DESIGN REPORT

Temporary Sedimentation Structure

N9-C1

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

TABLE OF CONTENTS

INTRODUCTION

Sedimentation Structure N9-C1 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-C1 and its watershed boundary are shown on Drawing No. 85400 (Sheet K-6) and Drawing No. 85405. The site-specific general construction plans are shown on the attached Exhibit 1.

This design report contains information specific to Structure N9-C1 that is in series with sedimentation structure N9-C. N9-C1 is the second pond in the series. Mine-wide design, construction, and reclamation information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona, for Peabody Western Coal Company", December, 1985 (PAP), Chapter 6, Attachment D, Volume 2, along with the methods and results of analyses used for slope stability, hydrology, and hydraulics, and in Chapter 6, Pages 11 to 42, "Sediment and Water Control Facility Plan".

INSPECTION

The construction site of the proposed Structure N9-C1 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.

SITE DESCRIPTION

LAND USE

The N9-C1 and N9-C Structures have a combined watershed of 496.49 acres and are located on a tributary upstream of Yellow Water Canyon Wash at the Kayenta Mine. The 477.24-acre watershed, which contributes directly to structure N9-C1 is classified as 50% spoil, 49% reclaimed and 1% undisturbed.

DESIGN ANALYSES

GENERAL

Structure N9-C1 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-C1 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 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 35-foot wide, riprap-lined, trapezoidal channel.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure N9-C1 will be constructed in series with proposed Structure N9-C. Structure N9-C1 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-C1 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-C1 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	1.509 mi.
2.	Elevation Difference, H	380 ft
3.	Time of Concentration, T_c	0.424 hr
4.	NRCS Curve Number	83
5.	Rainfall Depth, 10-year, 24-hour storm 100-year, 6-hour storm	2.1 in 2.4 in
6.	Drainage Area	477.24 acres

Values reported represent the watershed, which drains directly to Pond N9-C1. Hydrologic input parameters for structure N9-C are presented in separate a design report.

Muskingum routing parameters were utilized to route the 25-year hydrographs between the two 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-C1 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	253.85	291.02
Volume	ac-ft	30.40	24.96
Storage			
Peak Stage	msl	N/A	6656.3
Emerg. Spillway Elev.	msl	6654.4	6654.4
Peak Storage	ac-ft	N/A	23.7
Storage Capacity	ac-ft	19.62	19.62
Outflow			
Peak Flow	cfs	N/A	239.8
Spillway Elevation	msl	6697.4	6654.4
Embankment Crest Elev.	msl	6701.0	6659.4
Peak Stage	msl	--	6656.3
Freeboard	ft	--	3.1
Emergency Spillway Channel			
Flow Depth	ft	--	1.9
Critical Velocity	fps	--	6.0
Mannings "n"	--	--	0.048
Width	ft	--	35
Outflow Channel			
Slope	%	--	25
Normal Velocity	fps	--	9.5
Normal Depth	ft	--	0.8
Mannings "n"	--	--	0.066
Riprap D_{50}	in	--	9

EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for N9-C1 will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway) (Outflow)	3.0 2.0	ft
Channel Width		35	ft
Channel Length	(Spillway) (Outflow)	45 210	ft ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6654.4	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 1983 aerial topographic mapping conducted for Peabody Western Coal Company. Structure N9-C1 is designed to contain approximately 19.62 acre-feet.

The calculations for the sediment load entering structure N9-C1 were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.12
3	Slope Factor, LS	5.75
4.	Cover Factor, C	0.57
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 N9-C1, combined with Structure N9-C has adequate storage capacity to contain the 10-year, 24-hour storm and reasonable sediment storage capacity. The combined storage capacity was determined for all three structures in series and the results of the analysis are presented in the following table.

Combined Storage for Structures N9-C1 and N9-C

	N9-C1 (UPPER)	N9-C (LOWER)	COMBINED
Total Storage Capacity (ac-ft)	19.62	19.63	39.25
10-Year, 24-Hour Storm Inflow (ac-ft)	30.40	0.93	31.33
Available Sediment Storage Capacity (ac-ft)	-	-	7.92
Sediment Inflow Rate/Year (ac-ft/yr)	2.00	0.13	2.13
Sediment Storage Life (yr)	-	-	3.7

* * *

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

Appendix A- Hydrology, Hydraulic, and Sedimentation Calculations

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

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

Exhibit #1- N9-C1 and N9-C Proposed Sedimentation Ponds

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: N-9 MINING AREA

STRUCTURE: C1

TIME OF CONCENTRATION:

Start Elevation (ft) =	7020	
End Elevation (ft) =	6640	
Elevation Difference, E (ft) =	380	
Watercourse Length (ft) =	7967	
Watercourse Length (mi) =	1.509	
Tc = (11.9L^3/E)^0.385 =	0.424	hours

ROUTING PARAMETERS:

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

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Reclaimed Land	B	81	238.43	19312.83
Saltbrush	B	60	0.208	12.48
Sagebrush	B	60	0.017	1.02
Distrubed Land	B	86	238.58	20517.88
TOTAL:			477.24	39844.21

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 open pit is reclaimed and runoff from a larger area or regraded soil reports directly to the pond.

