16.4	2.46
7E	0.14	8.6	1.20
16C/16CE/16F	0.05	7.2	0.36
15A	0.37	3.6	1.33
X11AB	0.46	5.6	2.58
TOTAL:		51.8	9.60

Weighted K = Total K*Area/ Total Area = 0.19

SLOPE FACTOR:

Length (ft)		Slope (%)	m	Slope Angle (deg)	LS Factor
210	50	23.8%	0.6	13.4	6.41
220	80	36.4%	0.6	20.0	10.19
330	70	21.2%	0.6	12.0	7.41
280	40	14.3%	0.6	8.1	4.22
330	55	16.7%	0.6	9.5	5.61
280	90	32.1%	0.6	17.8	10.43
200	45	22.5%	0.6	12.7	5.86
200	30	15.0%	0.6	8.5	3.66
	38				

Average LS = 6.72

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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STRUCTURE: N11-J (Lower) Pond

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Pinyon Juniper	20%	25%	48.2	0.22	10.60	1.00	48.20
Sagebrush/Grass	20%	25%	3.6	0.20	0.72	1.00	3.60
Spoil	0%	0%	0	1.00	0.00	0.80	0.00
Reclaimed	40%	0%	0	0.15	0.00	0.40	0.00
TOTAL:			51.8		11.32		51.80

Weighted C = Total C*Area/ Total Area = 0.219

Weighted P = Total P*Area/ Total Area = 1.000

RAINFALL FACTOR:

R = 40

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CALCULATED SEDIMENT YIELD

STRUCTURE: N11-J (Lower) 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.

PARAMETER DESCRIPTION	VALUE	
Annual Rainfall Factor	40.00	
Soil Erodibility Factor	0.19	
Length Slope Factor	6.72	
Cover Factor	0.22	
Practice Factor	1.00	
Gross Annual Sediment Yield	10.89	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0053	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0048	acre-feet/acre/year
Watershed Area	51.8	acres
Watershed Annual Sediment Yield	0.25	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	0.25	acre-feet

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N11-J Critical Velocity
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	0.012500	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	40.00	ft
Discharge	354.50	cfs

Results		
Depth	1.30	ft
Flow Area	57.16	ft²
Wetted Perimeter	48.23	ft
Top Width	47.81	ft
Critical Depth	1.30	ft
Critical Slope	0.012503	ft/ft
Velocity	6.20	ft/s
Velocity Head	0.60	ft
Specific Energy	1.90	ft
Froude Number	1.00	
Flow is subcritical.		

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POND N11-J EMERGENCY SPILLWAY

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
40.00	3.0:1	3.0:1	25.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	354.50 cfs	
Depth:	0.85 ft	1.85 ft
Top Width:	45.08 ft	51.08 ft
Velocity:	9.83 fps	
X-Section Area:	36.05 sq ft	
Hydraulic Radius:	0.795	
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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N-6/N-11 Area

Pond N11-J

10-Year, 24-Hour 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	51.800	51.800	32.42	2.34

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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	51.800	0.102	0.000	0.000	78.000	F	32.42	2.337
	Σ	**51.800**						**32.42**	**2.337**

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APPENDIX C

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

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N-6/N-11 Area

Pond N11-J, N11-IJ, and N11-J2 in Series

100-Year, 6-Hour Storm

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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	==>	End	0.000	0.000	Pond N11-J (Lower)
Pond	#2	==>	#1	0.049	0.366	Pond N11-J1(Middle)
Pond	#3	==>	#2	0.036	0.388	Pond N11-J2 (Upper)

		#3 Pond
	#2 Pond	
#1 Pond		

Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	8. Large gullies, diversions, and low flowing streams	2.41	20.00	830.00	4.65	0.049
#2	**Muskingum K:**					**0.049**
#3	8. Large gullies, diversions, and low flowing streams	3.87	30.00	775.00	5.90	0.036
#3	**Muskingum K:**					**0.036**

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Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	In	490.500	490.500	449.79	40.10
	Out			378.70	40.10
#2	In	53.300	543.800	394.37	43.74
	Out			361.69	43.74
#1	In	51.800	595.600	375.92	46.86
	Out			354.54	46.86

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Structure Detail:

Structure #3 (Pond)

Pond N11-J2 (Upper)

Pond Inputs:

Initial Pool Elev:	6,725.90
Initial Pool:	19.85 ac-ft

Pond Results:

Peak Elevation:	6,728.81
Dewater Time:	0.31 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)
6,710.00	0.520	0.000	0.000	
6,710.50	0.555	0.269	0.000	
6,711.00	0.591	0.555	0.000	
6,711.50	0.628	0.860	0.000	
6,712.00	0.666	1.183	0.000	
6,712.50	0.706	1.526	0.000	
6,713.00	0.746	1.889	0.000	
6,713.50	0.788	2.273	0.000	
6,714.00	0.831	2.678	0.000	
6,714.50	0.875	3.104	0.000	
6,715.00	0.920	3.553	0.000	
6,715.50	0.966	4.024	0.000	
6,716.00	1.013	4.519	0.000	
6,716.50	1.061	5.038	0.000	
6,717.00	1.111	5.581	0.000	
6,717.50	1.161	6.148	0.000	
6,718.00	1.213	6.742	0.000	
6,718.50	1.265	7.361	0.000	
6,719.00	1.319	8.007	0.000	
6,719.50	1.374	8.680	0.000	
6,720.00	1.430	9.381	0.000	
6,720.50	1.484	10.110	0.000	
6,721.00	1.540	10.866	0.000	
6,721.50	1.596	11.650	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,722.00	1.654	12.463	0.000		
6,722.50	1.712	13.304	0.000		
6,723.00	1.772	14.175	0.000		
6,723.50	1.832	15.076	0.000		
6,724.00	1.894	16.008	0.000		
6,724.50	1.956	16.970	0.000		
6,725.00	2.020	17.964	0.000		
6,725.50	2.103	18.995	0.000		
6,725.90	2.171	19.849	0.000		
6,726.00	2.188	20.068	5.555	3.30	
6,726.50	2.274	21.183	33.305	1.00	
6,727.00	2.362	22.342	61.054	1.50	
6,727.50	2.451	23.545	128.176	0.80	
6,728.00	2.543	24.793	207.350	0.40	
6,728.50	2.635	26.088	304.651	0.25	
6,728.81	2.694	26.913	378.699	0.15	Peak Stage
6,729.00	2.730	27.429	424.946		
6,729.50	2.800	28.811	566.846		

Detailed Discharge Table

Elevation	Combined Total Discharge (cfs)
6,710.00	0.000
6,710.50	0.000
6,711.00	0.000
6,711.50	0.000
6,712.00	0.000
6,712.50	0.000
6,713.00	0.000
6,713.50	0.000
6,714.00	0.000
6,714.50	0.000
6,715.00	0.000
6,715.50	0.000
6,716.00	0.000
6,716.50	0.000
6,717.00	0.000
6,717.50	0.000
6,718.00	0.000

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Elevation	Combined Total Discharge (cfs)
6,718.50	0.000
6,719.00	0.000
6,719.50	0.000
6,720.00	0.000
6,720.50	0.000
6,721.00	0.000
6,721.50	0.000
6,722.00	0.000
6,722.50	0.000
6,723.00	0.000
6,723.50	0.000
6,724.00	0.000
6,724.50	0.000
6,725.00	0.000
6,725.50	0.000
6,725.90	0.000
6,726.00	5.555
6,726.50	33.305
6,727.00	61.054
6,727.50	128.176
6,728.00	207.350
6,728.50	304.651
6,729.00	424.946
6,729.50	566.846

Structure #2 (Pond)

Pond N11-J1(Middle)

Pond Inputs:

Initial Pool Elev:	6,697.40
Initial Pool:	19.82 ac-ft

Pond Results:

Peak Elevation:	6,699.66
Dewater Time:	0.32 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)	
6,680.00	0.360	0.000	0.000		
6,680.50	0.396	0.189	0.000		
6,681.00	0.434	0.397	0.000		
6,681.50	0.474	0.623	0.000		
6,682.00	0.515	0.871	0.000		
6,682.50	0.558	1.139	0.000		
6,683.00	0.603	1.429	0.000		
6,683.50	0.650	1.743	0.000		
6,684.00	0.698	2.079	0.000		
6,684.50	0.748	2.441	0.000		
6,685.00	0.800	2.828	0.000		
6,685.50	0.840	3.238	0.000		
6,686.00	0.880	3.668	0.000		
6,686.50	0.922	4.118	0.000		
6,687.00	0.965	4.590	0.000		
6,687.50	1.008	5.083	0.000		
6,688.00	1.053	5.598	0.000		
6,688.50	1.098	6.136	0.000		
6,689.00	1.144	6.696	0.000		
6,689.50	1.192	7.280	0.000		
6,690.00	1.240	7.888	0.000		
6,690.50	1.286	8.520	0.000		
6,691.00	1.333	9.175	0.000		
6,691.50	1.381	9.853	0.000		
6,692.00	1.430	10.556	0.000		
6,692.50	1.479	11.283	0.000		
6,693.00	1.530	12.035	0.000		
6,693.50	1.581	12.813	0.000		
6,694.00	1.633	13.617	0.000		
6,694.50	1.686	14.447	0.000		
6,695.00	1.740	15.303	0.000		
6,695.50	1.799	16.188	0.000		
6,696.00	1.858	17.102	0.000		
6,696.50	1.919	18.046	0.000		
6,697.00	1.980	19.021	0.000		
6,697.40	2.030	19.823	0.000		
6,697.50	2.043	20.027	8.680	3.60	
6,698.00	2.106	21.064	52.040	1.60	
6,698.50	2.171	22.133	95.399	1.40	
6,699.00	2.236	23.235	197.618	0.65	
6,699.50	2.303	24.370	315.922	0.35	
6,699.66	2.325	24.744	361.690	0.15	Peak Stage

