



PEABODY WESTERN COAL COMPANY

For

Navajo County, Arizona

Kayenta Mine

N9-E

Temporary Sedimentation Structure

DESIGN REPORT

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INTRODUCTION

Sedimentation Structure N9-E will be an earthen embankment, designed and constructed by Peabody Western Coal Company (PWCC) as a temporary sedimentation structure to control runoff and sediment from portions of the N9 disturbed surface mining area at the Kayenta Mine. The location of Structure N9-E and its watershed boundary are shown on Drawing No. 85400, (Sheet K-7), and Drawing No. 85405. The site-specific general construction plans are shown on the attached Exhibit 1.

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

INSPECTION

The construction site of the proposed Structure N9-E 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

Structure N9-E is assumed to be a Category A-3 embankment. The structure will be a homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 15 feet wide on top. A minimum upstream slope of 2H : 1V and minimum downstream slope of 4H : 1V were assumed. Based on the total embankment height of approximately 18 feet, these slopes are equal to or flatter than the recommended "worst case" embankment/foundation condition slopes in Table 3-6, Attachment D, Chapter 6; therefore, the embankment will be stable. The emergency spillway will be a minimum 20-foot wide, riprap-lined, trapezoidal channel.

STABILITY

Structure N9-E 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.

GENERAL

DESIGN ANALYSES

The N9-E Structure has a watershed of 97.98 acres and is located on a tributary upstream of Yellow Water Canyon Wash at the Kayenta Mine. The 97.98-acre watershed, which contributes directly to structure N9-E, is classified as 61% undisturbed and 39% spoil.

LAND USE

SITE DESCRIPTION

Appendices A, B, and C).

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

HYDRAULICS

Values reported represent the watershed, which drains directly to Pond N9-E.

1.	Water Course length, L	0.807 mi.
2.	Elevation Difference, H	230 ft
3.	Time of Concentration, T _c	0.250 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	97.98 acres

The following parameters were used in the hydrologic analysis:

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

HYDROLOGY

N9-E 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	62.81	73.22
Volume	ac-ft	6.24	5.13
Storage			
Peak Stage	msl	N/A	6616.3
Emerg. Spillway Elev.	msl	6615.3	6615.3
Peak Storage	ac-ft	N/A	16.02
Storage Capacity	ac-ft	14.62	14.62
Outflow			
Peak Flow	cfs	N/A	43.42
Spillway Elevation	msl	6615.3	6615.3
Embankment Crest Elev.	msl	6618.0	6618.0
Peak Stage	msl	--	6616.3
Freeboard	ft	--	1.7
Emergency Spillway Channel			
Flow Depth	ft	--	1.0
Critical Velocity	fps	--	4.6
Mannings "n"	--	--	0.048
Width	ft	--	20
Outflow Channel			
Slope	%	--	25
Normal Velocity	fps	--	6.9
Normal Depth	ft	--	0.5
Mannings "n"	--	--	0.065
Riprap D ₅₀	in	--	6

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.14
3.	Slope Factor, LS	6.44
4.	Cover Factor, C	0.52
5.	Erosion Control Factor, P	0.92

Universal Soil Loss Equation with the following parameters:

The calculations for the sediment load entering structure N9-E were made utilizing the Revised

approximately 14.62 acre-foot.

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

STORAGE CAPACITY

as a transition into the downstream channel.

A minimum 15-foot long riprap-lined channel will be constructed beyond the toe of the embankment

Minimum Channel Depth	(Spillway)	2.0	ft
Channel Width		20	ft
Channel Length	(Spillway)	31	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6615.3	ft

listed below. The alignment and dimensions are shown on Exhibit 1.

The emergency spillway and outlet channel for N9-E will be a trapezoidal channel with dimensions

EMERGENCY SPILLWAY AND OUTLET CHANNEL

Exhibit #1- N9-E Proposed Sedimentation Pond

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 drawing are attached and complete this design report.