DRAINAGE BASIN AREA:

477.24 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

STRUCTURE: C1

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area	K*Area
Reclaimed	0.12	238.43	28.61
12AB	0.43	0.048	0.02
13A	0.37	0.177	0.07
Disturbed	0.12	238.58	28.63
	TOTAL	477.24	57.33

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

SLOPE FACTOR:

Length (ft)		Slope (%)	m	Slope Angle (deg)	LS Factor
798	100	12.53%	0.60	7.14	6.69
730	110	15.07%	0.60	8.57	8.00
774	125	16.15%	0.60	9.17	9.01
584	55	9.42%	0.50	5.38	3.05
1124	93	8.27%	0.50	4.73	3.62
1248	136	10.90%	0.60	6.22	7.27
1405	100	7.12%	0.50	4.07	3.50
2060	169	8%	0.50	4.69	4.86

Average LS = 5.75

The LS Factor was calculated by:

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

Where:

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

STRUCTURE: C1

Cover and Practice Factors:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C * Area	Practive Factor, P	P * Area
Pinyon Juniper	40%	25%	0.00	0.22	0.00	1.00	0
Sagebrush, Grass	40%	25%	0.02	0.20	0.00	1.00	0.017
Saltbrush	40%	25%	0.21	0.20	0.04	1.00	0.208
Reclaimed	0%	0%	238.43	0.15	35.76	0.40	95.372
Disturbed	0%	0%	238.58	1.00	238.58	0.80	190.864
TOTAL:			477.24		274.39		286.46

Weighted C = Total C * Area / Total Area = 0.57

Weighted P = Total P * Area / Total Area = 0.60

RAINFALL FACTOR:

R= 40

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

STRUCTURE: C1

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

PARAMETER DESCRIPTION	VALUE
Annual Rainfall Factor (R)	40.00
Soil Erodibility Factor (K)	0.12
Length Slope Factor (L)	5.75
Cover Factor(C)	0.57
Practice Factor (P)	0.60
Gross Annual Sediment Yield	9.54 tons/acre/year
Sediment Density	94.00 pcf
Gross Annual Sediment Yield	0.0047 acre-feet/acre/year
Sediment Delivery Ratio	90%
Estimated Annual Sediment Yield	0.0042 acre-feet/acre/year
Watershed Area	477.24 acres
Watershed Annual Sediment Yield	2.00 acre-feet/year
Number of Years	1.00 years
Calculated Sediment Volume	2.00 acre-feet

TRAPEZOIDAL CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION
N9-C1 POND
November 10, 2004

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	291.02
Channel Bottom Slope (ft/ft)	0.005
Manning's Roughness Coefficient (n-value)	0.048
Channel Left Side Slope (horizontal/vertical)	3.0
Channel Right Side Slope (horizontal/vertical)	3.0
Channel Bottom Width (ft)	35.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Critical Depth (ft)	1.24
Critical Slope (ft/ft)	0.0326
Flow Velocity (fps)	6.04
Froude Number	1.0
Velocity Head (ft)	0.57
Energy Head (ft)	1.81
Cross-Sectional Area of Flow (sq ft)	48.17
Top Width of Flow (ft)	42.46

N9-C1 POND OUTFLOW CHANNEL

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
35.00	3.0:1	3.0:1	25.0	4.18		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	291.02 cfs	
Depth:	0.82 ft	5.00 ft
Top Width:	39.93 ft	65.01 ft
Velocity:	9.45 fps	
X-Section Area:	30.79 sq ft	
Hydraulic Radius:	0.766	
Froude Number:	1.90	
Manning's n:	0.0660	
Dmin:	5.00 in	
D50:	9.00 in	
Dmax:	12.00 in	

APPENDIX B

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

Peabody Western Coal
Kayenta Mine
N9-C1 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:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	477.240	477.240	253.85	30.40