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,700.00	2.370	25.538	458.824	
6,700.50	2.435	26.739	632.580	
6,701.00	2.500	27.973	834.292	

Detailed Discharge Table

Elevation	Combined Total Discharge (cfs)
6,680.00	0.000
6,680.50	0.000
6,681.00	0.000
6,681.50	0.000
6,682.00	0.000
6,682.50	0.000
6,683.00	0.000
6,683.50	0.000
6,684.00	0.000
6,684.50	0.000
6,685.00	0.000
6,685.50	0.000
6,686.00	0.000
6,686.50	0.000
6,687.00	0.000
6,687.50	0.000
6,688.00	0.000
6,688.50	0.000
6,689.00	0.000
6,689.50	0.000
6,690.00	0.000
6,690.50	0.000
6,691.00	0.000
6,691.50	0.000
6,692.00	0.000
6,692.50	0.000
6,693.00	0.000
6,693.50	0.000
6,694.00	0.000
6,694.50	0.000
6,695.00	0.000
6,695.50	0.000

DEC 2004
APPROVED

Elevation	Combined Total Discharge (cfs)
6,696.00	0.000
6,696.50	0.000
6,697.00	0.000
6,697.40	0.000
6,697.50	8.680
6,698.00	52.040
6,698.50	95.399
6,699.00	197.618
6,699.50	315.922
6,700.00	458.824
6,700.50	632.580
6,701.00	834.292

Structure #1 (Pond)

Pond N11-J (Lower)

Pond Inputs:

Initial Pool Elev:	6,664.80
Initial Pool:	16.66 ac-ft

Pond Results:

Peak Elevation:	6,667.04
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)
6,645.00	0.190	0.000	0.000	
6,645.50	0.212	0.101	0.000	
6,646.00	0.236	0.213	0.000	
6,646.50	0.261	0.337	0.000	
6,647.00	0.287	0.474	0.000	
6,647.50	0.314	0.624	0.000	
6,648.00	0.343	0.788	0.000	
6,648.50	0.373	0.967	0.000	
6,649.00	0.404	1.162	0.000	
6,649.50	0.436	1.372	0.000	
6,650.00	0.470	1.598	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,650.50	0.499	1.840	0.000		
6,651.00	0.529	2.097	0.000		
6,651.50	0.560	2.370	0.000		
6,652.00	0.592	2.658	0.000		
6,652.50	0.624	2.961	0.000		
6,653.00	0.658	3.282	0.000		
6,653.50	0.692	3.619	0.000		
6,654.00	0.727	3.974	0.000		
6,654.50	0.763	4.346	0.000		
6,655.00	0.800	4.737	0.000		
6,655.50	0.838	5.147	0.000		
6,656.00	0.877	5.575	0.000		
6,656.50	0.917	6.024	0.000		
6,657.00	0.957	6.492	0.000		
6,657.50	0.999	6.981	0.000		
6,658.00	1.041	7.491	0.000		
6,658.50	1.085	8.023	0.000		
6,659.00	1.129	8.576	0.000		
6,659.50	1.174	9.152	0.000		
6,660.00	1.220	9.750	0.000		
6,660.50	1.264	10.371	0.000		
6,661.00	1.308	11.014	0.000		
6,661.50	1.353	11.679	0.000		
6,662.00	1.399	12.367	0.000		
6,662.50	1.446	13.078	0.000		
6,663.00	1.493	13.813	0.000		
6,663.50	1.541	14.571	0.000		
6,664.00	1.590	15.354	0.000		
6,664.50	1.640	16.161	0.000		
6,664.80	1.670	16.658	0.000		
6,665.00	1.690	16.994	11.208	4.05	
6,665.50	1.700	17.841	39.202	1.20	
6,666.00	1.710	18.694	113.527	2.05	
6,666.50	1.720	19.551	218.928	0.60	
6,667.00	1.730	20.414	341.567	0.40	
6,667.04	1.754	20.490	354.535	0.10	Peak Stage
6,667.50	1.783	21.292	490.658		
6,668.00	1.836	22.196	669.416		
6,668.50	1.890	23.128	876.640		

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Detailed Discharge Table

Elevation	Combined Total Discharge (cfs)
6,645.00	0.000
6,645.50	0.000
6,646.00	0.000
6,646.50	0.000
6,647.00	0.000
6,647.50	0.000
6,648.00	0.000
6,648.50	0.000
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6,660.00	0.000
6,660.50	0.000
6,661.00	0.000
6,661.50	0.000
6,662.00	0.000
6,662.50	0.000
6,663.00	0.000
6,663.50	0.000
6,664.00	0.000
6,664.50	0.000
6,664.80	0.000

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Elevation	Combined Total Discharge (cfs)
6,665.00	11.208
6,665.50	39.202
6,666.00	113.527
6,666.50	218.928
6,667.00	341.567
6,667.50	490.658
6,668.00	669.416
6,668.50	876.640

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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	490.500	0.482	0.000	0.000	83.000	F	449.79	40.096
	Σ	**490.500**						**449.79**	**40.096**
#2	1	53.300	0.100	0.000	0.000	80.000	F	74.88	3.644
	Σ	**543.800**						**394.37**	**43.740**
#1	1	51.800	0.102	0.000	0.000	78.000	F	65.79	3.125
	Σ	**595.600**						**375.92**	**46.864**

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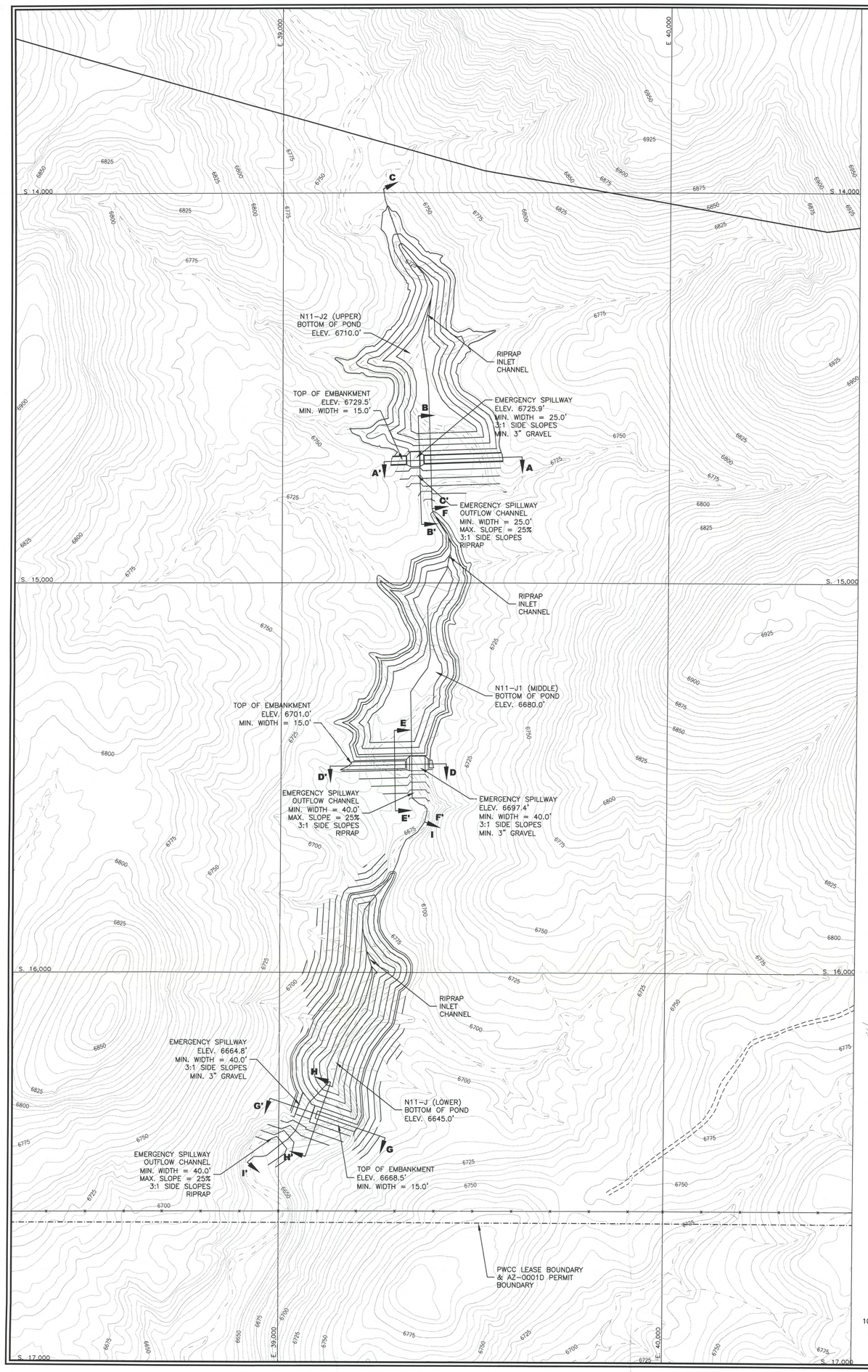
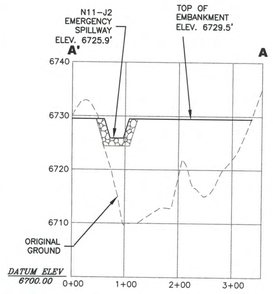
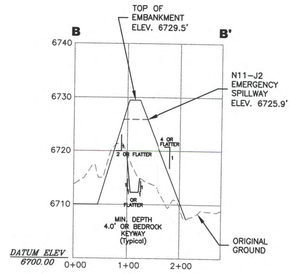
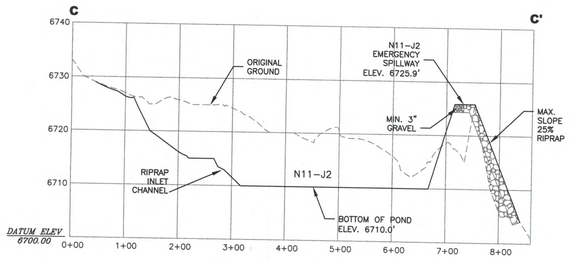