* * *

N9-E	
Total Storage Capacity (ac-ft)	14.62
10-Year, 24-Hour Storm Inflow (ac-ft)	6.24
Available Sediment Storage Capacity (ac-ft)	8.38
Sediment Inflow Rate/Year (ac-ft/yr)	0.74
Sediment Storage Life (yr)	11.3

Storage for Structure N9-E

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-E has sufficient storage capacity to contain the 10-year, 24-hour storm event. The storage capacity was determined for N9-E Structure and the results of the analysis are presented in the following table.

Hydrology, Hydraulic, and Sedimentation Calculations

APPENDIX A

**PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA**

PROJECT: N-9 MINING AREA

STRUCTURE: E

TIME OF CONCENTRATION:

Start Elevation (ft) = 6835

End Elevation (ft) = 6605

Elevation Difference, E (ft) = 230

Watercourse Length (ft) = 4262

Watercourse Length (mi) = 0.807

$T_c = (11.9L\sqrt{3/E})\sqrt{0.385} =$

0.250 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
Disturbed Land	D	86	0.018	1.548
Pinyon Juniper	B	65	2.331	151.515
Pinyon Juniper	D	83	50.369	4180.627
Saltbrush	B	60	0.95	57
Saltbrush	D	79	6.389	504.731
Disturbed Land	B	86	37.92	3261.12
TOTAL:				8156.541

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:

97.977 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

STRUCTURE: E

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area	K*Area
12AB	0.43	3.281	1.41
1AB	0.16	1.432	0.23
3CD	0.16	41.687	6.67
3DE	0.15	4.008	0.60
3F	0.02	9.649	0.19
Disturbed	0.12	37.92	4.55
TOTAL		97.977	13.65

Weighted K = Total K * Area / Total Area =

0.14

SLOPE FACTOR:

Length (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
630	16.98%	0.60	9.64	8.46
707	9.19%	0.50	5.25	3.24
901	13.10%	0.60	7.46	7.62

Average LS = 6.44

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: E

Cover and Practice Factors:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C * Area	Practice Factor, P	P * Area
Pinyon Juniper	40%	25%	52.7	0.22	11.59	1.00	52.7
Sagebrush, Grass	40%	25%	0	0.2	0.00	1.00	0
Saltbrush	40%	25%	7.339	0.2	1.47	1.00	7.339
Reclaimed	40%	25%	0.018	0.15	0.00	0.40	0.0072
Disturbed	0%	0%	37.92	1	37.92	0.80	30.336
TOTAL:							
			97.977	50.98		90.38	

Weighted C = Total C * Area / Total Area =
 Weighted P = Total P * Area / Total Area =

0.52
 0.92

RAINFALL FACTOR:

R = 40

**PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD**

STRUCTURE: E

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

PARAMETER DESCRIPTION	VALUE
Annual Rainfall Factor (R)	40.00
Soil Erodibility Factor (K)	0.14
Length Slope Factor (L)	6.44
Cover Factor(C)	0.52
Practice Factor (P)	0.92
Gross Annual Sediment Yield	17.23 tons/acre/year
Sediment Density	94.00 pcf
Gross Annual Sediment Yield	0.0084 acre-feet/acre/year
Sediment Delivery Ratio	90%
Estimated Annual Sediment Yield	0.0076 acre-feet/acre/year
Watershed Area	97.98 acres
Watershed Annual Sediment Yield	0.74 acre-feet/year
Number of Years	1.00 years
Calculated Sediment Volume	0.74 acre-feet

TRAPEZOIDAL CHANNEL ANALYSIS
 N9-E POND
 November 8, 2004

DESCRIPTION	VALUE
Flow Rate (cfs).....	73.22
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).....	0.72
Critical Slope (ft/ft).....	0.0391
Flow Velocity (fps).....	4.59
Froude Number.....	1.0
Velocity Head (ft).....	0.33
Energy Head (ft).....	1.05
Cross-Sectional Area of Flow (sq ft).....	15.94
Top Width of Flow (ft).....	24.32

