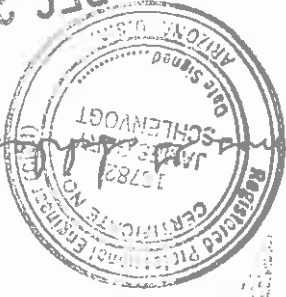


DEC 23 2004

*James Schlenvogt*



PEABODY WESTERN COAL COMPANY

For

Navajo County, Arizona

Kayenta Mine

N9-B2 (Upper)

Temporary Sedimentation Structure

DESIGN REPORT

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

The construction site of the proposed Structure N9-B2 was inspected in October, 2004 by a Registered Professional Engineer from Woodson Engineering, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized for embankment design and will be utilized during construction to construct a stable embankment.

#### INSPECTION

This design report contains information specific to Structure N9-B2 that is in series with sedimentation structures N9-B1 & N9-B. N9-B2 is the upper pond in the series. Mine-wide design, construction, and reclamation information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona, for Peabody Western Coal Company", December, 1985 (FAP), 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".

Sedimentation Structure N9-B2 will be an earthen embankment, designed and constructed by Peabody Western Coal Company as a temporary sedimentation structure to control runoff and sediment from portions of the N9 disturbed surface mining area at the Kayenta Mine. The location of Structure N9-B2 and its watershed boundary are shown on Drawing No. 85400, (Sheet K-6), and Drawing No. 85405. The site-specific general construction plans are shown on the attached Exhibit 1.

#### INTRODUCTION

## SITE DESCRIPTION

### LAND USE

The N9-B2, N9-B1 and N9-B Structures have a combined watershed of 43.57 acres and are located on a tributary upstream of Yellow Water Canyon Wash at the Kayenta Mine. The 147.51-acre watershed, which contributes directly to structure N9-B2, is classified as 61% undisturbed and 39% spoil.

## DESIGN ANALYSES

### GENERAL

Structure N9-B2 was designed under the supervision of a Registered Professional Engineer from Peabody Western Coal Company. The design was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of Interior, Office of Surface Mining (OSM) and included a review of available project files. The most current information contained in the Peabody Western Coal Company files includes topographic maps developed from aerial photography flown in 1983 for Peabody Western Coal Company and was used in the analyses of the structure.

### STABILITY

Structure N9-B2 is assumed to be a Category A-3 embankment. The structure will be a homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 15 feet wide on top. A minimum upstream slope of 2H:1V and a minimum downstream slope of 4H:1V were assumed. Based on the total embankment height of approximately 19.5 feet, these slopes are equal to or flatter than the recommended "worst case" embankment/foundation condition slopes in Table 3-6, Attachment D, Chapter 6; therefore, the embankment will be stable. The emergency spillway will be a minimum 20-foot wide, trapezoidal channel.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure N9-B2 will be constructed in series with proposed Structures N9-B1 and N9-B. Structure N9-B2 is classified as a low hazard structure (see Drawing No. 85408). In addition, the mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and be less than 20 vertical feet in height from the upstream toe of the embankment of the natural stream elevation to the emergency spillway invert elevation. N9-B2 is the upper pond in the series and has a capacity of less than 20 acre-feet; therefore, the spillway was analyzed using the 25-year, 6-hour storm event. All structures were conservatively assumed to be full to the emergency spillway at the time of design storm event. The storage capacity of structure N9-B2 was analyzed using the 10-year, 24-hour storm event. The combined ponds in series were verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Yellow Water Canyon Wash.

The following parameters were used in the hydrologic analysis:

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

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

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

## HYDRAULICS

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

N9-B2 SEDIMENTATION POND HYDRAULICS TABLE

	Units	10-Yr, 24-Hr Storm	25-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Empty	Full to emergency spillway
Inflow			
Peak Flow	Cfs	83.63	96.58
Volume	ac-ft	8.80	7.18
Storage			
Peak Stage	Msl	N/A	6777.2
Emerg. Spillway Elev.	Msl	6776.8	6776.8
Peak Storage	ac-ft	N/A	21.6
Storage Capacity	ac-ft	19.55	19.55
Outflow			
Peak Flow	Cfs	N/A	51.3
Spillway Elevation	Msl	6776.8	6776.8
Embankment Crest Elev.	Msl	6779.9	6779.9
Peak Stage	Msl	--	6777.9
Freeboard	ft	--	2.0
Emergency Spillway Channel			
Flow Depth	ft	--	1.1
Critical Velocity	Fps	--	4.98
Mannings "n"	--	--	0.048
Width	ft	--	20
Outflow Channel			
Slope	%	--	25
Normal Velocity	Fps	--	7.9
Normal Depth	ft	--	0.6
Mannings "n"	--	--	0.061
Riprap D <sub>50</sub>	In	--	6

EMERGENCY SPILLWAY AND OUTLET CHANNEL

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

Minimum Channel Depth	(Spillway)	2.0	ft
	(Outflow)	2.0	ft
Channel Width		20	ft
Channel Length	(Spillway)	34.2	ft
	(Outflow)	207	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
	(Outflow)	25	%
Spillway Elevation		6776.8	ft

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

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 1983 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-B2 is designed to contain approximately 19.55 acre-feet.