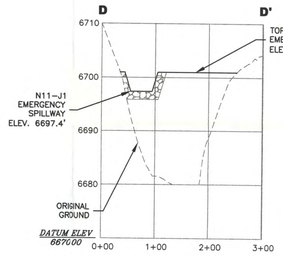
N11-J2 POND
CROSS-SECTION A-A'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



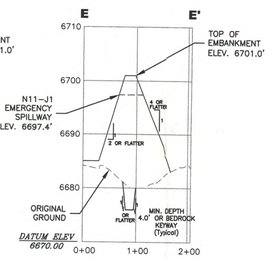
N11-J2 POND
CROSS-SECTION B-B'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



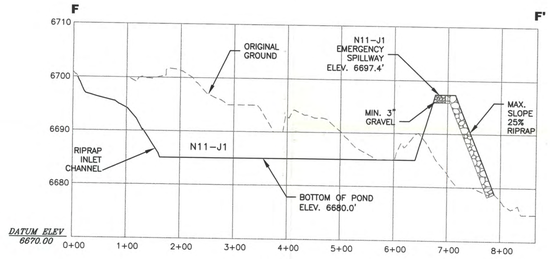
N11-J2 POND
CROSS-SECTION C-C'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



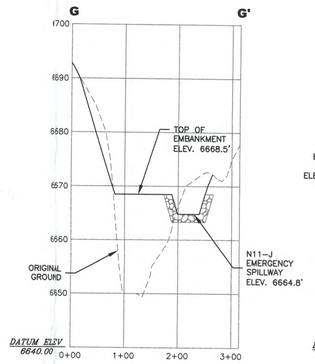
N11-J1 POND
CROSS-SECTION D-D'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



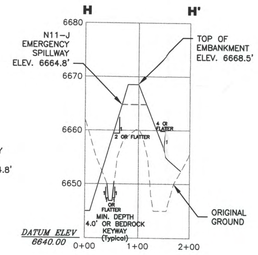
N11-J1 POND
CROSS-SECTION E-E'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



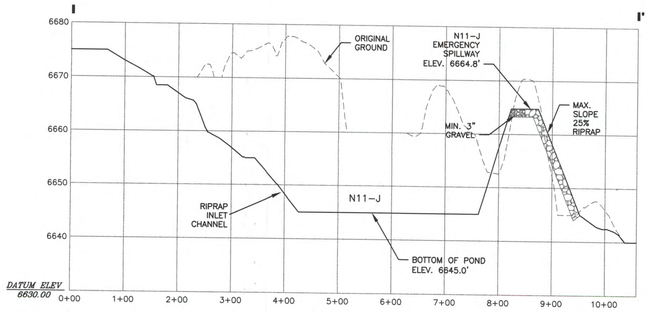
N11-J1 POND
CROSS-SECTION F-F'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



N11-J POND
CROSS-SECTION G-G'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



N11-J POND
CROSS-SECTION H-H'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



N11-J POND
CROSS-SECTION I-I'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'

N11-J2 POND STAGE CAPACITY TABLE

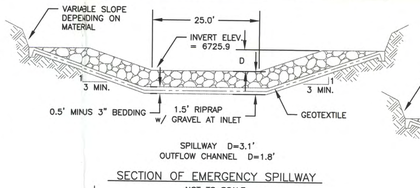
ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6710.0	0.0	0.52	0.00	BOTTOM OF POND
6715.0	5.0	0.92	3.55	
6720.0	10.0	1.43	9.38	
6725.0	15.0	2.02	17.96	
6725.9	15.9	2.17	19.85	EMERGENCY SPILLWAY
6729.5	19.5	2.80	28.81	TOP OF EMBANKMENT

N11-J1 POND STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6680.0	0.0	0.36	0.00	BOTTOM OF POND
6685.0	5.0	0.80	2.83	
6690.0	10.0	1.24	7.89	
6695.0	15.0	1.74	15.30	
6697.4	17.4	2.03	19.82	EMERGENCY SPILLWAY
6701.0	21.0	2.50	27.97	TOP OF EMBANKMENT

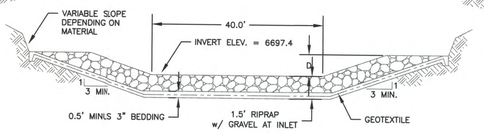
N11-J POND STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6645.0	0.0	0.19	0.00	BOTTOM OF POND
6650.0	5.0	0.47	1.60	
6655.0	10.0	0.80	4.34	
6660.0	15.0	1.22	9.75	
6664.8	19.8	1.67	16.66	EMERGENCY SPILLWAY
6668.5	23.5	1.89	23.13	TOP OF EMBANKMENT



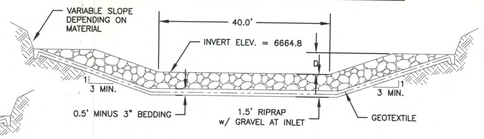
SPILLWAY D=3.1'
OUTFLOW CHANNEL D=1.8'

SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N11-J2 POND



SPILLWAY D=3.3'
OUTFLOW CHANNEL D=1.9'

SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N11-J1 POND



SPILLWAY D=3.2'
OUTFLOW CHANNEL D=1.9'

SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N11-J POND

PLAN VIEW

SCALE
100' 0 100' 200'
CONTOUR INTERVAL: 5FT.

ENGINEER'S CERTIFICATION

JAMES G. SCHLENVOGT
Engineering & Reclamation Manager
Peabody Western Coal Company

ARIZONA P.E. 18782
Date: AUG 13 2004

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REVISIONS		
DATE	CHK'D	DESCRIPTION
08/13/04	JGS	OSM RESPONSE

EXHIBIT #1
N11-J2, N11-J1 & N11-J
Proposed Sedimentation Ponds

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

DESIGNED BY: PWCC	AS SHOWN
DRAWN BY: MWH	DRAWING DATE: 12-15-2
CHECKED BY: J.G.S.	PHOTO DATE: 01-26-02
CONTOUR INT.: 5'	070103 J RmDsgn.dwg
	KAYFP1\

DESIGN REPORT

Temporary Sedimentation Structure

N11-J1 (Middle)

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

DEC 2004 APPROVED

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

DEC 15 2003

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 -N11-J2, N11-J1, and N11-J Proposed Sedimentation Ponds

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INTRODUCTION

Sedimentation Structure N11-J1 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 N11 Extension disturbed surface mining area at the Kayenta Mine. The location of Structure N11-J1 and its watershed boundary are shown on Drawing No. 85400 (Sheet L-8) 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 N11-J1 that is in series with sedimentation structures N11-J2 & N11-J. N11-J1 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 N11-J1 was inspected in December, 2003 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

The N11-J1, N11-J2 and N11-J Structures have a combined watershed of 595.6 acres and are located on a tributary upstream of Moenkopi Wash at the Kayenta Mine. The 53.3-acre watershed, which contributes directly to structure N11-J1 is classified as 98% undisturbed and 2% Spoil.

