DESIGN REPORT

Sedimentation Structure

J16-G1

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure J16-G1 will be an earthen embankment, designed and constructed by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Kayenta Mine. The location of Structure J16-G1 is shown on Plate 1, Site Plan.

This design report contains information specific to Structure J16-G1. Regional site information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company," along with the methods and results of analyses used for slope stability, hydrology and hydraulics.

INSPECTION

The proposed site of Structure J16-G1 was inspected by a senior geotechnical engineer from Dames & Moore in October, 1985 to ensure that the site is suitable and no adverse conditions exist to prevent the successful construction of the structure. A detailed geotechnical investigation was not performed.

SITE DESCRIPTION

LAND USE

Structure J16-G1 has a 260.8-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 65% disturbed, 20% Pinion/Juniper, 8% Sagebrush/grass, and 7% reclaimed.

EMBANKMENT

A homogeneous earthen embankment was assumed for the hydraulic analysis and to develop the volume-elevation curve shown on Plate 2. Upstream and downstream slopes of 2:1 and 3:1 (horizontal to vertical), respectively, were used. The assumed slopes were not evaluated for geotechnical considerations such as slope stability since the foundation or embankment material types have not been determined.

DESIGN ANALYSES

GENERAL

Structure J16-G1 was designed by an interdisciplinary team of engineers from Dames & Moore. 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 Coal

Company files includes topographic maps developed from aerial photography flown in 1985 for Peabody Coal Company and was used in the analyses of the structure.

STABILITY

The slopes of Structure J16-G1 will be chosen based on the stability analyses performed for existing structures in the General Report. The embankment fill materials and the type of foundation will be identified in the field and the stable slopes chosen based on the category classification of the structure.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J16-G1 is located upstream from Structure J16-G. The two structures have a combined storage capacity that is greater than 20 acre-feet. However, the spillway for J16-G1 was analyzed using the 25-year, 6-hour storm because J16-G1 is the upstream structure. The storage capacity of Structure J16-G1 was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.765	mi
2.	Elevation Difference, H	225	ft
3.	Time of Concentration, T_c	0.237	h
4.	Lag time, $0.6T_c$	0.142	h
5.	SCS Curve Number	90	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	260.8	acres

HYDRAULICS

The HEC-1 program was used to evaluate inflow to the planned 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.

J16-G1 HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	423	529
Volume	acre-ft	25.21	20.86
Storage			
Peak Stage	ft	6615.24	6615.36
Spillway Elevation . .	ft	6612.30	--
Peak Storage	acre-ft	-	--
Storage Capacity . . .	acre-ft	19.14	--
Outflow			
Peak Flow	cfs	5	272
Embankment Crest Elevation	ft	--	6616.50
Peak Stage	ft	--	6615.36
Freeboard	ft	--	1.14
Spillway Channel			
Flow Depth	ft	--	3.06
Critical Velocity. . .	fps	--	6.6
Manning's "n"		--	0.040
Outflow Channel			
Slope	%	--	28
Normal Velocity. . . .	fps	--	15.5
Normal Depth	ft	--	0.78
Manning's "n"		--	0.040

Spillway Channel

The spillway for J16-G1 will be a trapezoidal channel with the following dimensions:

Channel depth	4.1	ft
Channel width	20	ft
Channel length	40	ft
Side slopes (horizontal to vertical). .	3:1	
Average exit slope	0	percent

Outflow Channel

The outflow channel for Structure J16-G1 will be a trapezoidal channel with the following dimensions:

Channel width	20	ft
Channel length	130	ft
Side slopes (horizontal to vertical). .	3:1	
Average exit slope	28	percent

The alignment of the spillway and outflow channel are shown on Plate 1. The channel profile is shown on Plate 3 and the required dimensions are shown on Plates 4 and 5. The spillway, outflow channel and stilling basin should be protected against erosion using geotextile and riprap as shown on Plate 4.

STORAGE CAPACITY

The impoundment volume-elevation curve shown on Plate 2, Volume-Elevation Curve, J16-G1 is based on site specific topographic data developed for Peabody Coal Company in 1985, and 1985 site specific surveys, where available.

The calculations for the sediment load entering Structure J16-G1 were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.244
3. Slope Factor, LS 2.97
4. Cover Factor, C 0.70
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 J16-G1 is located upstream from Structure J16-G and contributes excess flow to J16-G during the 10-year, 24-hour storm. Therefore, the structures must be combined to determine the total sediment storage capacity. The results of the combined sediment inflow analysis are summarized in the following table.

COMBINED STORAGE FOR J16-G AND J16-G1

	J16-G1	J16-G	Total	
Total Storage Capacity	19.14	19.65	38.79	acre-ft
10-year, 24-hour Storm Inflow	25.21	1.15	26.36	acre-ft
Available Sediment Storage Capacity . .	--	—	12.43	acre-ft
Sediment Inflow Rate	2.32	0.642	2.96	acre-ft/yr
Sediment Storage Life	--	—	4	yrs

* * *

The following plates and appendix are attached and complete this design report.

Plate 1 - Site Plan J16-G1

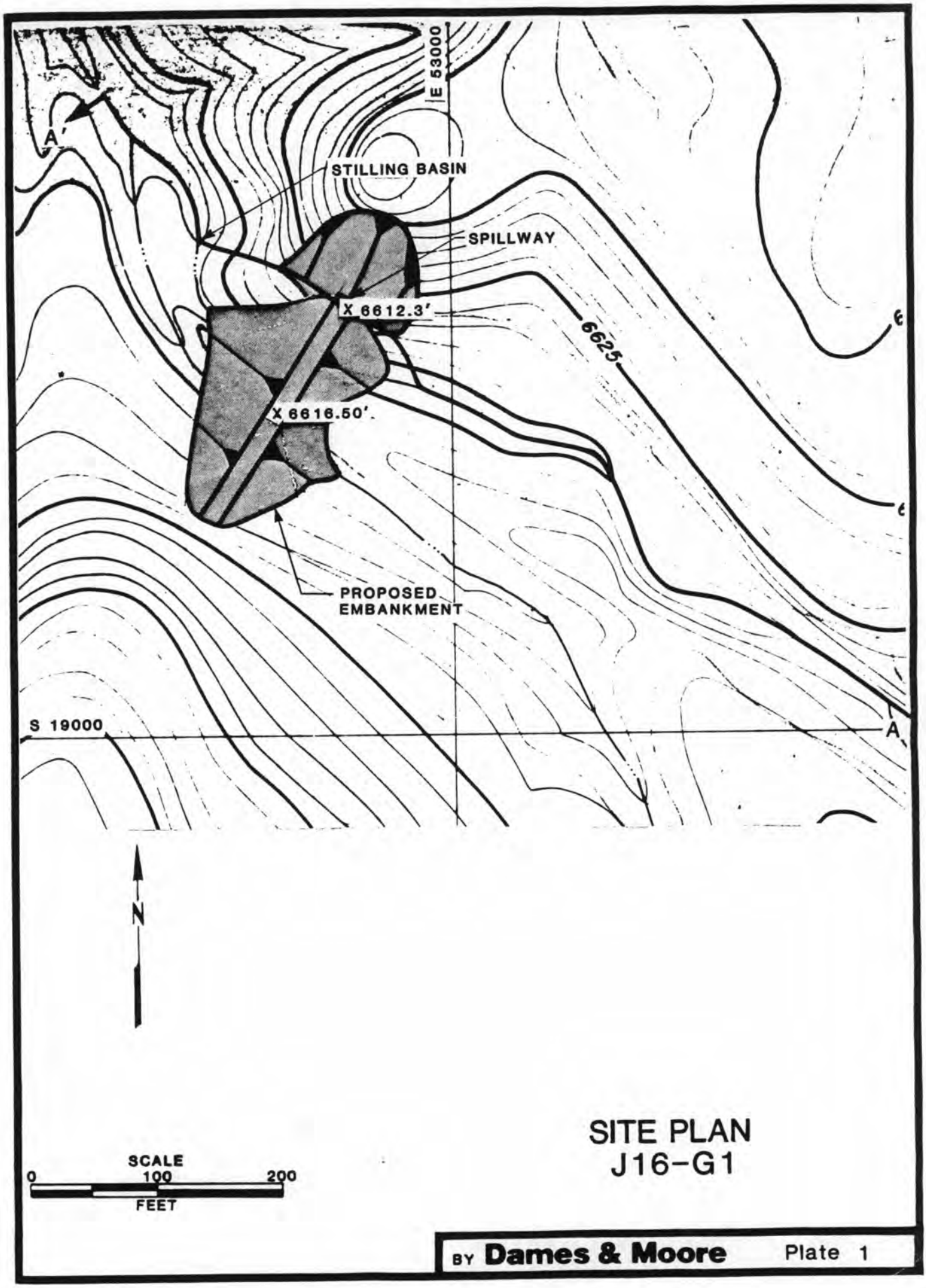
Plate 2 - Volume-Elevation Curve J16-G1

Plate 3 - Channel Profile J16-G1, A-A'