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N9-E POND OUTFLOW CHANNEL

Material: Riprap

Trapezoidal Channel

Freeboard	Freeboard	Freeboard	Depth (ft)	% of Depth	Freeboard	Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)
1.00	1.00	1.00	1.00	1.00	1.00	20.00	3.0:1	3.0:1	25.0

PADER Method - Steep Slope Design

w/o Freeboard	w/ Freeboard
Design Discharge:	73.22 cfs
Depth:	0.50 ft
Top Width:	22.98 ft
Velocity:	6.85 fps
X-Section Area:	10.69 sq ft
Hydraulic Radius:	0.462
Froude Number:	1.77
Manning's n:	0.0650
Dmin:	3.00 in
D50:	6.00 in
Dmax:	9.00 in

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

APPENDIX B

Peabody Western Coal
Kayenta Mine
N9-E POND DESIGN
10-YR 24-HR 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)	#
6.24	62.81	97.980	97.980	#1

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	97.980	0.250	0.000	0.000	83.000	F	62.81	6.240
		Σ						62.81	6.240

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

APPENDIX C

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

Gary Altisi

General Information

Storm Information:

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

Subwatershed Hydrology Details:

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	97.980	0.250	0.000	0.000	83.000	F	73.22	5.125
		Σ						73.22	5.125

Structure Networking:

Type	#	Stru	(flows	#	Stru	Musk. K	Musk. X	Description
Pond	# 1	==>	End	0.000	0.000			

#1
 Pond

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	97.980	97.980	73.22	5.13
In			43.42	5.13
Out				5.13

Structure Detail:

Structure #1 (Pond)

Pond Inputs:

Initial Pool Elev:	6,615.30
Initial Pool:	14.62 ac-ft

Emergency Spillway

Spillway Elev	6,615.30	31.20	3:00:1	3:00:1	20.00
Crest Length (ft)			Left	Right	Bottom
Width (ft)			Sideslope	Sideslope	Width (ft)

Pond Results:

Peak Elevation:	6,616.25
Dewater Time:	0.28 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)
6,600.00	0.430	0.000	0.000	0.000
6,600.50	0.470	0.225	0.000	0.000
6,601.00	0.513	0.471	0.000	0.000
6,601.50	0.557	0.738	0.000	0.000
6,602.00	0.603	1.028	0.000	0.000
6,602.50	0.650	1.341	0.000	0.000
6,603.00	0.700	1.678	0.000	0.000
6,603.50	0.751	2.041	0.000	0.000
6,604.00	0.804	2.430	0.000	0.000
6,604.50	0.859	2.845	0.000	0.000
6,605.00	0.916	3.289	0.000	0.000
6,605.50	0.914	3.746	0.000	0.000
6,606.00	0.913	4.203	0.000	0.000
6,606.50	0.912	4.659	0.000	0.000
6,607.00	0.910	5.115	0.000	0.000
6,607.50	0.909	5.570	0.000	0.000
6,608.00	0.908	6.024	0.000	0.000
6,608.50	0.906	6.478	0.000	0.000

Elevation (ac)	Area (ac-ft)	Capacity (cfs)	Discharge (hrs)
6,609.00	0.905	6.930	0.000
6,609.50	0.904	7.383	0.000
6,610.00	0.902	7.834	0.000
6,610.50	0.969	8.302	0.000
6,611.00	1.037	8.803	0.000
6,611.50	1.108	9.339	0.000
6,612.00	1.181	9.911	0.000
6,612.50	1.256	10.520	0.000
6,613.00	1.334	11.168	0.000
6,613.50	1.414	11.855	0.000
6,614.00	1.497	12.583	0.000
6,614.50	1.581	13.352	0.000
6,615.00	1.668	14.164	0.000
6,615.30	1.345	14.615	0.000
6,615.50	1.395	14.890	6.486
6,616.00	1.524	15.619	22.686
6,616.25	1.593	16.015	43.421
6,616.50	1.659	16.415	64.391
6,617.00	1.800	17.279	123.286
6,617.50	1.946	18.215	194.690
6,618.00	2.098	19.226	285.257