DESIGN ANALYSES

GENERAL

Structure N11-J1 was designed under the supervision of a Registered Professional Engineer from Peabody Western Coal Company. The design was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of Interior, Office of Surface Mining (OSM) and included a review of available project files. The most current information contained in the Peabody Western Coal Company files includes topographic maps developed from aerial photography flown in 1999 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure N11-J1 (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 40-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 N11-J1 will be constructed in series with proposed Structures N11-J2 and N11-J. Structure N11-J1 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 N11-J1 and N11-J2 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 N11-J1 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 Moenkopi Wash.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.405 mi.
2.	Elevation Difference, H	315 ft
3.	Time of Concentration, T_c	0.100 hr
4.	NRCS Curve Number	80
5.	Rainfall Depth, 10-year, 24-hour storm 100-year, 6-hour storm	2.1 in 2.4 in
6.	Drainage Area	53.3 acres

Values reported represent the watershed, which drains directly to Pond N11-J1. Hydrologic input parameters for structure N11-J2 and N11-J 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 Flow Master computer programs were used to evaluate inflow to the sedimentation structure, outflow from the structure and the resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following table (supporting calculations are presented in Appendices A, B, and C).

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N11-J1 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	38.1	394.4
Volume	ac-ft	2.77	43.74
Storage			
Peak Stage	msl	N/A	6699.7
Emerg. Spillway Elev.	msl	6697.4	6697.4
Peak Storage	ac-ft	N/A	24.7
Storage Capacity	ac-ft	19.82	19.82
Outflow			
Peak Flow	cfs	N/A	361.7
Spillway Elevation	msl	6697.4	6697.4
Embankment Crest Elev.	msl	6701.0	6701.0
Peak Stage	msl	--	6699.7
Freeboard	ft	--	1.3
Emergency Spillway Channel			
Flow Depth	ft	--	2.3
Critical Velocity	fps	--	6.2
Mannings "n"	--	--	0.03
Width	ft	--	40
Outflow Channel			
Slope	%	--	25
Normal Velocity	fps	--	9.9
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 N11-J1 will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway)	3.3	ft
	(Outflow)	1.9	
Channel Width		40	ft
Channel Length	(Spillway)	45	ft
	(Outflow)	100	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6697.4	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 1999 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N11-J1 is designed to contain approximately 19.8 acre-feet.

The calculations for the sediment load entering structure N11-J1 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	0.17
3.	Slope Factor, LS	6.94
4.	Cover Factor, C	0.23
5.	Erosion Control Factor, P	1.0

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 N11-J1, combined with

Structures N11-J2 and N11-J 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 N11-J2, N11-J1 and N11-J

	N11-J2 (UPPER)	N11-J1 (MIDDLE)	N11-J (LOWER)	COMBINED
Total Storage Capacity (ac-ft)	19.85	19.82	16.66	56.33
10-Year, 24-Hour Storm Inflow(ac-ft)	31.24	2.77	2.33	36.34
Available Sediment Storage Capacity	-	-	-	19.99
Sediment Inflow Rate/Year (ac-ft/yr)	5.57	0.26	0.25	6.08
Sediment Storage Life (yr)	-	-	-	3.3

* * *

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- N11-J2, N11-J1 and N11-J 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: N11/N6 AREA

STRUCTURE: N11-J1 (Middle) Pond

TIME OF CONCENTRATION:

Start Elevation (ft) =	6995
End Elevation (ft) =	6680
Elevation Difference, E (ft) =	315
Watercourse Length (ft) =	2136
Watercourse Length, L (mi) =	0.405
Tc = (11.9L^3/E)^0.385 =	0.100 hours

ROUTING PARAMETERS:

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

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Pinyon Juniper	B	65	0	0
Pinyon Juniper	D	83	45.4	3768.2
Sagebrush	B	60	6.9	414
Disturbed-Spoil		86	1	86
TOTAL:			53.3	4268.2

Weighted CN = Total CN*Area/ Total Area = 80

Note: During operations the open pit will collect most of the runoff from disturbed areas. The worst case is when the final pit is reclaimed and runoff from a large area of regraded spoil reports directly to the pond.

DRAINAGE BASIN AREA:

53.3 Acres

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4

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

STRUCTURE: N11-J1 (Middle) Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
1AB	0.16	0.5	0.08
3CD	0.16	12.5	2.00
3DE	0.15	13.1	1.97
7E	0.14	13.8	1.93
16C/16CE/16F	0.05	5.5	0.28
15A	0.37	6.9	2.55
Mine/roads	0.46	1	0.46
TOTAL:		53.3	9.27

Weighted K = Total K*Area/ Total Area = 0.17

SLOPE FACTOR:

Length (ft)		Slope (%)	m	Slope Angle (deg)	LS Factor
260	45	17.3%	0.6	9.8	5.08
290	55	19.0%	0.6	10.7	6.04
330	130	39.4%	0.6	21.5	14.03
260	45	17.3%	0.6	9.8	5.08
220	30	13.6%	0.6	7.8	3.44
290	50	17.2%	0.6	9.8	5.40
200	40	20.0%	0.6	11.3	5.13
300	100	33.3%	0.6	18.4	11.27

Average LS = 6.94

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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STRUCTURE: N11-J1 (Middle) Pond

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Pinyon Juniper	20%	25%	45.4	0.22	9.99	1.00	45.40
Sagebrush/Grass	20%	25%	6.9	0.20	1.38	1.00	6.90
Disturbed-spoil	0%	0%	1	1.00	1.00	0.80	0.80
Reclaimed	40%	0%	0	0.15	0.00	0.40	0.00
TOTAL:			53.3		12.37		53.10

Weighted C = Total C*Area/ Total Area = 0.232

Weighted P = Total P*Area/ Total Area = 0.996

RAINFALL FACTOR:

R = 40

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CALCULATED SEDIMENT YIELD

STRUCTURE: N11-J1 (Middle) 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.

PARAMETER DESCRIPTION	VALUE	
Annual Rainfall Factor	40.00	
Soil Erodibility Factor	0.17	
Length Slope Factor	6.94	
Cover Factor	0.23	
Practice Factor	1.00	
Gross Annual Sediment Yield	11.15	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0054	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0049	acre-feet/acre/year
Watershed Area	53.3	acres
Watershed Annual Sediment Yield	0.26	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	0.26	acre-feet

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N11-J1 Critical Velocity
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	0.012400	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	40.00	ft
Discharge	361.70	cfs

Results		
Depth	1.32	ft
Flow Area	58.05	ft^2
Wetted Perimeter	48.35	ft
Top Width	47.92	ft
Critical Depth	1.32	ft
Critical Slope	0.012454	ft/ft
Velocity	6.23	ft/s
Velocity Head	0.60	ft
Specific Energy	1.92	ft
Froude Number	1.00	
Flow is subcritical.		

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POND N11-J1 EMERGENCY SPILLWAY

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
40.00	3.0:1	3.0:1	25.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	361.70 cfs	
Depth:	0.86 ft	1.86 ft
Top Width:	45.15 ft	51.15 ft
Velocity:	9.91 fps	
X-Section Area:	36.51 sq ft	
Hydraulic Radius:	0.804	
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

N-6/N-11 Area

Pond N11-J1

10-Year, 24-Hour Storm

djk/tel

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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	In	53.300	53.300	38.05	2.77
	Out			1.26	2.44

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Structure Detail:

Structure #1 (Pond)

Pond N11-J1

Pond Inputs:

Initial Pool Elev:	5.00
Initial Pool:	23.74 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
5.00	20.00	3.00:1	3.00:1	20.00

Pond Results:

Peak Elevation:	5.17
Dewater Time:	2.05 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)	
1.00	2.000	0.000	0.000		
1.50	2.914	1.221	0.000		
2.00	4.000	2.943	0.000		
2.50	4.949	5.176	0.000		
3.00	6.000	7.909	0.000		
3.50	6.905	11.133	0.000		
4.00	7.873	14.824	0.000		
4.50	8.905	19.016	0.000		
5.00	10.000	23.740	0.000		Spillway #1
5.17	9.770	25.481	1.257	32.40	Peak Stage
5.50	10.192	28.788	3.643		
6.00	10.385	33.932	49.679		
6.50	10.581	39.173	103.690		
7.00	10.778	44.513	176.689		
7.50	10.977	49.952	266.492		
8.00	11.178	55.491	373.219		
8.50	11.381	61.130	497.171		
9.00	11.585	66.872	638.741		

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
9.50	11.792	72.716	798.371	
10.00	12.000	78.664	976.527	

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

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
1.00	0.000	0.000
1.50	0.000	0.000
2.00	0.000	0.000
2.50	0.000	0.000
3.00	0.000	0.000
3.50	0.000	0.000
4.00	0.000	0.000
4.50	0.000	0.000
5.00	0.000	0.000
5.50	3.643	3.643
6.00	49.679	49.679
6.50	103.690	103.690
7.00	176.689	176.689
7.50	266.492	266.492
8.00	373.219	373.219
8.50	497.171	497.171
9.00	638.741	638.741
9.50	798.371	798.371
10.00	976.527	976.527

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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	53.300	0.100	0.000	0.000	80.000	F	38.05	2.773
	Σ	**53.300**						**38.05**	**2.773**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	3.87	30.00	775.00	5.900	0.036
#1	**1**	**Muskingum K:**					**0.000**