Plate 4 - Spillway and Outflow Channel Cross Section J16-G1

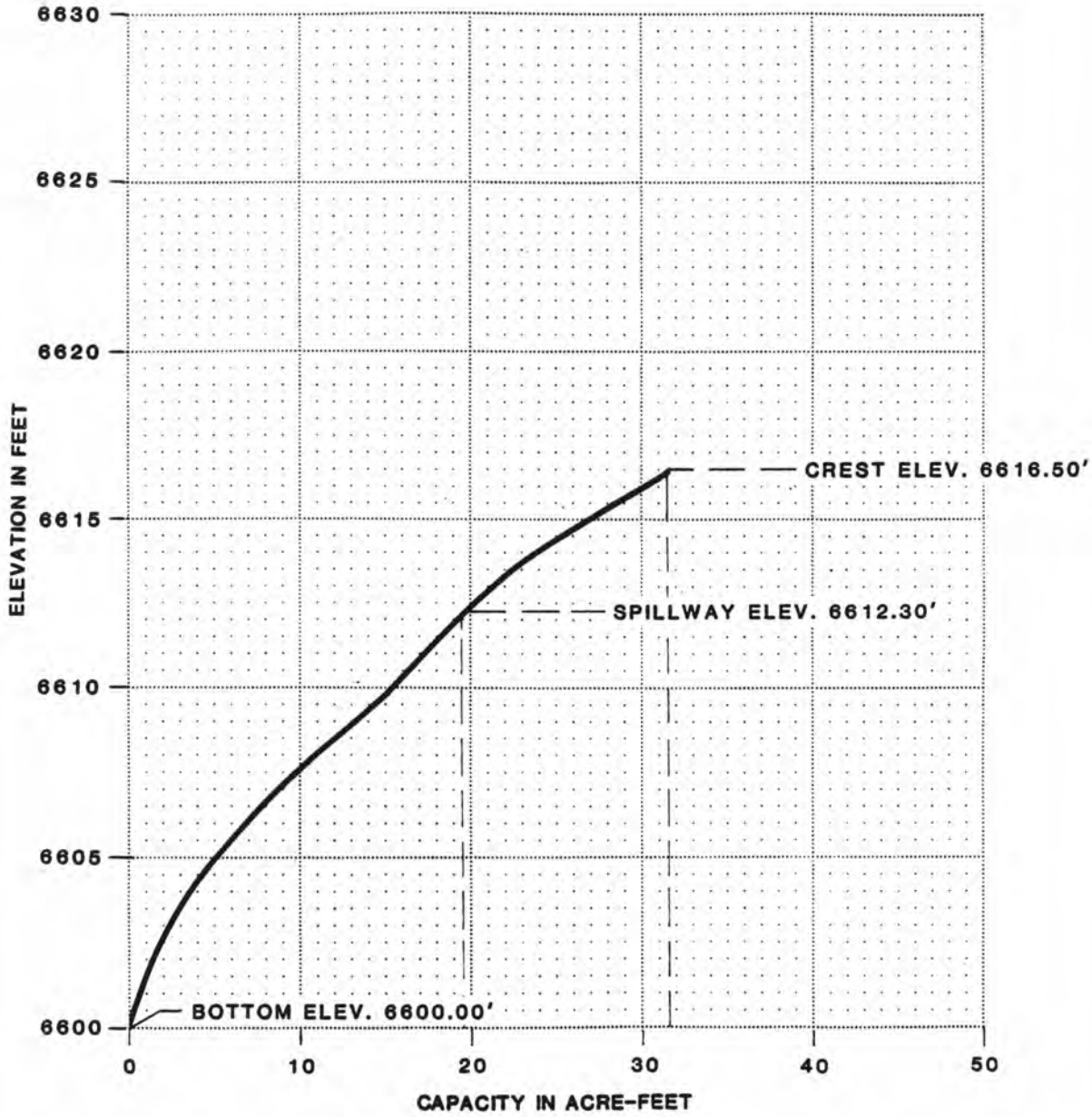
Plate 5 - Spillway Stilling Basin Plan J16-G1

Appendix A - Hydrology and Hydraulic Calculations



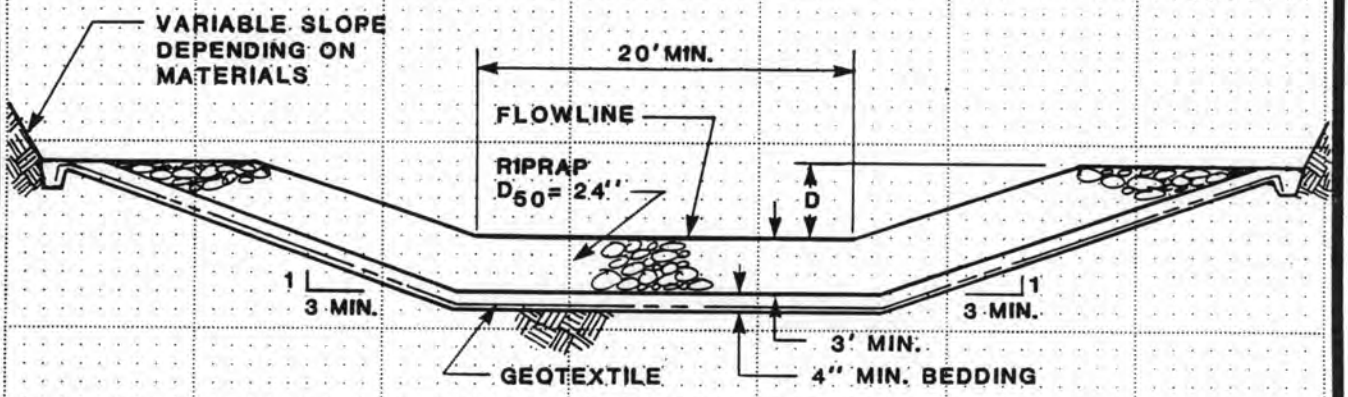
SITE PLAN
J16-G1

BY **Dames & Moore** Plate 1



VOLUME-ELEVATION CURVE
J16-G1

BY **Dames & Moore** Plate 2



SPILLWAY CHANNEL

D = 4.1'

LENGTH = 40'

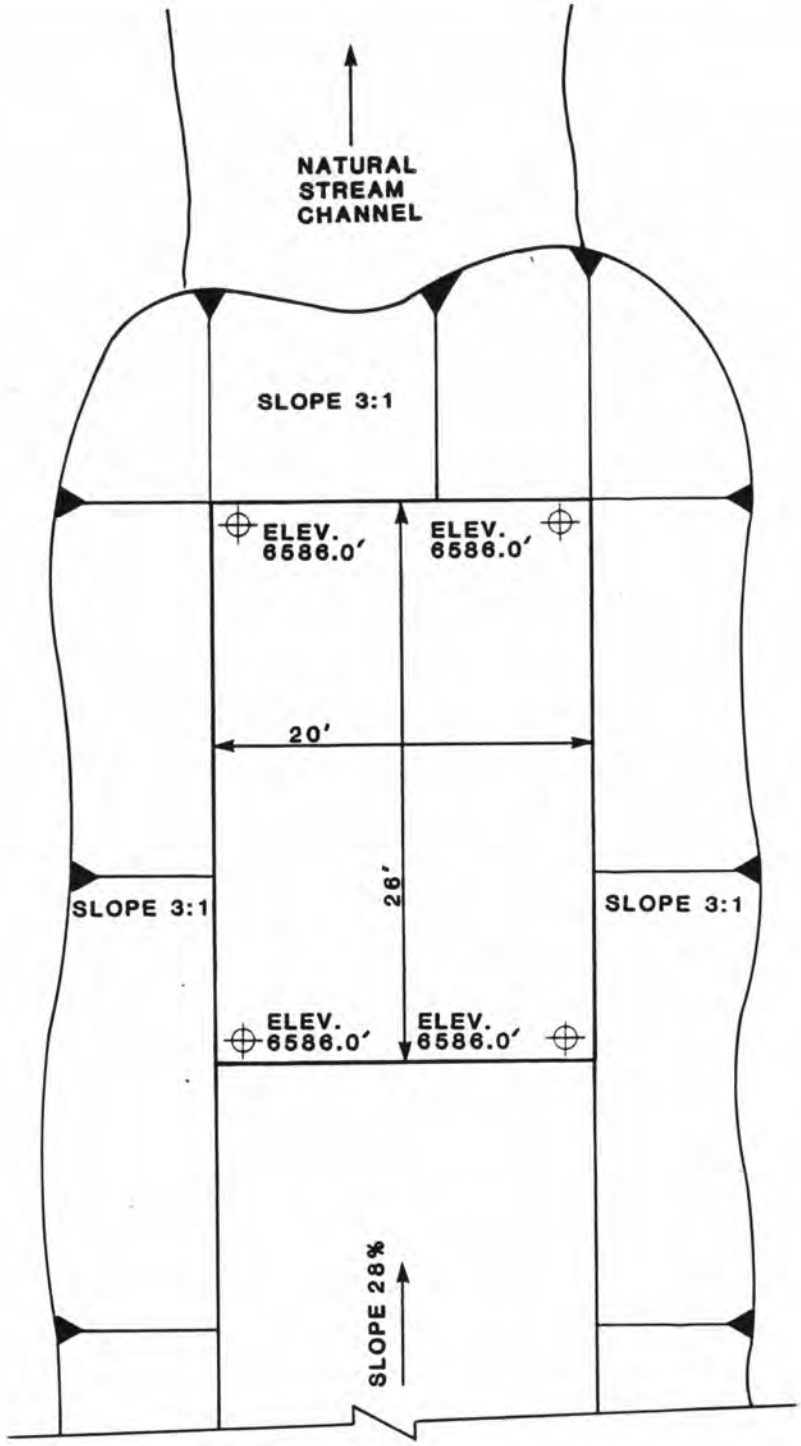
FLOWLINE ELEV.= 6612.30'

OUTFLOW CHANNEL

D = 2'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J16-G1

BY **Dames & Moore** Plate 4



MINIMUM HEIGHT OF RIPRAP ALONG SIDEWALLS ABOVE THE BASIN FLOOR = 7.2'

MINIMUM DEPTH OF BASIN FLOOR BELOW NATURAL STREAMBED ≈4.4'

SPILLWAY STILLING BASIN PLAN J16-G1

BY **Dames & Moore** Plate 5

APPENDIX A

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J16-61 SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6815 − 6590 = 225 ft. ✓

WATER COURSE LENGTH = 10.1 (400) = 4040 ft. = 0.765 mi. ✓

$$T_c = \left(\frac{11.9\ (0.765)^3}{225}\right)^{0.385} = 0.237 \text{ hr.} \checkmark$$