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	477.240	0.424	0.000	0.000	83.000	F	253.85	30.396
	$\sum$	**477.240**						**253.85**	**30.396**

APPENDIX C

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

Peabody Western Coal
Kayenta Mine
N9-C1 POND DESIGN
25YR 6HR STORM

Gary Altsisi

General Information

Storm Information:

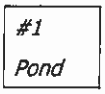
Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.900 Inches

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	477.240	0.424	0.000	0.000	83.000	F	291.02	24.964
	Σ	**477.240**						**291.02**	**24.964**

Structure Networking:

Type	Stru #	(flows Into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	N9-C1



Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	477.240	477.240	291.02	24.96
	Out			239.81	24.96

Structure Detail:

Structure #1 (Pond)

N9-C1

Pond Inputs:

Initial Pool Elev:	6,654.40
Initial Pool:	19.62 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,654.40	45.00	3.00:1	3.00:1	35.00

Pond Results:

Peak Elevation:	6,656.31
Dewater Time:	0.24 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)
6,640.00	0.911	0.000	0.000	
6,640.50	0.939	0.463	0.000	
6,641.00	0.968	0.939	0.000	
6,641.50	0.997	1.430	0.000	
6,642.00	1.026	1.936	0.000	
6,642.50	1.056	2.457	0.000	
6,643.00	1.086	2.992	0.000	
6,643.50	1.117	3.543	0.000	
6,644.00	1.148	4.110	0.000	
6,644.50	1.180	4.692	0.000	
6,645.00	1.212	5.290	0.000	
6,645.50	1.243	5.903	0.000	
6,646.00	1.274	6.532	0.000	
6,646.50	1.305	7.177	0.000	
6,647.00	1.337	7.838	0.000	
6,647.50	1.369	8.514	0.000	
6,648.00	1.402	9.207	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,648.50	1.435	9.916	0.000		
6,649.00	1.468	10.642	0.000		
6,649.50	1.502	11.384	0.000		
6,650.00	1.536	12.144	0.000		
6,650.50	1.572	12.921	0.000		
6,651.00	1.609	13.716	0.000		
6,651.50	1.646	14.530	0.000		
6,652.00	1.684	15.362	0.000		
6,652.50	1.722	16.214	0.000		
6,653.00	1.760	17.084	0.000		
6,653.50	1.799	17.974	0.000		
6,654.00	1.838	18.883	0.000		
6,654.40	1.870	19.625	0.000		Spillway #1
6,654.50	1.875	19.812	7.649	2.20	
6,655.00	1.899	20.755	45.856	1.90	
6,655.50	2.154	21.768	84.064	0.85	
6,656.00	2.425	22.912	174.574	0.50	
6,656.31	2.605	23.707	239.805	0.20	Peak Stage
6,656.50	2.712	24.196	279.950		
6,657.00	3.014	25.626	407.605		
6,657.50	3.333	27.212	563.656		
6,658.00	3.668	28.962	745.489		
6,658.50	4.019	30.883	952.365		
6,659.00	4.385	32.983	1,172.390		
6,659.50	4.767	35.270	1,420.010		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,640.00	0.000	0.000
6,640.50	0.000	0.000
6,641.00	0.000	0.000
6,641.50	0.000	0.000
6,642.00	0.000	0.000
6,642.50	0.000	0.000
6,643.00	0.000	0.000
6,643.50	0.000	0.000
6,644.00	0.000	0.000

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,644.50	0.000	0.000
6,645.00	0.000	0.000
6,645.50	0.000	0.000
6,646.00	0.000	0.000
6,646.50	0.000	0.000
6,647.00	0.000	0.000
6,647.50	0.000	0.000
6,648.00	0.000	0.000
6,648.50	0.000	0.000
6,649.00	0.000	0.000
6,649.50	0.000	0.000
6,650.00	0.000	0.000
6,650.50	0.000	0.000
6,651.00	0.000	0.000
6,651.50	0.000	0.000
6,652.00	0.000	0.000
6,652.50	0.000	0.000
6,653.00	0.000	0.000
6,653.50	0.000	0.000
6,654.00	0.000	0.000
6,654.40	0.000	0.000
6,654.50	7.649	7.649
6,655.00	45.856	45.856
6,655.50	84.064	84.064
6,656.00	174.574	174.574
6,656.50	279.950	279.950
6,657.00	407.605	407.605
6,657.50	563.656	563.656
6,658.00	745.489	745.489
6,658.50	952.365	952.365
6,659.00	1,172.390	1,172.390
6,659.50	1,420.010	1,420.010