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APPENDIX C

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

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N-6/N-11 Area

Pond N11-J, N11-IJ, and N11-J2 in Series

100-Year, 6-Hour Storm

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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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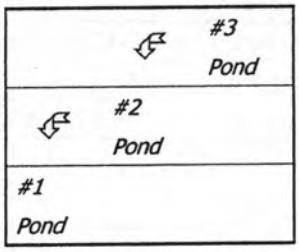
Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond N11-J (Lower)
Pond	#2	==>	#1	0.049	0.366	Pond N11-J1(Middle)
Pond	#3	==>	#2	0.036	0.388	Pond N11-J2 (Upper)



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	8. Large gullies, diversions, and low flowing streams	2.41	20.00	830.00	4.65	0.049
#2	**Muskingum K:**					**0.049**
#3	8. Large gullies, diversions, and low flowing streams	3.87	30.00	775.00	5.90	0.036
#3	**Muskingum K:**					**0.036**

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Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#3	In	490.500	490.500	449.79	40.10
	Out			378.70	40.10
#2	In	53.300	543.800	394.37	43.74
	Out			361.69	43.74
#1	In	51.800	595.600	375.92	46.86
	Out			354.54	46.86

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Structure Detail:

Structure #3 (Pond)

Pond N11-J2 (Upper)

Pond Inputs:

Initial Pool Elev:	6,725.90
Initial Pool:	19.85 ac-ft

Pond Results:

Peak Elevation:	6,728.81
Dewater Time:	0.31 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)
6,710.00	0.520	0.000	0.000	
6,710.50	0.555	0.269	0.000	
6,711.00	0.591	0.555	0.000	
6,711.50	0.628	0.860	0.000	
6,712.00	0.666	1.183	0.000	
6,712.50	0.706	1.526	0.000	
6,713.00	0.746	1.889	0.000	
6,713.50	0.788	2.273	0.000	
6,714.00	0.831	2.678	0.000	
6,714.50	0.875	3.104	0.000	
6,715.00	0.920	3.553	0.000	
6,715.50	0.966	4.024	0.000	
6,716.00	1.013	4.519	0.000	
6,716.50	1.061	5.038	0.000	
6,717.00	1.111	5.581	0.000	
6,717.50	1.161	6.148	0.000	
6,718.00	1.213	6.742	0.000	
6,718.50	1.265	7.361	0.000	
6,719.00	1.319	8.007	0.000	
6,719.50	1.374	8.680	0.000	
6,720.00	1.430	9.381	0.000	
6,720.50	1.484	10.110	0.000	
6,721.00	1.540	10.866	0.000	
6,721.50	1.596	11.650	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,722.00	1.654	12.463	0.000		
6,722.50	1.712	13.304	0.000		
6,723.00	1.772	14.175	0.000		
6,723.50	1.832	15.076	0.000		
6,724.00	1.894	16.008	0.000		
6,724.50	1.956	16.970	0.000		
6,725.00	2.020	17.964	0.000		
6,725.50	2.103	18.995	0.000		
6,725.90	2.171	19.849	0.000		
6,726.00	2.188	20.068	5.555	3.30	
6,726.50	2.274	21.183	33.305	1.00	
6,727.00	2.362	22.342	61.054	1.50	
6,727.50	2.451	23.545	128.176	0.80	
6,728.00	2.543	24.793	207.350	0.40	
6,728.50	2.635	26.088	304.651	0.25	
6,728.81	2.694	26.913	378.699	0.15	Peak Stage
6,729.00	2.730	27.429	424.946		
6,729.50	2.800	28.811	566.846		

Detailed Discharge Table

Elevation	Combined Total Discharge (cfs)
6,710.00	0.000
6,710.50	0.000
6,711.00	0.000
6,711.50	0.000
6,712.00	0.000
6,712.50	0.000
6,713.00	0.000
6,713.50	0.000
6,714.00	0.000
6,714.50	0.000
6,715.00	0.000
6,715.50	0.000
6,716.00	0.000
6,716.50	0.000
6,717.00	0.000
6,717.50	0.000
6,718.00	0.000

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Elevation	Combined Total Discharge (cfs)
6,718.50	0.000
6,719.00	0.000
6,719.50	0.000
6,720.00	0.000
6,720.50	0.000
6,721.00	0.000
6,721.50	0.000
6,722.00	0.000
6,722.50	0.000
6,723.00	0.000
6,723.50	0.000
6,724.00	0.000
6,724.50	0.000
6,725.00	0.000
6,725.50	0.000
6,725.90	0.000
6,726.00	5.555
6,726.50	33.305
6,727.00	61.054
6,727.50	128.176
6,728.00	207.350
6,728.50	304.651
6,729.00	424.946
6,729.50	566.846

Structure #2 (Pond)

Pond N11-J1(Middle)

Pond Inputs:

Initial Pool Elev:	6,697.40
Initial Pool:	19.82 ac-ft

Pond Results:

Peak Elevation:	6,699.66
Dewater Time:	0.32 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)	
6,680.00	0.360	0.000	0.000		
6,680.50	0.396	0.189	0.000		
6,681.00	0.434	0.397	0.000		
6,681.50	0.474	0.623	0.000		
6,682.00	0.515	0.871	0.000		
6,682.50	0.558	1.139	0.000		
6,683.00	0.603	1.429	0.000		
6,683.50	0.650	1.743	0.000		
6,684.00	0.698	2.079	0.000		
6,684.50	0.748	2.441	0.000		
6,685.00	0.800	2.828	0.000		
6,685.50	0.840	3.238	0.000		
6,686.00	0.880	3.668	0.000		
6,686.50	0.922	4.118	0.000		
6,687.00	0.965	4.590	0.000		
6,687.50	1.008	5.083	0.000		
6,688.00	1.053	5.598	0.000		
6,688.50	1.098	6.136	0.000		
6,689.00	1.144	6.696	0.000		
6,689.50	1.192	7.280	0.000		
6,690.00	1.240	7.888	0.000		
6,690.50	1.286	8.520	0.000		
6,691.00	1.333	9.175	0.000		
6,691.50	1.381	9.853	0.000		
6,692.00	1.430	10.556	0.000		
6,692.50	1.479	11.283	0.000		
6,693.00	1.530	12.035	0.000		
6,693.50	1.581	12.813	0.000		
6,694.00	1.633	13.617	0.000		
6,694.50	1.686	14.447	0.000		
6,695.00	1.740	15.303	0.000		
6,695.50	1.799	16.188	0.000		
6,696.00	1.858	17.102	0.000		
6,696.50	1.919	18.046	0.000		
6,697.00	1.980	19.021	0.000		
6,697.40	2.030	19.823	0.000		
6,697.50	2.043	20.027	8.680	3.60	
6,698.00	2.106	21.064	52.040	1.60	
6,698.50	2.171	22.133	95.399	1.40	
6,699.00	2.236	23.235	197.618	0.65	
6,699.50	2.303	24.370	315.922	0.35	
6,699.66	2.325	24.744	361.690	0.15	Peak Stage

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,700.00	2.370	25.538	458.824	
6,700.50	2.435	26.739	632.580	
6,701.00	2.500	27.973	834.292	

Detailed Discharge Table

Elevation	Combined Total Discharge (cfs)
6,680.00	0.000
6,680.50	0.000
6,681.00	0.000
6,681.50	0.000
6,682.00	0.000
6,682.50	0.000
6,683.00	0.000
6,683.50	0.000
6,684.00	0.000
6,684.50	0.000
6,685.00	0.000
6,685.50	0.000
6,686.00	0.000
6,686.50	0.000
6,687.00	0.000
6,687.50	0.000
6,688.00	0.000
6,688.50	0.000
6,689.00	0.000
6,689.50	0.000
6,690.00	0.000
6,690.50	0.000
6,691.00	0.000
6,691.50	0.000
6,692.00	0.000
6,692.50	0.000
6,693.00	0.000
6,693.50	0.000
6,694.00	0.000
6,694.50	0.000
6,695.00	0.000
6,695.50	0.000

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Elevation	Combined Total Discharge (cfs)
6,696.00	0.000
6,696.50	0.000
6,697.00	0.000
6,697.40	0.000
6,697.50	8.680
6,698.00	52.040
6,698.50	95.399
6,699.00	197.618
6,699.50	315.922
6,700.00	458.824
6,700.50	632.580
6,701.00	834.292

Structure #1 (Pond)

Pond N11-J (Lower)

Pond Inputs:

Initial Pool Elev:	6,664.80
Initial Pool:	16.66 ac-ft

Pond Results:

Peak Elevation:	6,667.04
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)
6,645.00	0.190	0.000	0.000	
6,645.50	0.212	0.101	0.000	
6,646.00	0.236	0.213	0.000	
6,646.50	0.261	0.337	0.000	
6,647.00	0.287	0.474	0.000	
6,647.50	0.314	0.624	0.000	
6,648.00	0.343	0.788	0.000	
6,648.50	0.373	0.967	0.000	
6,649.00	0.404	1.162	0.000	
6,649.50	0.436	1.372	0.000	
6,650.00	0.470	1.598	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,650.50	0.499	1.840	0.000		
6,651.00	0.529	2.097	0.000		
6,651.50	0.560	2.370	0.000		
6,652.00	0.592	2.658	0.000		
6,652.50	0.624	2.961	0.000		
6,653.00	0.658	3.282	0.000		
6,653.50	0.692	3.619	0.000		
6,654.00	0.727	3.974	0.000		
6,654.50	0.763	4.346	0.000		
6,655.00	0.800	4.737	0.000		
6,655.50	0.838	5.147	0.000		
6,656.00	0.877	5.575	0.000		
6,656.50	0.917	6.024	0.000		
6,657.00	0.957	6.492	0.000		
6,657.50	0.999	6.981	0.000		
6,658.00	1.041	7.491	0.000		
6,658.50	1.085	8.023	0.000		
6,659.00	1.129	8.576	0.000		
6,659.50	1.174	9.152	0.000		
6,660.00	1.220	9.750	0.000		
6,660.50	1.264	10.371	0.000		
6,661.00	1.308	11.014	0.000		
6,661.50	1.353	11.679	0.000		
6,662.00	1.399	12.367	0.000		
6,662.50	1.446	13.078	0.000		
6,663.00	1.493	13.813	0.000		
6,663.50	1.541	14.571	0.000		
6,664.00	1.590	15.354	0.000		
6,664.50	1.640	16.161	0.000		
6,664.80	1.670	16.658	0.000		
6,665.00	1.690	16.994	11.208	4.05	
6,665.50	1.700	17.841	39.202	1.20	
6,666.00	1.710	18.694	113.527	2.05	
6,666.50	1.720	19.551	218.928	0.60	
6,667.00	1.730	20.414	341.567	0.40	
6,667.04	1.754	20.490	354.535	0.10	Peak Stage
6,667.50	1.783	21.292	490.658		
6,668.00	1.836	22.196	669.416		
6,668.50	1.890	23.128	876.640		

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Detailed Discharge Table

Elevation	Combined Total Discharge (cfs)
6,645.00	0.000
6,645.50	0.000
6,646.00	0.000
6,646.50	0.000
6,647.00	0.000
6,647.50	0.000
6,648.00	0.000
6,648.50	0.000
6,649.00	0.000
6,649.50	0.000
6,650.00	0.000
6,650.50	0.000
6,651.00	0.000
6,651.50	0.000
6,652.00	0.000
6,652.50	0.000
6,653.00	0.000
6,653.50	0.000
6,654.00	0.000
6,654.50	0.000
6,655.00	0.000
6,655.50	0.000
6,656.00	0.000
6,656.50	0.000
6,657.00	0.000
6,657.50	0.000
6,658.00	0.000
6,658.50	0.000
6,659.00	0.000
6,659.50	0.000
6,660.00	0.000
6,660.50	0.000
6,661.00	0.000
6,661.50	0.000
6,662.00	0.000
6,662.50	0.000
6,663.00	0.000
6,663.50	0.000
6,664.00	0.000
6,664.50	0.000
6,664.80	0.000

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Elevation	Combined Total Discharge (cfs)
6,665.00	11.208
6,665.50	39.202
6,666.00	113.527
6,666.50	218.928
6,667.00	341.567
6,667.50	490.658
6,668.00	669.416
6,668.50	876.640

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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	490.500	0.482	0.000	0.000	83.000	F	449.79	40.096
	Σ	**490.500**						**449.79**	**40.096**
#2	1	53.300	0.100	0.000	0.000	80.000	F	74.88	3.644
	Σ	**543.800**						**394.37**	**43.740**
#1	1	51.800	0.102	0.000	0.000	78.000	F	65.79	3.125
	Σ	**595.600**						**375.92**	**46.864**

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DESIGN REPORT

Temporary Sedimentation Structure

N11-J2 (Upper)

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

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

DEC 15 2003

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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 -N11-J2, N11-J1, and N11-J Proposed Sedimentation Ponds

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INTRODUCTION

Sedimentation Structure N11-J2 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 N11 Extension disturbed surface mining area at the Kayenta Mine. The location of Structure N11-J2 and its watershed boundary are shown on Drawing No. 85400, (Sheet L-8), 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 N11-J2 that is in series with sedimentation structures N11-J1 & N11-J. N11-J2 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 N11-J2 was inspected in December, 2003 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

The N11-J2, N11-J1 and N11-J Structures have a combined watershed of 595.6 acres and are located on a tributary upstream of Moenkopi Wash at the Kayenta Mine. The 490.5-acre watershed, which contributes directly to structure N11-J2, is classified as 5% undisturbed, 58% reclaimed, and 37% spoil.

DESIGN ANALYSES

GENERAL

Structure N11-J2 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 regnlations of the United States Department of Interior, Office of Surface Mining (OSM) and included a review of available project files. The most current information contained in the Peabody Western Coal Company files includes topographic maps developed from aerial photography flown in 1999 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure N11-J2 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 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 N11-J2 will be constructed in series with proposed Structures N11-J1 and N11-J. Structure N11-J2 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. N11-J2 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 N11-J2 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 Moenkopi Wash.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	1.533 mi.
2.	Elevation Difference, H	285 ft
3.	Time of Concentration, T_c	0.482 hr
4.	NRCS Curve Number	83
5.	Rainfall Depth, 10-year, 24-hour storm 25-year, 6-hour storm	2.1 in 1.9 in
6.	Drainage Area	490.5 acres

Values reported represent the watershed, which drains directly to Pond N11-J2. Hydrologic input parameters for structure N11-J1 and N11-J 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.

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HYDRAULICS

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

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N11-J2 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	247.3	281.8
Volume	ac-ft	31.24	25.66
Storage			
Peak Stage	msl	N/A	6728.0
Emerg. Spillway Elev.	msl	6725.9	6725.9
Peak Storage	ac-ft	N/A	24.9
Storage Capacity	ac-ft	19.85	19.85
Outflow			
Peak Flow	cfs	N/A	215.2
Spillway Elevation	msl	6725.9	6725.9
Embankment Crest Elev.	msl	6729.5	6729.5
Peak Stage	msl	--	6728.0
Freeboard	ft	--	1.5
Emergency Spillway Channel			
Flow Depth	ft	--	2.1
Critical Velocity	fps	--	5.97
Mannings "n"	--	--	0.03
Width	ft	--	25
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 N11-J2 will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway)	3.1	ft
	(Outflow)	1.8	ft
Channel Width		25	ft
Channel Length	(Spillway)	45	ft
	(Outflow)	90	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6725.9	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 1999 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N11-J2 is designed to contain approximately 19.85 acre-feet.

The calculations for the sediment load entering structure N11-J2 were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

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1.	Rainfall Factor, R	40
	Soil Erodibility Factor, K	0.26
3.	Slope Factor, LS	7.84
4.	Cover Factor, C	0.53
5.	Erosion Control Factor, P	0.60

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 N11-J2 does not have sufficient storage to contain the 10-year, 24-hour storm; however, the storage of all three ponds, (N11-J2, N11-J1 & N11-J), 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 N11-J2, N11-J1 and N11-J

	N11-J2 (UPPER)	N11-J1 (MIDDLE)	N11-J (LOWER)	COMBINED
Total Storage Capacity (ac-ft)	19.85	19.82	16.66	56.33
10-Year, 24-Hour Storm Inflow (ac-ft)	31.24	2.77	2.33	36.34
Available Sediment Storage Capacity (ac-ft)	-	-	-	19.99
Sediment Inflow Rate/Year (ac-ft/yr)	5.57	0.26	0.25	6.08
Sediment Storage Life (yr)	-	-	-	3.3

* * *

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- N11-J2, N11-J1 & N11-J 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: N11/N6 AREA

STRUCTURE: N11-J2 (Upper) Pond

TIME OF CONCENTRATION:

Start Elevation (ft) =	7000
End Elevation (ft) =	6715
Elevation Difference, E (ft) =	285
Watercourse Length (ft) =	8094
Watercourse Length, L (mi) =	1.533
Tc = (11.9L^3/E)^0.385 =	0.482 hours

ROUTING PARAMETERS:

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

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Pinyon Juniper	B	65	0	0
Pinyon Juniper	D	83	14.1	1170.3
Sagebrush	B	60	7.8	468
Spoil		86	216.4	18610.4
Reclaim	C	81	252.2	20428.2
TOTAL:			490.5	40676.9

Weighted CN = Total CN*Area/ Total Area = 83

Note: During operations the open pit will collect most of the runoff from disturbed areas. The worst case is when the final pit is reclaimed and runoff from a large area of regraded spoil reports directly to the pond.