LAG TIME = $0.6 T_c$ = 0.142 hr. ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
169.41	DIST	—	—	94 (.65)
17.32	RECL	fair	D	81 (.07)
20.88	S-G	average	D	79 (.08)
53.23	P-J	average	#22 D 83(.9); #36 B 65(.1)	82 (0.20)
				89.49

236.97 #22 DIST, RECL, S-G, P-J
23.87 #36 DIST, RECL, P-J
FROM E,H SOILS MAPS 7-25-73

USE 90 ✓

DRAINAGE BASIN AREA

260.84 ACRES 0.408 SQ. MILE ✓

BY ___ DATE BHM 11/5/85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

Universal Soil Loss Equation

Rainfall Factor

R = 40

Soil Erodibility Factor

Soil Type =	7%	EH 35	.07 (.42)
	84%	EH 22	.84 (.22)
	9%	EH 36	.09 (.33)
			.244

K = .244 ✓

Slope Factor

Length (ft.)	Δ Elev (ft.)	Slope (%)	LS
500	90	18%	7.89 (.2)
500	45	9.	2.64 (.3)
500	25	5.	1.2 (.5)

S = 2.97 ✓

Cover Factor

Area (ac.)	Cover Type	% Cover	Canopy (%)	Weighted C
65%	disturbed	—	—	1.0 (.65)
7%	reclaimed	—	—	.15 (.07)
8%	S-G	40	25	.13 (.08)
20	P-J	40	25	.14 (.20)

C = 0.70 ✓

Erosion Control Factor

P = 1.0

Sediment Inflow

$A = 40(.244)(2.97)(.7)(1.0) = 20.29$ ton/acre/year ✓

$A = 20.29\left(\frac{1}{2047}\right)(260.8)(.9) = 2.32$ acre-feet/year ✓

BY ___ DATE ___ CHECKED BY BHM 11/5/85 COPY TO EO ___

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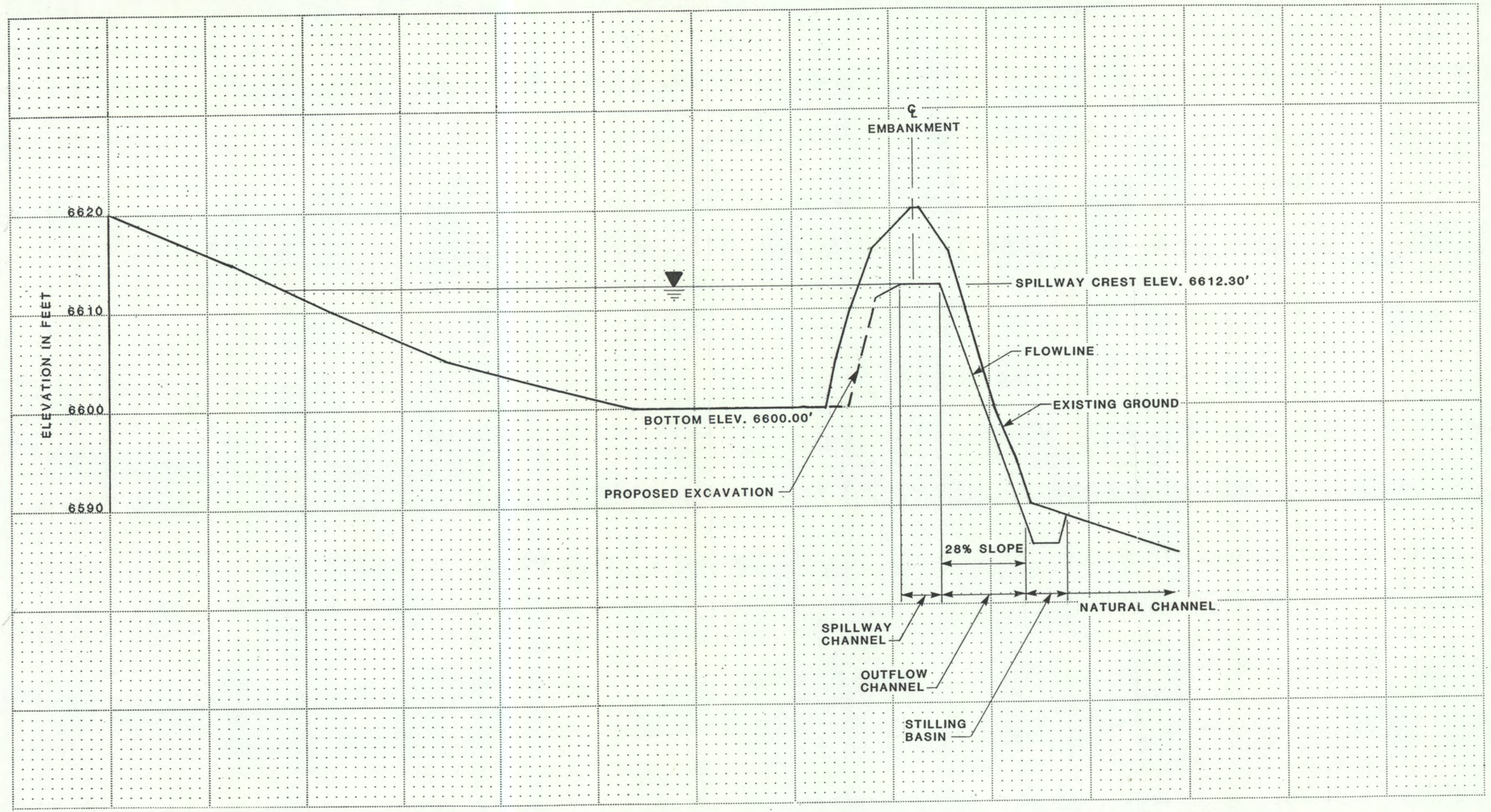

SCALE
0 100 200
FEET

CHANNEL PROFILE A-A'
J16- G1

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 3

DESIGN REPORT

Temporary Sedimentation Structure

J19-A

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

APPROVED
OCT 2002

Registered Professional Engineer (Civil)
CERTIFICATE NO.
18782
JAMES GARY
SCHOENVOGT
Date Signed
ARIZONA
DEC 07 2001

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APPENDIX C -SEDCAD4 (Input and Output) 25-Year, 6-Hour Storm Event
EXHIBIT #1 -J19-A Proposed Sedimentation Pond

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INTRODUCTION

Sedimentation Structure J19-A will be a completely incised pond designed and constructed by Peabody Western Coal Company as a temporary sedimentation structure to control runoff and sediment from portions of the proposed J-19 West disturbed surface mining area at the Kayenta Mine. The location of Structure J19-A and its watershed boundary are shown on Drawing No. 85400 (Sheets M-10) 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 J19-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, Pages 11 to 42, "Sediment and Water Control Facility Plan".

INSPECTION

The construction site of the proposed Structure J19-A was inspected in September, 2001 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions existed. 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 J19-A Structure has a watershed of 107.8 acres and is located on a tributary upstream of the Dugout Valley Wash at the Kayenta Mine. The 107.8-acre watershed, which contributes directly to structure J19-A is classified as 51% spoil and 49% disturbed.

DESIGN ANALYSES

GENERAL

Structure J19-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 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 J19-A is completely incised, designed to totally contain the 10-year, 24-hour storm event. A natural drainage channel located as shown on Exhibit #1 will be utilized as the emergency spillway. The natural ground surrounding the emergency spillway channel is at a minimum elevation of 6827.5'. This natural ground is adequate for freeboard requirements. All side slopes will be equal to or flatter than 3.0:1(horizontal to vertical). In addition, all slopes will be stabilized for erosional stability based on the Surface Stabilization Plan requirement, (see permit, Chapter 26), 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 natural drainage, maintained at a minimum 15-foot width, and riprap-lined as shown on Exhibit # 1.

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HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure J19-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 since it is completely incised, there will not be an embankment. The spillway was analyzed using the 25-year, 6-hour storm. Structure J19-A was conservatively assumed to be full to the emergency spillway at the time of the design storm event. The storage capacity of structure J19-A was analyzed using the 10-year, 24-hour storm event. The pond was verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Dugout Valley Wash.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.530 mi.
2.	Elevation Difference, H	166 ft
3.	Time of Concentration, T_c	0.174 hr
4.	NRCS Curve Number	88
5.	Rainfall Depth, 10-year, 24-hour storm 25-year, 6-hour storm	2.1 in 1.9 in
6.	Drainage Area	107.8 ac

Values reported represent the watershed, which drains directly to Pond J19-A.

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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J19-A 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	103.1	124.8
Volume	ac-ft	9.4	8.0
Storage			
Peak Stage	msl	N/A	6826.4
Emergency Spillway Elev.	msl	6825.0	6825.0
Peak Storage	ac-ft	N/A	21.1
Storage Capacity	ac-ft	18.3	18.3
Outflow			
Peak Flow	cfs	N/A	64.7
Spillway Elevation	msl	6825.0	6825.0
Embankment Crest Elev.	msl	6827.5	6827.5
Peak Stage	msl	--	6826.4
Freeboard	ft	--	1.1
Emergency Spillway Channel			
Flow Depth	ft	--	1.4
Critical Velocity	fps	--	4.7
Mannings "n"	--	--	0.03
Width	ft	--	15
Outflow Channel			
Slope	%		3.5
Normal Velocity	fps	--	5.2
Normal Depth	ft	--	0.7
Mannings "n"	--	--	0.04
Riprap D_{50}	in	--	3

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J19-A will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit #1.

Minimum Channel Depth	(Spillway)	2.4	ft
	(Outflow)	1.7	ft
Channel Width		15	ft
Channel Length	(Spillway)	31.5	ft
	(Outflow)	50	ft
Side slopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	3.5	%
Spillway Elevation		6825.0	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 design topography. Structure J19-A is designed to contain approximately 18.3 acre-feet.

The calculations for the sediment load entering structure J19-A were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

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	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.17
3.	Slope Factor, LS	3.89
4.	Cover Factor, C	0.90
5.	Erosion Control Factor, P	0.90

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume is available for storing sediment. Structure J19-A has sufficient storage to contain the 10-year, 24-hour storm. The total storage capacity was determined for structure J19-A and the results of the analysis are presented below.