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

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



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

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

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

Appendix A- Hydrology, Hydraulic, and Sedimentation Calculations

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

\* \* \*

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

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

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

Hydrology, Hydraulic, and Sedimentation Calculations

## APPENDIX A

**PEABODY WESTERN COAL COMPANY  
CALCULATED HYDROLOGIC DATA**

**PROJECT: N-9 MINING AREA**

**STRUCTURE: B2**

**TIME OF CONCENTRATION:**

7090	=	Start Elevation (ft)
6760	=	End Elevation (ft)
330	=	Elevation Difference, E (ft)
5455	=	Watercourse Length (ft)
1.033	=	Watercourse Length (mi)
0.289	=	$T_c = (1.49L^{0.76}/E^{0.385})$
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	13.963	907.595
Pinyon Juniper	D	83	73.69	6116.27
Saltbrush	D	79	0.691	54.589
Sagebrush	B	60	1.345	80.7
Sagebrush	D	79	0.782	61.778
Distributed Land	B	86	57.04	4905.44
<b>TOTAL:</b>				12126.372
				147.511

Weighted CN = Total CN \* Area / Total Area =

82

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

**DRAINAGE BASIN AREA:** 147.511 Acres

PEABODY WESTERN COAL COMPANY  
CALCULATED SEDIMENTOLOGY DATA

STRUCTURE: B2

SOIL ERODIBILITY FACTOR:

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

Weighted K = Total K \* Area / Total Area =

0.11

SLOPE FACTOR:

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

Average LS = 9.85

The LS Factor was calculated by:

LS=(Slope Length/72.6)<sup>m</sup>\*(10.8sin(slope angle)+.03) for slopes < 9%  
 LS=(Slope Length/72.6)<sup>m</sup>\*(16.8sin(slope angle)-0.5) for slopes > 9%

Where:

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

**STRUCTURE: B2**

*Cover and Practive Factors:*

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

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

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

**RAINFALL FACTOR:**

R = 40

**PEABODY WESTERN COAL COMPANY  
CALCULATED SEDIMENT YIELD**

**STRUCTURE: B2**

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

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

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

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

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

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

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

PADER Method - Steep Slope Design

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VKD)
20.00	3:0:1	3:0:1	25.0	1.00		

Trapezoidal Channel

Material: Riprap

**N9-B2 POND OUTFLOW CHANNEL**



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

APPENDIX B

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

Gary Altsisi

### ***General Information***

### ***Storm Information:***

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

**Structure Summary:**

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

***Subwatershed Hydrology Detail:***

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	147.510	0.289	0.000	0.000	82.000	F	83.63	8.795
		<b>Σ</b>	<b>147.510</b>					<b>83.63</b>	<b>8.795</b>

SBD/CAD4 (Input and Output) 25-Year, 6-Hour Storm Event

APPENDIX C

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

Gary Altisi

### **General Information**

### **Storm Information:**

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



**Structure Summary:**

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

*Structure #1 (Pond)*

*N9-B2 POND*

Pond Inputs:

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

Emergency Spillway

Spillway Elev	6,776.80	Crest Length (ft)	34.20	Left Slope	3:00:1	Right Slope	3:00:1	Bottom Width (ft)	20.00
---------------	----------	-------------------	-------	------------	--------	-------------	--------	-------------------	-------

Pond Results:

Peak Elevation:	6,777.85
Dewater Time:	0.35 days

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

Elevation-Capacity-Discharge Table

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

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

Detailed Discharge Table

Combined	Total	Emergency Spillway (cfs)	Elevation
0.000	0.000	0.000	6,760.00
0.000	0.000	0.000	6,760.50
0.000	0.000	0.000	6,761.00
0.000	0.000	0.000	6,761.50
0.000	0.000	0.000	6,762.00
0.000	0.000	0.000	6,762.50
0.000	0.000	0.000	6,763.00
0.000	0.000	0.000	6,763.50

Combined	Total	Elevation	Emergency Spillway (cfs)	Discharge (cfs)
0.000	0.000	6,764.00	0.000	0.000
0.000	0.000	6,764.50	0.000	0.000
0.000	0.000	6,765.00	0.000	0.000
0.000	0.000	6,765.50	0.000	0.000
0.000	0.000	6,766.00	0.000	0.000
0.000	0.000	6,766.50	0.000	0.000
0.000	0.000	6,767.00	0.000	0.000
0.000	0.000	6,767.50	0.000	0.000
0.000	0.000	6,768.00	0.000	0.000
0.000	0.000	6,768.50	0.000	0.000
0.000	0.000	6,769.00	0.000	0.000
0.000	0.000	6,769.50	0.000	0.000
0.000	0.000	6,770.00	0.000	0.000
0.000	0.000	6,770.50	0.000	0.000
0.000	0.000	6,771.00	0.000	0.000
0.000	0.000	6,771.50	0.000	0.000
0.000	0.000	6,772.00	0.000	0.000
0.000	0.000	6,772.50	0.000	0.000
0.000	0.000	6,773.00	0.000	0.000
0.000	0.000	6,773.50	0.000	0.000
0.000	0.000	6,774.00	0.000	0.000
0.000	0.000	6,774.50	0.000	0.000
0.000	0.000	6,775.00	0.000	0.000
0.000	0.000	6,775.50	0.000	0.000
0.000	0.000	6,776.00	0.000	0.000
0.000	0.000	6,776.50	0.000	0.000
0.000	0.000	6,776.80	0.000	0.000
6.305	6.305	6,777.00	6.305	6.305
22.053	22.053	6,777.50	22.053	22.053
63.313	63.313	6,778.00	63.313	63.313
121.954	121.954	6,778.50	121.954	121.954
193.061	193.061	6,779.00	193.061	193.061
282.223	282.223	6,779.50	282.223	282.223
391.648	391.648	6,780.00	391.648	391.648

**Subwatershed Hydrology Detail:**

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)		
#1	1	147.510	0.289	0.000	0.000	82.000	F	96.58	7.176		
		<b>Σ 147.510</b>								<b>96.58</b>	<b>7.176</b>