DRAINAGE BASIN AREA:

490.5 Acres

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

STRUCTURE: N11-J2 (Upper) Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
1AB	0.16	0.1	0.02
3CD	0.16	13.1	2.10
3F	0.02	0	0.00
7E	0.14	0.6	0.08
16C/16CE/16F	0.05	0.3	0.02
15A	0.37	7.8	2.89
X11AB	0.46	0	0.00
Mine	0.22	0	0.00
Road	0.22	0	0.00
Spoil	0.12	216.4	25.97
Reclaim	0.38	252.2	95.84
TOTAL:		490.5	126.90

Weighted K = Total K*Area/ Total Area = 0.26

SLOPE FACTOR:

Length (ft)		Slope (%)	m	Slope Angle (deg)	LS Factor
420	120	28.6%	0.6	15.9	11.80
150	40	26.7%	0.6	14.9	5.92
150	35	23.3%	0.6	13.1	5.13
150	40	26.7%	0.6	14.9	5.92
150	35	23.3%	0.6	13.1	5.13
150	40	26.7%	0.6	14.9	5.92
400	100	25.0%	0.6	14.0	9.95
390	110	28.2%	0.6	15.8	11.13
380	95	25.0%	0.6	14.0	9.65

Average LS = 7.84

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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STRUCTURE: N11-J2 (Upper) Pond

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Pinyon Juniper	20%	25%	14.1	0.22	3.10	1.00	14.10
Sagebrush/Grass	20%	25%	7.8	0.20	1.56	1.00	7.80
Spoil	0%	0%	216.4	1.00	216.40	0.80	173.12
Reclaimed	40%	0%	252.2	0.15	37.83	0.40	100.88
TOTAL:			490.5		258.89		295.90

Weighted C = Total C*Area/ Total Area = 0.528

Weighted P = Total P*Area/ Total Area = 0.603

RAINFALL FACTOR:

R = 40

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

STRUCTURE: N11-J2 (Upper) 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.

PARAMETER DESCRIPTION	VALUE	
Annual Rainfall Factor	40.00	
Soil Erodibility Factor	0.26	
Length Slope Factor	7.84	
Cover Factor	0.53	
Practice Factor	0.60	
Gross Annual Sediment Yield	25.83	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0126	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0114	acre-feet/acre/year
Watershed Area	490.5	acres
Watershed Annual Sediment Yield	5.57	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	5.57	acre-feet

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N11-J2 Critical Velocity
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	0.012890	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	25.00	ft
Discharge	215.20	cfs

Results		
Depth	1.25	ft
Flow Area	36.03	ft^2
Wetted Perimeter	32.92	ft
Top Width	32.52	ft
Critical Depth	1.25	ft
Critical Slope	0.012885	ft/ft
Velocity	5.97	ft/s
Velocity Head	0.55	ft
Specific Energy	1.81	ft
Froude Number	1.00	
Flow is supercritical.		

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POND N11-J2 EMERGENCY SPILLWAY

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:	215.20 cfs	
Depth:	0.83 ft	1.83 ft
Top Width:	30.00 ft	36.00 ft
Velocity:	9.38 fps	
X-Section Area:	22.94 sq ft	
Hydraulic Radius:	0.758	
Froude Number:	1.89	
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
N-6/N-11 Area

Pond N11-J2

10-Year, 24-Hour Storm

djk/tel

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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	490.500	490.500	247.34	31.24

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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	490.500	0.482	0.000	0.000	83.000	F	247.34	31.240
	Σ	**490.500**						**247.34**	**31.240**

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APPENDIX C

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

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Peabody Western
N-6/N-11 Area

Pond N11-J2 Upper Alone

25-Year, 6-Hour Storm

djk/tel

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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)
#3	In	490.500	490.500	281.75	25.66
	Out			215.24	25.66

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Structure Detail:

Structure #3 (Pond)

Pond N11-J(Upper)

Pond Inputs:

Initial Pool Elev:	6,725.90
Initial Pool:	19.85 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,725.90	45.20	3.00:1	3.00:1	25.00

Pond Results:

Peak Elevation:	6,728.04
Dewater Time:	0.30 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)
6,710.00	0.520	0.000	0.000	
6,710.50	0.555	0.269	0.000	
6,711.00	0.591	0.555	0.000	
6,711.50	0.628	0.860	0.000	
6,712.00	0.666	1.183	0.000	
6,712.50	0.706	1.526	0.000	
6,713.00	0.746	1.889	0.000	
6,713.50	0.788	2.273	0.000	
6,714.00	0.831	2.678	0.000	
6,714.50	0.875	3.104	0.000	
6,715.00	0.920	3.553	0.000	
6,715.50	0.966	4.024	0.000	
6,716.00	1.013	4.519	0.000	
6,716.50	1.061	5.038	0.000	
6,717.00	1.111	5.581	0.000	
6,717.50	1.161	6.148	0.000	
6,718.00	1.213	6.742	0.000	
6,718.50	1.265	7.361	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,719.00	1.319	8.007	0.000		
6,719.50	1.374	8.680	0.000		
6,720.00	1.430	9.381	0.000		
6,720.50	1.484	10.110	0.000		
6,721.00	1.540	10.866	0.000		
6,721.50	1.596	11.650	0.000		
6,722.00	1.654	12.463	0.000		
6,722.50	1.712	13.304	0.000		
6,723.00	1.772	14.175	0.000		
6,723.50	1.832	15.076	0.000		
6,724.00	1.894	16.008	0.000		
6,724.50	1.956	16.970	0.000		
6,725.00	2.020	17.964	0.000		
6,725.50	2.103	18.995	0.000		
6,725.90	2.171	19.849	0.000		Spillway #1
6,726.00	2.188	20.068	5.555	3.35	
6,726.50	2.274	21.183	33.305	1.35	
6,727.00	2.362	22.342	61.054	1.45	
6,727.50	2.451	23.545	128.176	0.60	
6,728.00	2.543	24.793	207.350	0.40	
6,728.04	2.551	24.898	215.236	0.05	Peak Stage
6,728.50	2.635	26.088	304.652		
6,729.00	2.730	27.429	424.946		
6,729.50	2.800	28.811	566.846		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,710.00	0.000	0.000
6,710.50	0.000	0.000
6,711.00	0.000	0.000
6,711.50	0.000	0.000
6,712.00	0.000	0.000
6,712.50	0.000	0.000
6,713.00	0.000	0.000
6,713.50	0.000	0.000
6,714.00	0.000	0.000
6,714.50	0.000	0.000
6,715.00	0.000	0.000

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Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,715.50	0.000	0.000
6,716.00	0.000	0.000
6,716.50	0.000	0.000
6,717.00	0.000	0.000
6,717.50	0.000	0.000
6,718.00	0.000	0.000
6,718.50	0.000	0.000
6,719.00	0.000	0.000
6,719.50	0.000	0.000
6,720.00	0.000	0.000
6,720.50	0.000	0.000
6,721.00	0.000	0.000
6,721.50	0.000	0.000
6,722.00	0.000	0.000
6,722.50	0.000	0.000
6,723.00	0.000	0.000
6,723.50	0.000	0.000
6,724.00	0.000	0.000
6,724.50	0.000	0.000
6,725.00	0.000	0.000
6,725.50	0.000	0.000
6,725.90	0.000	0.000
6,726.00	5.555	5.555
6,726.50	33.305	33.305
6,727.00	61.054	61.054
6,727.50	128.176	128.176
6,728.00	207.350	207.350
6,728.50	304.652	304.652
6,729.00	424.946	424.946
6,729.50	566.846	566.846

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	490.500	0.482	0.000	0.000	83.000	F	281.75	25.658
	Σ	**490.500**						**281.75**	**25.658**