Storage for Structure J19-A

Total Storage Capacity	18.3 ac-ft
10-year, 24-hour Storm Inflow	9.4 ac-ft
Available Sediment Storage Capacity	8.9 ac-ft
Sediment Inflow Rate/Year	1.01 ac-ft/yr
Sediment Storage Life	8.8 years

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* * *

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- J19-A Proposed Sedimentation Pond

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J19 AREA

STRUCTURE: J19A Pond

TIME OF CONCENTRATION:

Start Elevation (ft) =	6991
End Elevation (ft) =	6825
Elevation Difference, E (ft) =	166
Watercourse Length (ft) =	2799
Watercourse Length, L (mi) =	0.530
Tc = (11.9L^3/E)^0.385 =	0.174 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
Pinyon Juniper	D	83		0
Sagebrush	D	79		0
Disturbed - Mine		90	53	4770
Disturbed - Spoil		86	54.8	4712.8
Reclaimed	C	81	0	0
TOTAL:			107.8	9482.8

Weighted CN = Total CN*Area/ Total Area = 88

DRAINAGE BASIN AREA:

107.8 Acres

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J19A Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
1B	0.15		0.00
1C	0.14		0.00
3BC	0.16		0.00
5	0.58		0.00
12	0.38		0.00
13	0.41		0.00
15	0.37		0.00
34-spoil	0.12	54.8	6.58
Reclaimed	0.38		0.00
Mine Pits	0.22	53	11.66
TOTAL:		107.8	18.24

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

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
200	75	37.5%	0.6	20.6	9.92
180	10	5.6%	0.5	3.2	0.99
150	45	30.0%	0.6	16.7	6.69
300	30	10.0%	0.5	5.7	2.38
150	45	30.0%	0.6	16.7	6.69
230	25	10.9%	0.6	6.2	2.63
500	30	6.0%	0.5	3.4	1.78
170	30	17.6%	0.6	10.0	4.03
170	25	14.7%	0.6	8.4	3.24
190	30	15.8%	0.6	9.0	3.78
170	30	17.6%	0.6	10.0	4.03
430	30	7.0%	0.5	4.0	1.90
230	15	6.5%	0.5	3.7	1.30
300	25	8.3%	0.5	4.8	1.88
150	10	6.7%	0.5	3.8	1.08
190	45	23.7%	0.6	13.3	6.01
210	55	26.2%	0.6	14.7	7.10
120	20	16.7%	0.6	9.5	3.06
340	55	16.2%	0.6	9.2	5.51

Average LS = 3.89

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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PROJECT: J19A 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%	0	0.22	0.00	1.00	0.00
Sagebrush/Grass	20%	25%	0	0.20	0.00	1.00	0.00
Disturbed	0%	0%	53	1.00	53.00	1.00	53.00
Spoil	0%	0%	54.8	0.80	43.84	0.80	43.84
Reclaimed	40%	0%	0	0.15	0.00	0.40	0.00
TOTAL:			107.8		96.84		96.84

Weighted C = Total C*Area/ Total Area = 0.898

Weighted P = Total P*Area/ Total Area = 0.898

RAINFALL FACTOR:

R = 40

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: J19A Pond

The following spreadsheet calculates the predicted sediment yield for the project area. The gross sediment yie 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	3.89	
Cover Factor	0.90	
Practice Factor	0.90	
Gross Annual Sediment Yield	21.27	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0104	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0094	acre-feet/acre/year
Watershed Area	107.8	acres
Watershed Annual Sediment Yield	1.01	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	1.01	acre-feet

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J-19A, Emergency Spillway Outlet

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
15.00	3.0:1	3.0:1	3.5	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	64.70 cfs	
Depth:	0.73 ft	1.73 ft
Top Width:	19.37 ft	25.37 ft
Velocity:	5.17 fps	
X-Section Area:	12.52 sq ft	
Hydraulic Radius:	0.639	
Froude Number:	1.13	
Manning's n:	0.0400	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

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J19-A Em. Spillway Critical Velocity
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Pond J19-A
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.015000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	15.00	ft
Discharge	64.70	cfs

Results		
Depth	0.79	ft
Flow Area	13.71	ft²
Wetted Perimeter	19.99	ft
Top Width	19.74	ft
Critical Depth	0.79	ft
Critical Slope	0.015069	ft/ft
Velocity	4.72	ft/s
Velocity Head	0.35	ft
Specific Energy	1.14	ft
Froude Number	1.00	
Flow is subcritical.		

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APPENDIX B

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

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Peabody Western
Pond J19A

10-year, 24-hour

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djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

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	107.800	107.800	103.08	9.40

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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	107.800	0.174	0.000	0.000	88.000	F	103.08	9.400
	$\sum$	**107.800**						**103.08**	**9.400**

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APPENDIX C

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

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Peabody Western
Pond J19A

25-year, 6-hour

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djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

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)
#1	In	107.800	107.800	124.80	7.95
	Out			64.74	7.95

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Structure Detail:

Structure #1 (Pond)

Peak Flow & Runoff Volume

Pond Inputs:

Initial Pool Elev:	6,825.00
Initial Pool:	18.27 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,825.00	31.50	3.00:1	3.00:1	15.00

Pond Results:

Peak Elevation:	6,826.35
Dewater Time:	0.34 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)
6,810.00	0.300	0.000	0.000	
6,810.50	0.356	0.164	0.000	
6,811.00	0.416	0.357	0.000	
6,811.50	0.481	0.581	0.000	
6,812.00	0.551	0.839	0.000	
6,812.50	0.626	1.133	0.000	
6,813.00	0.705	1.466	0.000	
6,813.50	0.789	1.839	0.000	
6,814.00	0.878	2.256	0.000	
6,814.50	0.972	2.718	0.000	
6,815.00	1.070	3.228	0.000	
6,815.50	1.110	3.773	0.000	
6,816.00	1.150	4.338	0.000	
6,816.50	1.191	4.924	0.000	
6,817.00	1.233	5.530	0.000	
6,817.50	1.276	6.157	0.000	
6,818.00	1.319	6.806	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,818.50	1.363	7.477	0.000		
6,819.00	1.408	8.169	0.000		
6,819.50	1.454	8.885	0.000		
6,820.00	1.500	9.623	0.000		
6,820.50	1.544	10.384	0.000		
6,821.00	1.589	11.168	0.000		
6,821.50	1.634	11.973	0.000		
6,822.00	1.680	12.802	0.000		
6,822.50	1.727	13.654	0.000		
6,823.00	1.774	14.529	0.000		
6,823.50	1.822	15.428	0.000		
6,824.00	1.871	16.351	0.000		
6,824.50	1.920	17.299	0.000		
6,825.00	1.970	18.272	0.000		Spillway #1
6,825.50	2.036	19.273	17.123	6.65	
6,826.00	2.103	20.308	34.246	1.10	
6,826.35	2.151	21.066	64.739	0.50	Peak Stage
6,826.50	2.171	21.376	77.193		
6,827.00	2.240	22.479	128.800		
6,827.50	2.310	23.616	195.917		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,810.00	0.000	0.000
6,810.50	0.000	0.000
6,811.00	0.000	0.000
6,811.50	0.000	0.000
6,812.00	0.000	0.000
6,812.50	0.000	0.000
6,813.00	0.000	0.000
6,813.50	0.000	0.000
6,814.00	0.000	0.000
6,814.50	0.000	0.000
6,815.00	0.000	0.000
6,815.50	0.000	0.000
6,816.00	0.000	0.000
6,816.50	0.000	0.000

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Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,817.00	0.000	0.000
6,817.50	0.000	0.000
6,818.00	0.000	0.000
6,818.50	0.000	0.000
6,819.00	0.000	0.000
6,819.50	0.000	0.000
6,820.00	0.000	0.000
6,820.50	0.000	0.000
6,821.00	0.000	0.000
6,821.50	0.000	0.000
6,822.00	0.000	0.000
6,822.50	0.000	0.000
6,823.00	0.000	0.000
6,823.50	0.000	0.000
6,824.00	0.000	0.000
6,824.50	0.000	0.000
6,825.00	0.000	0.000
6,825.50	17.123	17.123
6,826.00	34.246	34.246
6,826.50	77.193	77.193
6,827.00	128.800	128.800
6,827.50	195.917	195.917

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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	107.800	0.174	0.000	0.000	88.000	F	124.80	7.953
	$\sum$	**107.800**						**124.80**	**7.953**

