DESIGN REPORT

Temporary Impoundment Structure

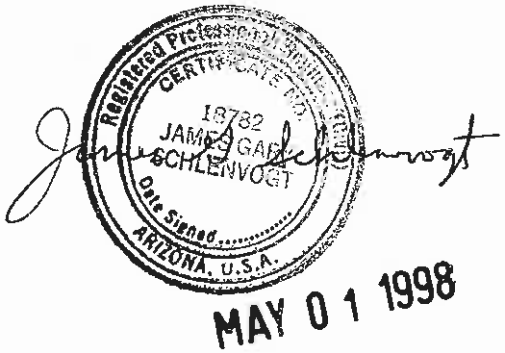
CW-A

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY



MAY 01 1998

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EXHIBIT #1 CW-A Temporary Impoundment Design

INTRODUCTION

Impoundment Structure CW-A is an existing earthen embankment, designed and constructed by Peabody Western Coal Company as a temporary impoundment structure to impound water for the N-6 Water Tank for the Black Mesa Mine. The N-6 Water Tank's water is utilized to water the roads and control dust. The pond receives runoff from the N-6 watershed, pumped water from the J2-A Dam or water from the WW #2 to WW #5 pipeline. The impoundments provides surge storage capacity to allow a submersible pump installed in the ponding area to pump water, as required, to the N-6 Water Tank. CW-A is not designed as a siltation control structure. The sediment control for the entire CW-A watershed is incorporated into the design for the downstream sediment structure J2-A assuming CW-A is non-existent. The location of structure CW-A and its watershed boundary are shown on Drawing No. 85400 (Sheet K-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 CW-A. 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, "Sediment and Water Control Facility Plan".

INSPECTION

The construction site of the Structure CW-A was inspected in February, 1998 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions exist for this structure. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized for embankment design.

SITE DESCRIPTION

LAND USE

Structure CW-A has a 1230-acre drainage area and is located upstream of sediment structure J2-A on the Wild Ram Valley Wash and a tributary to Coal Mine Wash. The watershed is classified as 70% reclaimed, 16% undisturbed 14% disturbed.

DESIGN ANALYSES

GENERAL

Structure CW-A 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 including 816.49 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 1990 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure CW-A is a Category A-5 embankment. A homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 12 feet wide on top was constructed. A minimum upstream slope of 2.0:1 (horizontal to vertical) and a downstream slope of 4.0:1 were utilized. Based on the total embankment height of approximately 20 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 21-foot wide riprap-lined trapezoidal channel.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A and B). Structure CW-A 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 spillway for the CW-A pond was analyzed using the 25-year, 6-hour storm. Structure CW-A was conservatively assumed to be full to the emergency spillway prior to the time of the 25-year storm event. CW-A Pond currently stores approximately 9.34 ac.-ft. The storage capacity is adequate to provide surge storage capacity, allowing a submersible pump installed in the ponding area to pump water, as required, to the N-6 Water Tank. The water is utilized for dust control for the mining operation.

The following parameters were used in the hydrologic analysis:

		25yr-6hr Storm	
1.	Water Course length, L	3.341	mi.
2.	Elevation Difference, H	450	ft
3.	Time of Concentration, T_c	0.995	hr
4.	SCS Curve Number	81	
5.	Rainfall Depth, 25-year, 6-hour storm	1.9	in
6.	Drainage Area	1230	acres

HYDRAULICS

The SEDCAD+ and Flow Master computer programs were used to evaluate inflow to the impoundment 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 and B).

CW-A POND HYDRAULICS TABLE

	Units	25-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Full to emergency spillway
Inflow		
Peak Flow	cfs	402.1
Volume	ac-ft	55.6
Storage		
Storage Capacity	ac-ft	9.34
Outflow		
Peak Flow	cfs	332.8
Spillway Elevation	msl	6471.9
Embankment Crest Elev.	msl	6476.0
Peak Stage	msl	6474.8
Freeboard	ft	1.2
Emergency Spillway Channel		
Flow Depth	ft	2.9
Critical Velocity	fps	7.0
Mannings "n"	--	.031
Width	ft	21
Outflow Channel		
Slope	%	9.2
Normal Velocity	fps	9.4
Normal Depth	ft	1.4
Mannings "n"	--	0.054
Riprap D_{50}	in	9

EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for CW-A is a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway) (Outflow)	3.9 2.4	ft ft
Channel Width		21	ft
Channel Length	(Spillway) (Outflow)	35 200	ft ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	9.2	%
Spillway Elevation		6471.9	ft

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

* * *

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

Appendix A - Hydrology and Hydraulic Calculations

Appendix B - SEDCAD+ (Input and Output) 25-Year, 6-Hour Storm Event

Exhibit # 1 - CW-A Temporary Impoundment Design

APPENDIX A

Hydrology and Hydraulic Calculations

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: TEMPORARY IMPOUNDMENT

STRUCTURE: CW-A

TIME OF CONCENTRATION:

Start Elevation (ft) =	6920
End Elevation (ft) =	6470
Elevation Difference, E (ft) =	450
Watercourse Length (ft) =	17640
Watercourse Length, L (mi) =	3.341

Tc = (11.9L^3/E)^0.385 = 0.995 hours

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Topsoil	C	81	15.1	1223.1
Reclaimed	C	81	846.8	68590.8
Disturbed	C	91	171.3	15588.3
Pinyon-Juniper	C	78	91.6	7144.8
Sagebrush	C	73	105.2	7679.6
TOTAL:			1230	100226.6

Weighted CN = Total CN*Area/ Total Area = 81

DRAINAGE BASIN AREA:

1230.0 Acres

CW-A temporary impoundment
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	CW-A temporary impoundment
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.031	
Channel Slope	0.012529	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	21.00	ft
Discharge	332.80	cfs

Results		
Depth	1.81	ft
Flow Area	47.87	ft²
Wetted Perimeter	32.45	ft
Top Width	31.87	ft
Critical Depth	1.81	ft
Critical Slope	0.012529	ft/ft
Velocity	6.95	ft/s
Velocity Head	0.75	ft
Specific Energy	2.56	ft
Froude Number	1.00	
Flow is supercritical.		

SEDCAD+ RIPRAP CHANNEL DESIGN

CW-A SPILLWAY

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	332.80 cfs	
Slope	9.20 %	
Sideslopes (L and R)	3.00:1	3.00:1
Bottom Width	21.00 feet	
Freeboard	1 ft	

RESULTS:

Steep Slope Design - PADER Method

Depth	1.41 ft
with Freeboard	2.41 ft
Top Width	29.44 ft
with Freeboard	35.44 ft
Velocity	9.38 fps
Cross Sectional Area	35.48 sq ft
Hydraulic Radius	1.19 ft
Manning's n	0.054
Froude Number	1.51
Dmax	0.938 ft (11.25 in)
D50	0.750 ft (9.00 in)
D10	0.250 ft (3.00 in)

APPENDIX B

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

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY : TEMPORARY IMPOUNDMENT CW-A

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\1000\SEDCAD\CW-A

Date: 03-12-1998

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\CW-A User: D. GLEASON
Date: 03-12-1998 Time: 12:03:08
PEABODY WESTERN COAL COMPANY : TEMPORARY IMPOUNDMENT CW-A
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	1230.00	81	F	0.995	0.000	0.000	0.0	55.57	402.11
		Type: Pond Label: CW-A POND								
111	Structure	1230.00							55.57	
111	Total IN	1230.00							55.57	402.11
111	Total OUT								55.57	332.83

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\CW-A User: D. GLEASON
Date: 03-12-1998 Time: 12:03:08
PEABODY WESTERN COAL COMPANY : TEMPORARY IMPOUNDMENT CW-A
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J1, B1, S1
CW-A POND

Drainage Area from J1, B1, S1, SWS(s)1: 1230.0 acres
Total Contributing Drainage Area: 1230.0 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	6471.9
Crest Length (ft)	35.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	21.0

RESULTS:

Permanent Pool (ac-ft)
9.2

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	55.57	402.11
OUT	55.57	332.83

Peak Elevation	Hydrograph Detention Time (hrs)
6474.8	0.45

****

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\CW-A User: D. GLEASON
Date: 03-12-1998 Time: 12:03:08
PEABODY WESTERN COAL COMPANY : TEMPORARY IMPOUNDMENT CW-A
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J1, B1, S1
CW-A POND

Drainage Area from J1, B1, S1, SWS(s)1: 1230.0 acres
Total Contributing Drainage Area: 1230.0 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6466.40	0.00	0.00	0.00	0.00	
6467.40	1.00	0.85	0.28	0.00	
6468.40	2.00	1.53	1.46	0.00	
6469.40	3.00	1.94	3.19	0.00	
6470.40	4.00	2.34	5.33	0.00	
6471.40	5.00	2.68	7.83	0.00	
6471.90	5.50	2.88	9.22	0.00	Stage of SW#1
6472.40	6.00	3.08	10.71	16.38	
6472.60	6.20	3.18	11.34	22.93	
6472.70	6.30	3.23	11.66	29.84	
6472.80	6.40	3.28	11.98	37.43	
6472.90	6.50	3.32	12.31	45.65	
6473.40	7.00	3.57	14.03	101.63	
6473.90	7.50	3.84	15.89	169.19	
6474.40	8.00	4.10	17.87	252.33	
6474.78	8.38	4.32	19.48	332.83	Peak Stage
6474.90	8.50	4.38	19.99	358.37	
6475.00	8.60	4.44	20.43	381.66	