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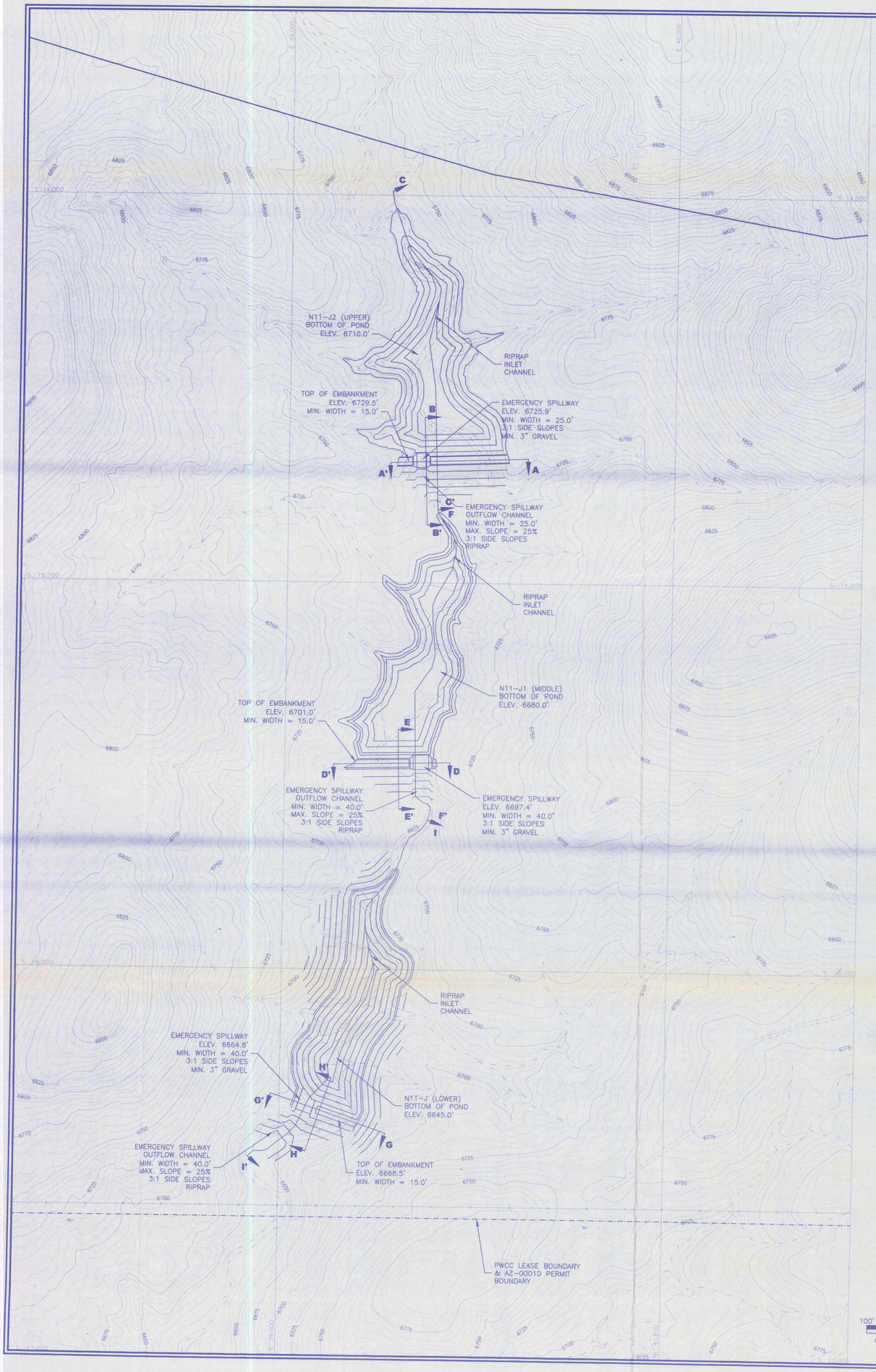
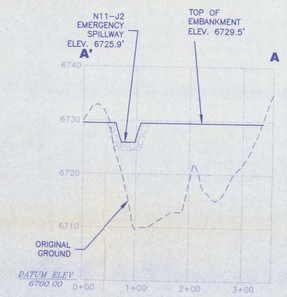
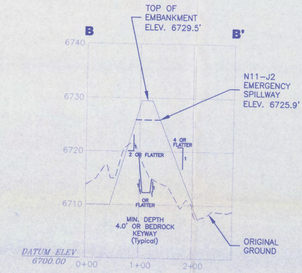




N11-J2 POND
CROSS-SECTION A-A'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



N11-J2 POND
CROSS-SECTION B-B'
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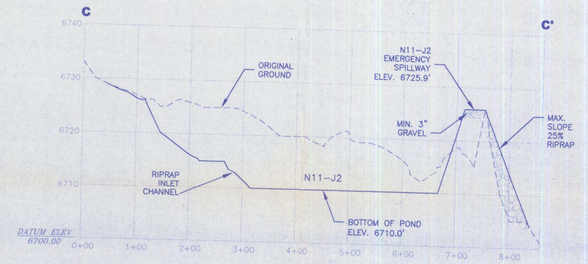
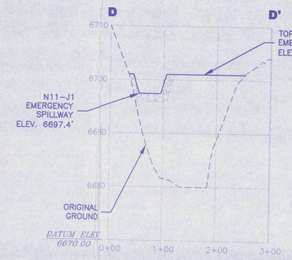
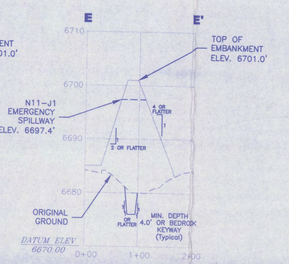
VERTICAL 1"=10'



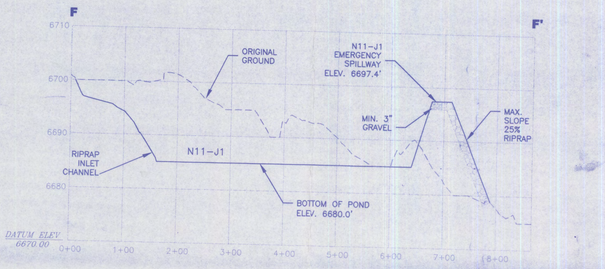
N11-J2 POND
CROSS-SECTION C-C'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



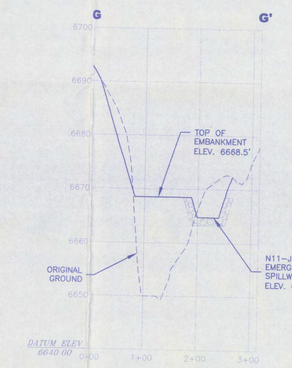
N11-J1 POND
CROSS-SECTION D-D'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



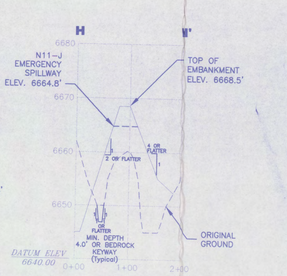
N11-J1 POND
CROSS-SECTION E-E'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



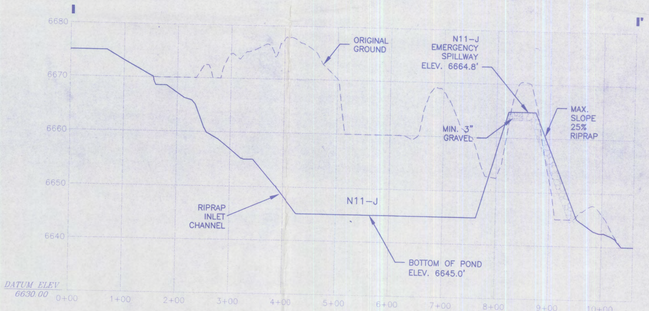
N11-J1 POND
CROSS-SECTION F-F'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



N11-J POND
CROSS-SECTION G-G'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



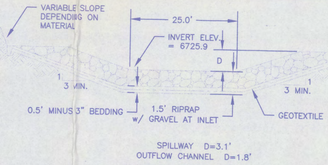
N11-J POND
CROSS-SECTION H-H'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'



N11-J POND
CROSS-SECTION I-I'
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=10'

N11-J2 POND STAGE CAPACITY TABLE

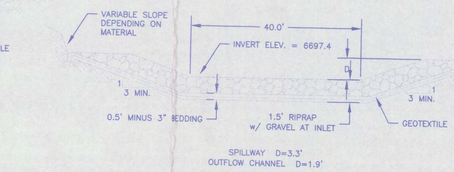
ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6710.0	0.0	0.52	0.00	BOTTOM OF POND
6715.0	5.0	0.92	3.55	
6720.0	10.0	1.43	9.38	
6725.0	15.0	2.02	17.96	
6725.9	15.9	2.17	19.85	EMERGENCY SPILLWAY
6729.5	19.5	2.80	28.81	TOP OF EMBANKMENT



SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N11-J2 POND

N11-J1 POND STAGE CAPACITY TABLE

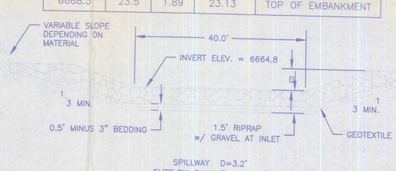
ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6680.0	0.0	0.36	0.00	BOTTOM OF POND
6685.0	5.0	0.80	2.83	
6690.0	10.0	1.24	7.89	
6695.0	15.0	1.74	15.30	
6697.4	17.4	2.03	19.82	EMERGENCY SPILLWAY
6701.0	21.0	2.50	27.97	TOP OF EMBANKMENT



SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N11-J1 POND

N11-J POND STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6645.0	0.0	0.19	0.00	BOTTOM OF POND
6650.0	5.0	0.47	1.60	
6655.0	10.0	0.80	4.34	
6660.0	15.0	1.22	9.75	
6664.8	19.8	1.67	16.66	EMERGENCY SPILLWAY
6668.5	23.5	1.89	23.13	TOP OF EMBANKMENT



SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE
N11-J POND

PLAN VIEW
SCALE
100' 0 100' 200'
CONTOUR INTERVAL: 5FT.

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ENGINEER'S CERTIFICATION
ARIZONA P.E. 18782
Date: DEC 15 2003

REVISIONS		
DATE	CHK'D	DESCRIPTION

EXHIBIT #1
N11-J2, N11-J1 & N11-J
Proposed Sedimentation Ponds

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

DESIGNED BY: PWCC	AS SHOWN
DRAWN BY: MWH	DRAWING DATE: 12-15-2003
CHECKED BY: J.G.S.	PHOTO DATE: 01-26-02
CONTOUR INT.: 5'	070103 J RmDsgn.dwg