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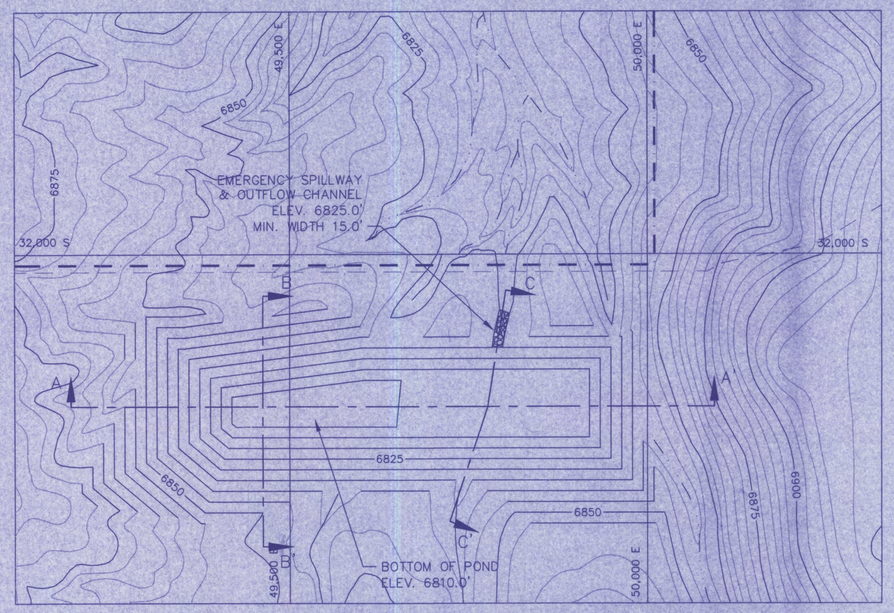
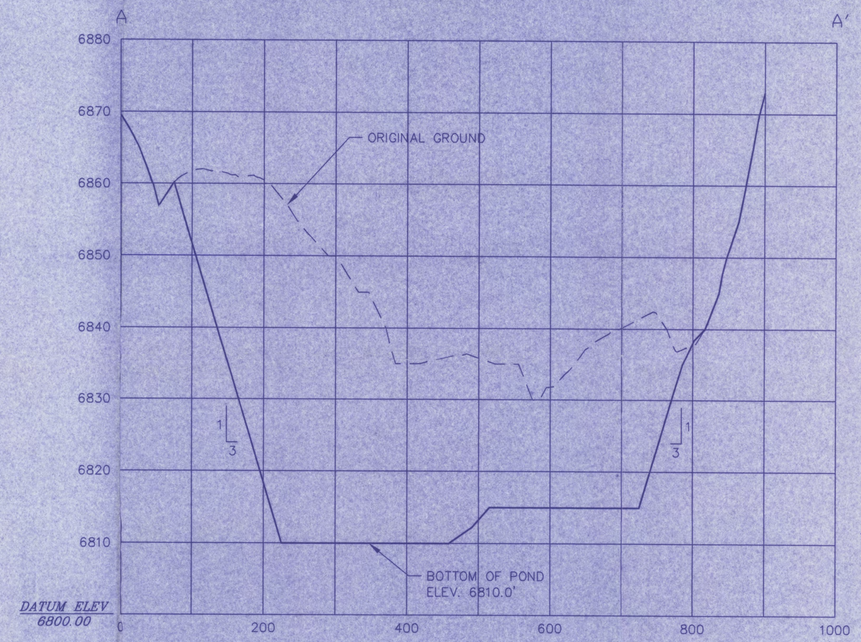


N

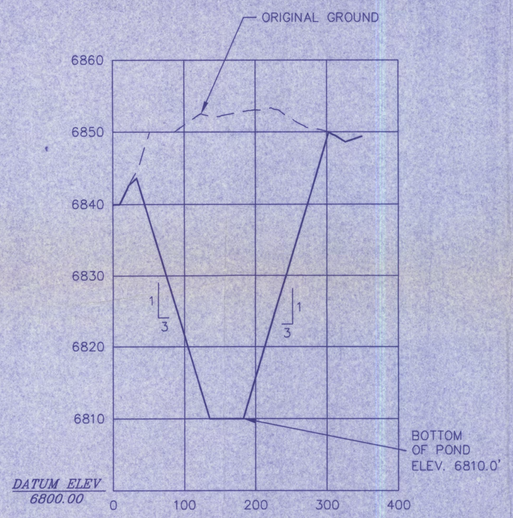
PLAN VIEW

SCALE: 1" = 100'
PHOTO DATE: 4/21/99
C.I. = 5'



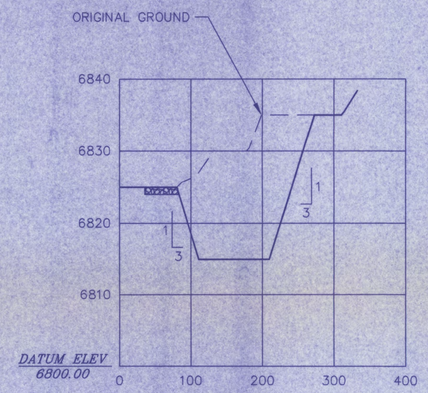
SECTION A - A'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'



SECTION B - B'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'

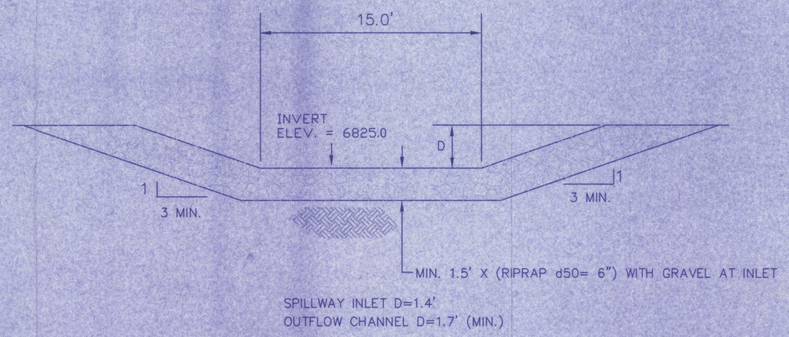


SECTION C - C'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'

J19-A POND STAGE CAPACITY

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	TOT. CAP. (AC.-FT.)	DESCRIPTION
6810	0.0	0.30	0.00	BOTTOM OF POND
6815	5.0	1.07	3.23	
6820	10.0	1.50	9.62	
6825	15.0	1.97	18.27	EMERGENCY SPILLWAY
6827.5	17.5	2.31	23.62	TOP OF EMBANKMENT



J19-A POND
TYPICAL CROSS-SECTION OF EMERGENCY SPILLWAY OUTFLOW
NOT TO SCALE

ENGINEER'S CERTIFICATION

JAMES E. SCHLENDORF
ENGINEERING & RECLAMATION MANAGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782
DATE: SEP 28 2001

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NOTES:
1) General location, see Drawing No. 85400, Sheets M-10 and Drawing No. 85405.
2) See Chapter 6, Kayenta PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the distrubed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.

REVISIONS

DATE	CHK'D	DESCRIPTION

EXHIBIT #1
J19-A
PROPOSED SEDIMENTATION POND

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

DESIGNED BY: MW	SCALE: 1"=100'
DRAWN BY: JMB	DRAWING DATE: 05-07-01
CHECKED BY: JGS	PHOTO DATE: 04-21-99
CONTOUR INT.: 5'	DWG FILE: 081501_J21A POND.DWG

DESIGN REPORT

Temporary Sedimentation Structure

J19-B

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

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OCT 2002

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

DEC 07 2001

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APPENDIX D -J19-B Temporary Diversion
EXHIBIT #1 -J19-B Temporary Diversion

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INTRODUCTION

Sedimentation Structure J19-B 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 proposed J-19 West disturbed surface mining area at the Kayenta Mine. The location of Structure J19-B and its watershed boundary are shown on Drawing No. 85400 (Sheets M-10) 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 J19-B. 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 J19-B was inspected in September, 2001 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions existed. 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 J19-B Structure has a watershed of 88.6 acres and is located on a tributary upstream of Red Peak Valley Wash at the Kayenta Mine. The 88.6-acre watershed, which contributes directly to structure J19-B is classified as 17% undisturbed, 44% spoil, 21% Topsoil Piles (vegetated) and 18% disturbed.

DESIGN ANALYSES

GENERAL

Structure J19-B 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 J19-B 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 13 feet wide on top. A minimum upstream slope of 2.5H:1V and minimum downstream slope of 3.25H:1V were assumed. Based on the total embankment height of approximately 14.5 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 15-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 J19-B 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 was analyzed using the 25-year, 6-hour storm. Structure J19-B was conservatively assumed to be full to the emergency spillway at the time of the design storm event. The storage capacity of structure J19-B was analyzed using the 10-year, 24-hour storm event. The pond was verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Red Peak Valley Wash.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.590 mi.
2.	Elevation Difference, H	273 ft
3.	Time of Concentration, T_c	0.163 hr
4.	NRCS Curve Number	85
5.	Rainfall Depth, 10-year, 24-hour storm 25-year, 6-hour storm	2.1 in 1.9 in
6.	Drainage Area	88.6 ac

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Values reported represent the watershed, which drains directly to Pond J19-B.

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).

J19-B 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	70.8	86.2
Volume	ac-ft	6.4	5.3
Storage			
Peak Stage	msl	N/A	6770.7
Emergency Spillway Elev.	msl	6769.5	6769.5
Peak Storage	ac-ft	N/A	14.6
Storage Capacity	ac-ft	12.9	12.9
Outflow			
Peak Flow	cfs	N/A	54.9
Spillway Elevation	msl	6769.5	6769.5
Embankment Crest Elev.	msl	6772.2	6772.2
Peak Stage	msl	--	6770.7
Freeboard	ft	--	1.5
Emergency Spillway Channel			
Flow Depth	ft	--	1.2
Critical Velocity	fps	--	4.6
Mannings "n"	--	--	0.03
Width	ft	--	15
Outflow Channel			
Slope	%	5	30.8
Normal Velocity	fps	--	5.3	7.1
Normal Depth	ft	--	0.6	0.5
Mannings "n"	--	--	0.042	0.066
Riprap D_{50}	in	--	3	6

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J19-B will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit #1.

Minimum Channel Depth	(Spillway)	2.2	ft
	(Outflow)	1.5	ft
Channel Width		15	ft
Channel Length	(Spillway)	28.75	ft
	(Outflow)	100	ft
Side slopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	30.8	%
Spillway Elevation		6769.5	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 design topography. Structure J19-B is designed to contain approximately 12.9 acre-feet.

The calculations for the sediment load entering structure J19-B 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	0.20
3.	Slope Factor, LS	5.5
4.	Cover Factor, C	0.69
5.	Erosion Control Factor, P	0.79

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume is available for storing sediment. Structure J19-B has sufficient storage to contain the 10-year, 24-hour storm. The total storage capacity was determined for structure J19-B and the results of the analysis are presented below.