Detailed Discharge Table

Combined Total Discharge (cfs)	Elevation Emergency Spillway (cfs)	Discharge (cfs)
6,600.00	0.000	0.000
6,600.50	0.000	0.000
6,601.00	0.000	0.000
6,601.50	0.000	0.000
6,602.00	0.000	0.000
6,602.50	0.000	0.000
6,603.00	0.000	0.000
6,603.50	0.000	0.000
6,604.00	0.000	0.000
6,604.50	0.000	0.000
6,605.00	0.000	0.000
6,605.50	0.000	0.000
6,606.00	0.000	0.000

Combined	Total	Elevation	Emergency	Spillway (cfs)	Discharge	(cfs)
0.000	0.000	6,606.50	0.000	0.000	0.000	0.000
0.000	0.000	6,607.00	0.000	0.000	0.000	0.000
0.000	0.000	6,607.50	0.000	0.000	0.000	0.000
0.000	0.000	6,608.00	0.000	0.000	0.000	0.000
0.000	0.000	6,608.50	0.000	0.000	0.000	0.000
0.000	0.000	6,609.00	0.000	0.000	0.000	0.000
0.000	0.000	6,609.50	0.000	0.000	0.000	0.000
0.000	0.000	6,610.00	0.000	0.000	0.000	0.000
0.000	0.000	6,610.50	0.000	0.000	0.000	0.000
0.000	0.000	6,611.00	0.000	0.000	0.000	0.000
0.000	0.000	6,611.50	0.000	0.000	0.000	0.000
0.000	0.000	6,612.00	0.000	0.000	0.000	0.000
0.000	0.000	6,612.50	0.000	0.000	0.000	0.000
0.000	0.000	6,613.00	0.000	0.000	0.000	0.000
0.000	0.000	6,613.50	0.000	0.000	0.000	0.000
0.000	0.000	6,614.00	0.000	0.000	0.000	0.000
0.000	0.000	6,614.50	0.000	0.000	0.000	0.000
0.000	0.000	6,615.00	0.000	0.000	0.000	0.000
6.486	6.486	6,615.50	6.486	6.486	6.486	6.486
22.686	22.686	6,616.00	22.686	22.686	22.686	22.686
64.391	64.391	6,616.50	64.391	64.391	64.391	64.391
123.286	123.286	6,617.00	123.286	123.286	123.286	123.286
194.690	194.690	6,617.50	194.690	194.690	194.690	194.690
285.257	285.257	6,618.00	285.257	285.257	285.257	285.257

Peabody Western Coal
Kayenta Mine
N9-E POND TEMPORARY DIVERSION
DESIGN
100-YR 6-HR STORM

Gary Altsisi

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.400 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	22.370	0.250	0.000	0.000	83.000	F	26.40	1.829
		Σ	22.370					26.40	1.829

Structure Summary:

Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
22.370	22.370	26.40	1.83
#1			

w/o Freeboard	w/ Freeboard
Design Discharge:	26.40 cfs
Depth:	1.29 ft
Top Width:	7.75 ft
Velocity:	5.27 fps
X-Section Area:	5.01 sq ft
Hydraulic Radius:	0.613
Froude Number:	1.15

Limiting Velocity (fps)	Freeboard	Freeboard % of Depth	Freeboard Depth (ft)	Manning's n	Slope (%)	Right Side Slope Ratio	Left Side Slope Ratio
6.0	1.00			0.0250	1.5	3.0:1	3.0:1

Triangular Channel

Material: Shales and hardpans

N9-E POND TEMPORARY DIVERSION