Storage for Structure J19-B

Total Storage Capacity	12.9 ac-ft
10-year, 24-hour Storm Inflow	6.4 ac-ft
Available Sediment Storage Capacity	6.5 ac-ft
Sediment Inflow Rate/Year	0.94 ac-ft/yr
Sediment Storage Life	6.9 years

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* * *

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- J19-B Proposed Sedimentation Ponds

Appendix D- J19-B Temporary Diversion

Exhibit #1- J19-B Temporary Diversion

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J19 AREA

STRUCTURE: J19B Pond

TIME OF CONCENTRATION:

Start Elevation (ft) =	7023
End Elevation (ft) =	6750
Elevation Difference, E (ft) =	273
Watercourse Length (ft) =	3116
Watercourse Length, L (mi) =	0.590
Tc = (11.9L^3/E)^0.385 =	0.163 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	14.8	1228.4
Sagebrush	D	79	0	0
Disturbed - Mine		90	17	1530
Disturbed - Spoil		86	38.3	3293.8
Reclaimed	C	81	18.5	1498.5
TOTAL:			88.6	7550.7

Weighted CN = Total CN*Area/ Total Area = 85

DRAINAGE BASIN AREA:

88.6 Acres

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J19B Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
1B	0.15	0	0.00
1C	0.14	0	0.00
3BC	0.16	14.8	2.37
5	0.58	0	0.00
12	0.38	0	0.00
13	0.41	0	0.00
15	0.37	0	0.00
34-spoil	0.12	38.3	4.60
Reclaimed	0.38	18.5	7.03
Mine Pits	0.22	17	3.74
TOTAL:		88.6	17.73

Weighted K = Total K*Area/ Total Area = 0.20

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
210	45	21.4%	0.6	12.1	5.71
220	45	20.5%	0.6	11.6	5.58
150	15	10.0%	0.5	5.7	1.68
170	40	23.5%	0.6	13.2	5.58
330	30	9.1%	0.5	5.2	2.18
180	25	13.9%	0.6	7.9	3.12
280	30	10.7%	0.6	6.1	2.90
110	20	18.2%	0.6	10.3	3.21
260	30	11.5%	0.6	6.6	3.07
330	65	19.7%	0.6	11.1	6.81
220	50	22.7%	0.6	12.8	6.27
250	120	48.0%	0.6	25.6	14.22
250	100	40.0%	0.6	21.8	12.05
170	50	29.4%	0.6	16.4	7.07
200	20	10.0%	0.5	5.7	1.94
160	45	28.1%	0.6	15.7	6.50
260	65	25.0%	0.6	14.0	7.69
160	25	15.6%	0.6	8.9	3.36

Average LS = 5.50

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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PROJECT: J19B 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%	14.8	0.22	3.26	1.00	14.80
Sagebrush/Grass	20%	25%	0	0.20	0.00	1.00	0.00
Disturbed	0%	0%	17	1.00	17.00	1.00	17.00
Spoil	0%	0%	38.3	1.00	38.30	0.80	30.64
Reclaimed	40%	0%	18.5	0.15	2.78	0.40	7.40
TOTAL:			88.6		61.33		69.84

Weighted C = Total C*Area/ Total Area = 0.692

Weighted P = Total P*Area/ Total Area = 0.788

RAINFALL FACTOR:

R = 40

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: J19B Pond

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

PARAMETER DESCRIPTION	VALUE	
Annual Rainfall Factor	40.00	
Soil Erodibility Factor	0.20	
Length Slope Factor	5.50	
Cover Factor	0.69	
Practice Factor	0.79	
Gross Annual Sediment Yield	24.01	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0117	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0106	acre-feet/acre/year
Watershed Area	88.6	acres
Watershed Annual Sediment Yield	0.94	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	0.94	acre-feet

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J19-B Emergency Spillway Outflow

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
15.00	3.0:1	3.0:1	30.8	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	54.90 cfs	
Depth:	0.47 ft	1.47 ft
Top Width:	17.82 ft	23.82 ft
Velocity:	7.12 fps	
X-Section Area:	7.71 sq ft	
Hydraulic Radius:	0.429	
Froude Number:	1.91	
Manning's n:	0.0660	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

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J19-B Emergency Spillway Outflow

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
15.00	3.0:1	3.0:1	5.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	54.90 cfs	
Depth:	0.61 ft	1.61 ft
Top Width:	18.68 ft	24.68 ft
Velocity:	5.31 fps	
X-Section Area:	10.34 sq ft	
Hydraulic Radius:	0.548	
Froude Number:	1.26	
Manning's n:	0.0420	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

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Pond J19B, Em. Spilway Critical Velocity
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\2470172 peabody\task 22h\task 22h\flowmaster\j19d.fm2
Worksheet	J19B Critical Velocity
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.016000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	15.00	ft
Discharge	54.90	cfs

Results		
Depth	0.70	ft
Flow Area	12.06	ft^2
Wetted Perimeter	19.46	ft
Top Width	19.23	ft
Critical Depth	0.71	ft
Critical Slope	0.015526	ft/ft
Velocity	4.55	ft/s
Velocity Head	0.32	ft
Specific Energy	1.03	ft
Froude Number	1.01	
Flow is supercritical.		

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APPENDIX B

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

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Peabody Western
Pond J19B

10-year, 24-hour

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djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

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	88.600	88.600	70.83	6.42

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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	88.600	0.163	0.000	0.000	85.000	F	70.83	6.417
	$\sum$	**88.600**						**70.83**	**6.417**

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APPENDIX C

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

4 OCT 2002 APPROVED

Peabody Western

Pond J19-B

25-year, 6-hour

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djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

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)
#1	In	88.600	88.600	86.18	5.34
	Out			54.92	4.97

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Structure Detail:

Structure #1 (Pond)

runoff volume

Pond Inputs:

Initial Pool Elev:	6,769.50
Initial Pool:	12.94 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,769.50	28.75	3.00:1	3.00:1	15.00

Pond Results:

Peak Elevation:	6,770.73
Dewater Time:	2.98 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)
6,755.00	0.520	0.000	0.000	
6,755.50	0.542	0.265	0.000	
6,756.00	0.564	0.542	0.000	
6,756.50	0.587	0.830	0.000	
6,757.00	0.611	1.129	0.000	
6,757.50	0.634	1.441	0.000	
6,758.00	0.659	1.764	0.000	
6,758.50	0.683	2.099	0.000	
6,759.00	0.708	2.447	0.000	
6,759.50	0.734	2.808	0.000	
6,760.00	0.760	3.181	0.000	
6,760.50	0.786	3.568	0.000	
6,761.00	0.813	3.967	0.000	
6,761.50	0.839	4.380	0.000	
6,762.00	0.867	4.807	0.000	
6,762.50	0.895	5.247	0.000	
6,763.00	0.923	5.701	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,763.50	0.951	6.170	0.000		
6,764.00	0.981	6.653	0.000		
6,764.50	1.010	7.150	0.000		
6,765.00	1.040	7.663	0.000		
6,765.50	1.068	8.190	0.000		
6,766.00	1.097	8.731	0.000		
6,766.50	1.127	9.287	0.000		
6,767.00	1.156	9.858	0.000		
6,767.50	1.186	10.444	0.000		
6,768.00	1.217	11.044	0.000		
6,768.50	1.247	11.660	0.000		
6,769.00	1.278	12.292	0.000		
6,769.50	1.310	12.939	0.000		Spillway #1
6,770.00	1.355	13.605	0.119	67.59*	
6,770.50	1.400	14.293	35.017	3.65	
6,770.73	1.421	14.621	54.918	0.25	Peak Stage
6,771.00	1.446	15.005	78.178		
6,771.50	1.493	15.739	130.457		
6,772.00	1.540	16.497	199.035		
6,772.20	1.600	16.812	231.537		

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

Detailed Discharge Table

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Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,755.00	0.000	0.000
6,755.50	0.000	0.000
6,756.00	0.000	0.000
6,756.50	0.000	0.000
6,757.00	0.000	0.000
6,757.50	0.000	0.000
6,758.00	0.000	0.000
6,758.50	0.000	0.000
6,759.00	0.000	0.000
6,759.50	0.000	0.000
6,760.00	0.000	0.000
6,760.50	0.000	0.000
6,761.00	0.000	0.000

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,761.50	0.000	0.000
6,762.00	0.000	0.000
6,762.50	0.000	0.000
6,763.00	0.000	0.000
6,763.50	0.000	0.000
6,764.00	0.000	0.000
6,764.50	0.000	0.000
6,765.00	0.000	0.000
6,765.50	0.000	0.000
6,766.00	0.000	0.000
6,766.50	0.000	0.000
6,767.00	0.000	0.000
6,767.50	0.000	0.000
6,768.00	0.000	0.000
6,768.50	0.000	0.000
6,769.00	0.000	0.000
6,769.50	0.000	0.000
6,770.00	0.119	0.119
6,770.50	35.017	35.017
6,771.00	78.178	78.178
6,771.50	130.457	130.457
6,772.00	199.035	199.035
6,772.20	231.537	231.537

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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	88.600	0.163	0.000	0.000	85.000	F	86.18	5.336
	$\sum$	**88.600**						**86.18**	**5.336**

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~~APPENDIX D~~

~~J19-B TEMPORARY DIVERSION~~

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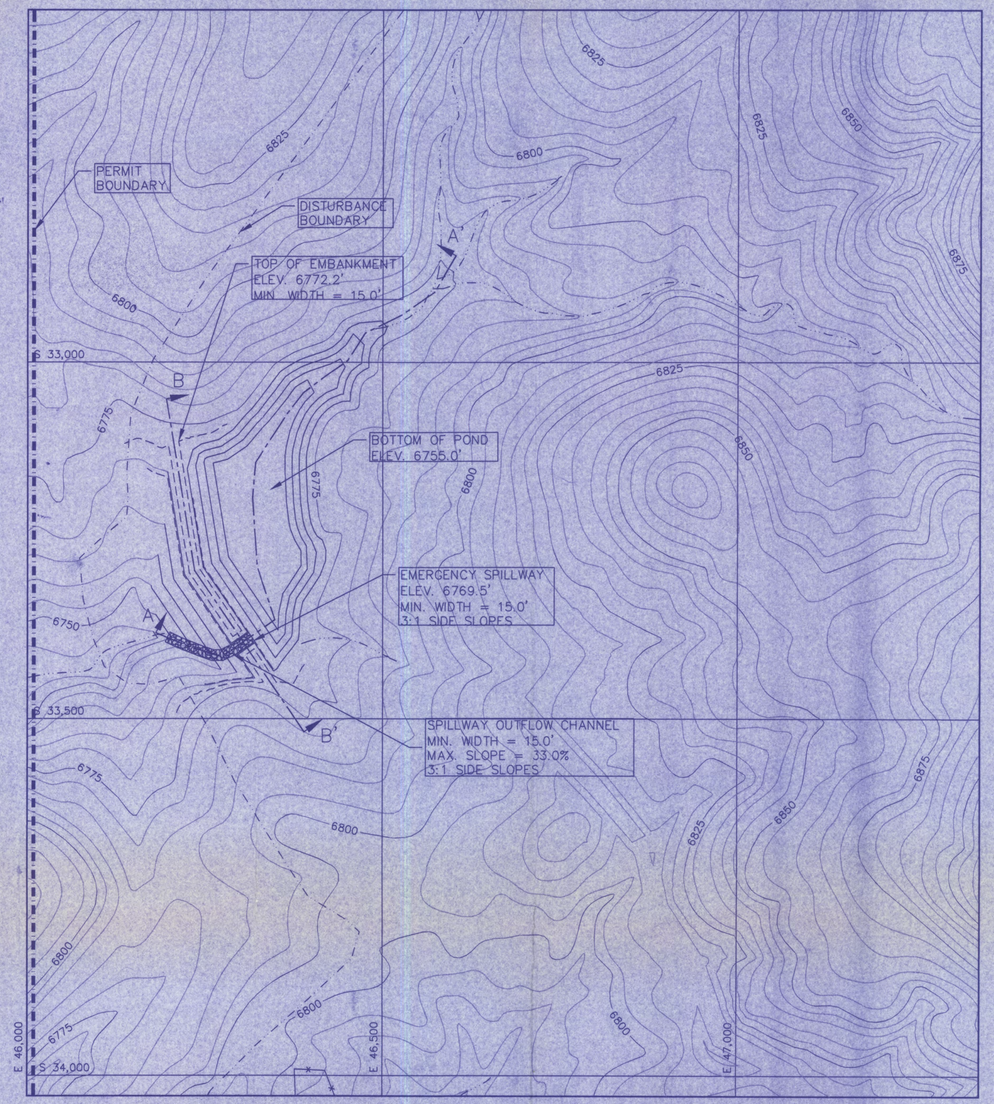
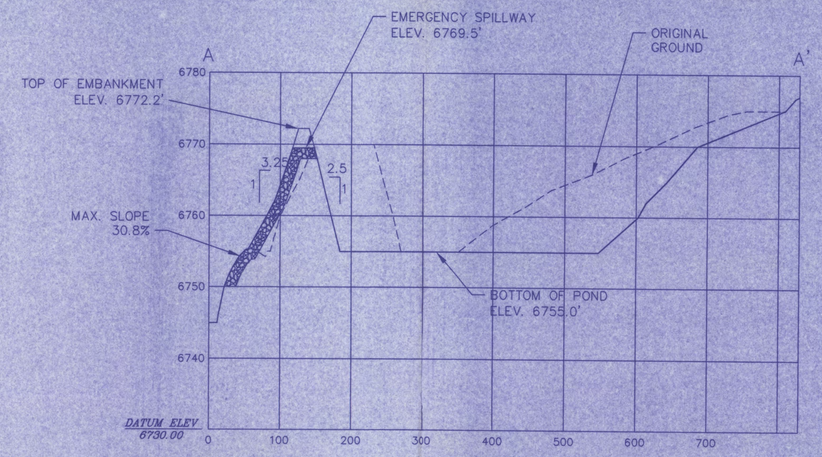


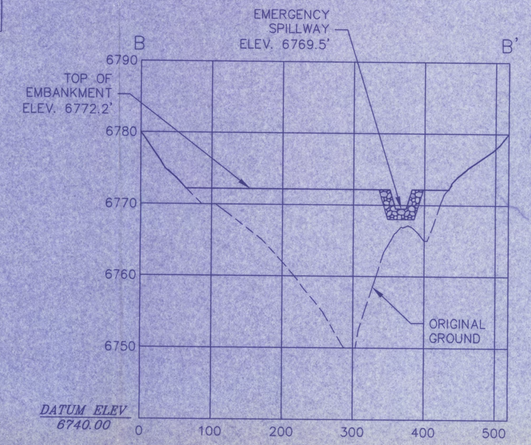
PLAN VIEW

SCALE: 1" = 100'
PHOTO DATE: 4/21/99
C.I. = 5'



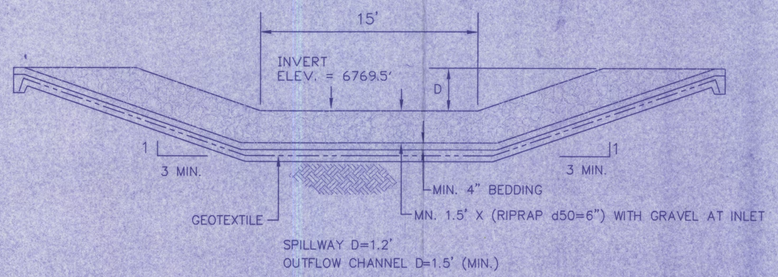
SECTION A-A'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'



SECTION B-B'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'



J19-B POND
TYPICAL CROSS-SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE

J19-B POND STAGE/CAPACITY (SEE NOTE #7)

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	TOT. CAP. (AC.-FT.)	DESCRIPTION
6755	0.0	0.52	0.00	BOTTOM OF POND
6760	5.0	0.76	3.18	
6765	10.0	1.04	7.66	
6769.5	14.5	1.31	12.94	EMERGENCY SPILLWAY
6772	17.0	1.54	16.50	
6772.2	17.2	1.60	16.81	TOP OF EMBANKMENT

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ENGINEER'S CERTIFICATION

JAMES G. SCHLENVOGT
ENGINEERING & RECLAMATION MANAGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782
DATE: SEP 28 2001

NOTES:
1) General location, see Drawing No. 85400, Sheets M-10 and Drawing No. 85405.
2) See Chapter 6, Kayenta PAP for Construction Specifications.
3) See Vol. 2, Chapte 6, Attachment D, Sections 1-3 for description of Geotechnical Evalution.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the disturbed area above the high waterline shall be in accordance with tie approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.
7) Stage/Capacity from SEDCAD4 25-year, 6-hour print out.

REVISIONS

DATE	CHK'D	DESCRIPTION

EXHIBIT #1
J19-B
PROPOSED SEDIMENTATION POND

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

DESIGNED BY: MW	SCALE: 1"=100'
DRAWN BY: JMB	DRAWING DATE: 04-30-01
CHECKED BY: JGS	PHOTO DATE: 04-21-99
CONTOUR INT.: 5'	DWG FILE: 081601_J19B POND.DWG

APPENDIX D

J19-B TEMPORARY DIVERSION

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PEABODY WESTERN – KAYENTA MINE

J-19 WEST AREA

TEMPORARY DIVERSION CHANNELS

PURPOSE: To provide runoff control from potential mine disturbance areas and to provide stable temporary diversion channels in the J-19 West area of the Kayenta Mine. The following channel has been included in this design submittal:

J-19 WEST AREA

- J19-B Diversion Channel, (see Exhibit #1, J19-B Temporary Diversion)

Design Parameters – Channels

To allow construction to be field-fitted for this temporary diversion channel, three alternative trapezoidal or triangular channels (Design A, Design B, or Design C) are recommended. The channel designs will vary based on channel slope and site conditions

The following design parameters are common to all temporary channel designs.

1. All designs are based on the 10-year, 6-hour precipitation event = 1.6 inches.
2. All areas are disturbed (mine, spoil, topsoil piles) or undisturbed. Curve numbers used include; mine = 90, spoil = 86, topsoil piles = 81(temp. reclaimed) and undisturbed = varies.

Note: The following applies to all channel designs:

1. Design selection will be field-fitted to complement the site conditions.
2. Sedcad4 Hydrology and Channel design outputs are attached.
3. If bedrock is encountered during excavation, Design C will not require the installation of riprap.
4. Minimum 20-ft length of ripraped or graveled channel between Design A and Designs B and C.
5. See Chapter 26 for terrace and downdrain construction specifications.
6. Maximum slope design for graded spoil-lined channel limited by critical slope.
7. Depth of flow (d) based on minimum slope, Velocity (v) based on maximum slope.
8. Side-slopes will be a minimum of 2H: 1V. or flatter.

Design A: Earth/Graded Spoil-lined trapezoidal or triangular channel. This design will apply to slopes up to the calculated Critical slope.

Design B: Gravel-lined trapezoidal or triangular channel. This design will apply until a velocity of 6.0 fps is exceeded.

Design C: Riprap-lined trapezoidal or triangular channel. This design will apply for all subsequent slopes until a limiting velocity of 10.0 fps is exceeded.

Design summaries for the channels are shown on Table J19-1. Hydrology calculations for the channel is attached as Appendix A. Channel designs and critical slope calculations are attached as Appendix B.

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TABLE J19-1
J-19 Diversion Channel Summary

Temporary Channel J19-B

Typical Rip Rap Lined Channel

Channel	Flow (Q) (cfs)	Slope (%)	Bottom Width (ft)	Side Slope H:1V (ft)	Depth Flow (ft)	Velocity (fps)	Free Board (ft)	Total Depth (ft)	Rip Rap (in)	Watershed (acres)	Time of Concentration (hr)	Curve Number	Design
J19-B	13	0.5 - 1.7	0	3	1.3	4.03	1	2.3	N/A	13.6	0.067	86	A
	13	1.8 - 4.9	0	3	1.0	6.00	1	2.0	Gravel				B
Q10/6	13	5.0 - 10	0	3	0.9	6.44	1	1.9	3				C
	13	11.0 - 30	0	3	0.8	7.62	1	1.8	6				C

Design Flow: 10-year, 6-hour Storm

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Peabody Western
Pond J19B
Diversion Channel

10-year, 6-hour

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OCT 2002

djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.600 inches

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Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	13.600	13.600	12.97	0.63

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J19-B Diversion Channel

Material: Graded Spoil

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.5	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	13.00 cfs	
Depth:	1.30 ft	2.30 ft
Top Width:	7.82 ft	13.82 ft
Velocity:	2.55 fps	
X-Section Area:	5.10 sq ft	
Hydraulic Radius:	0.618	
Froude Number:	0.56	

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J19-B Diversion Channel

Material: Graded Spoil

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	1.7	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	13.00 cfs	
Depth:	1.04 ft	2.04 ft
Top Width:	6.22 ft	12.22 ft
Velocity:	4.03 fps	
X-Section Area:	3.22 sq ft	
Hydraulic Radius:	0.492	
Froude Number:	0.99	

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J19-B Diversion Channel

Material: Gravel

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	4.9	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	13.00 cfs	
Depth:	0.85 ft	1.85 ft
Top Width:	5.10 ft	11.10 ft
Velocity:	6.00 fps	
X-Section Area:	2.17 sq ft	
Hydraulic Radius:	0.403	
Froude Number:	1.62	

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J19-B Diversion Channel

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.0:1	3.0:1	11.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	13.00 cfs	
Depth:	0.81 ft	1.81 ft
Top Width:	4.88 ft	10.88 ft
Velocity:	6.55 fps	
X-Section Area:	1.98 sq ft	
Hydraulic Radius:	0.386	
Froude Number:	1.81	
Manning's n:	0.0400	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

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J19-B Diversion Channel

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.0:1	3.0:1	30.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	13.00 cfs	
Depth:	0.75 ft	1.75 ft
Top Width:	4.53 ft	10.53 ft
Velocity:	7.62 fps	
X-Section Area:	1.71 sq ft	
Hydraulic Radius:	0.358	
Froude Number:	2.19	
Manning's n:	0.0540	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

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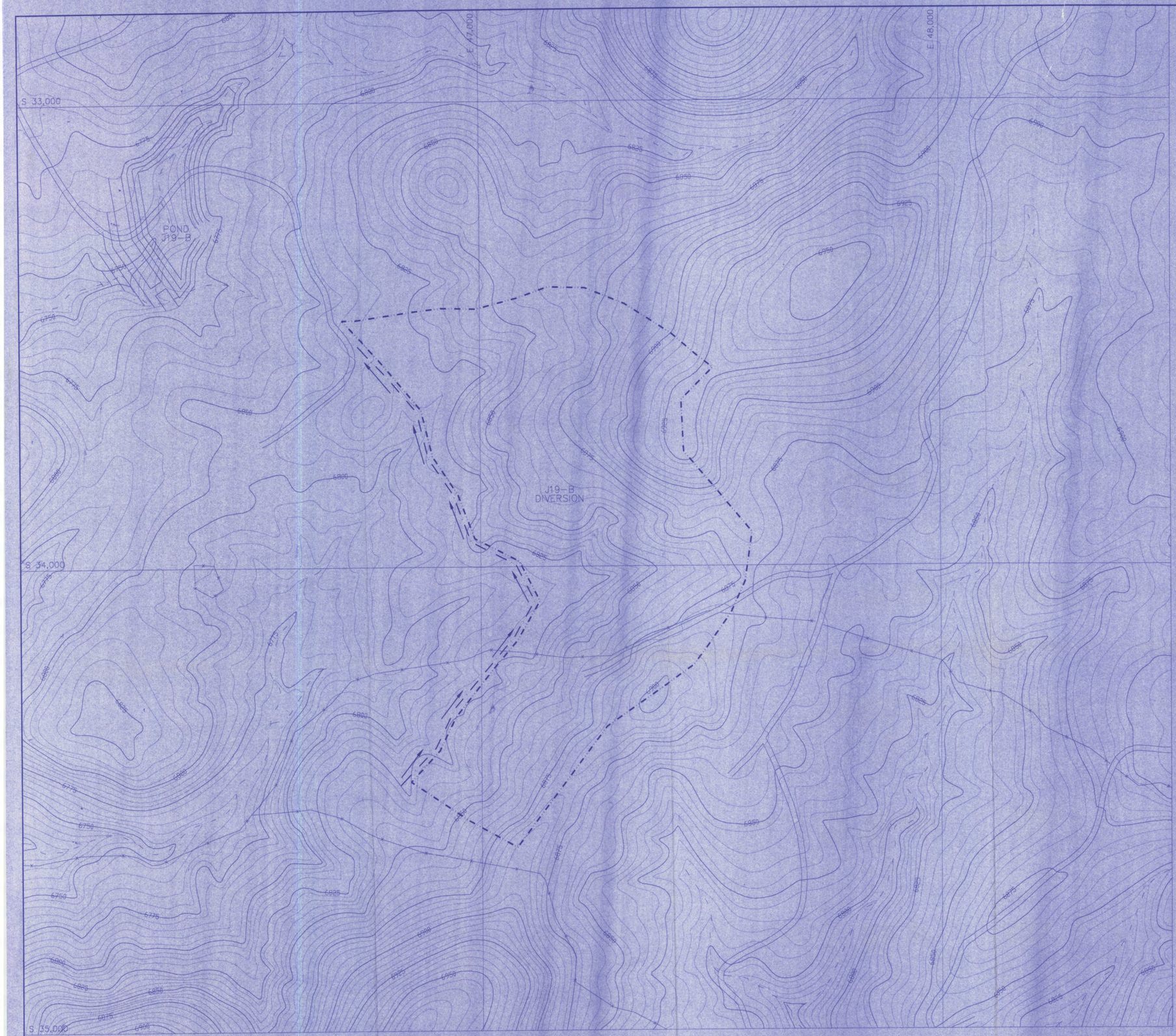

NOTES:

(1). Construct temporary diversions/berms to control runoff from mining disturbance areas in accordance with the requirements in the J-19 West Area, Temporary Diversion Channels Design Report and in Chapter 26. - Terreace Design. Field-fit location to minimize disturbance.

N

SCALE

100' 0 100' 200'

CONTOUR INTERVAL 5FT.

APPROVED OCT 2002

ENGINEER'S CERTIFICATION

JAMES G. SCHLENVOGT
ENGINEER & RECLAMATION MANAGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782

DATE: DEC 07 2001

REVISIONS		
DATE	CHK'D	DESCRIPTION

EXHIBIT #1
J19-B
TEMPORARY DIVERSION

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

DESIGNED BY: MW	SCALE: 1"=100'
DRAWN BY: JMB	DRAWING DATE: 09-28-01
CHECKED BY: JGS	PHOTO DATE: XX-XX-XX
CONTOUR INT.: 5'	DWG FILE: J19-B WTRSHD

DESIGN REPORT

Temporary Sedimentation Structure

J19-D

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

APPROVED
OCT 2002

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

SEP 12 2002

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EXHIBIT #1 -J19-D Proposed Sedimentation Pond

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J19-D 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	100.2	118.9
Volume	ac-ft	9.5	7.9
Storage			
Peak Stage	msl	N/A	6745.8
Emergency Spillway Elev.	msl	6744.5	6744.5
Peak Storage	ac-ft	N/A	22.1
Storage Capacity	ac-ft	19.8	19.8
Outflow			
Peak Flow	cfs	N/A	79.5
Spillway Elevation	msl	6744.5	6744.5
Embankment Crest Elev.	msl	6747.3	6747.3
Peak Stage	msl	--	6745.8
Freeboard	ft	--	1.5
Emergency Spillway Channel			
Flow Depth	ft	--	1.3
Critical Velocity	fps	--	4.7
Mannings "n"	--	--	0.03
Width	ft	--	20
Outflow Channel			
Slope	%	4.2	25
Normal Velocity	fps	--	5.4	7.1
Normal Depth	ft	--	0.7	0.5
Mannings "n"	--	--	0.041	0.064
Riprap D_{50}	in	--	3	6

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J19-D will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit #1.

Minimum Channel Depth	(Spillway)	2.3	ft
	(Outflow)	1.5	ft
Channel Width		20	ft
Channel Length	(Spillway)	28.75	ft
	(Outflow)	100	ft
Side slopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6744.5	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 design topography. Structure J19-D is designed to contain approximately 19.8 acre-feet.

The calculations for the sediment load entering structure J19-D 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	0.24
3.	Slope Factor, LS	7.34
4.	Cover Factor, C	0.58
5.	Erosion Control Factor, P	0.78

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume is available for storing sediment. Structure J19-D has sufficient storage to contain the 10-year, 24-hour storm. The total storage capacity was determined for structure J19-D and the results of the analysis are presented below.

Storage for Structure J19-D

Total Storage Capacity	19.8 ac-ft
10-year, 24-hour Storm Inflow	9.5 ac-ft
Available Sediment Storage Capacity	10.3 ac-ft
Sediment Inflow Rate/Year	1.82 ac-ft/yr
Sediment Storage Life	5.7 years

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* *

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- J19-D Proposed Sedimentation Pond

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J19 AREA

STRUCTURE: J19D Pond

TIME OF CONCENTRATION:

Start Elevation (ft) =	6931
End Elevation (ft) =	6720
Elevation Difference, E (ft) =	211
Watercourse Length (ft) =	3469
Watercourse Length, L (mi) =	0.657
Tc = (11.9L^3/E)^0.385 =	0.203 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	25.2	2091.6
Sagebrush	D	79	0	0
Disturbed - Mine		90	41.3	3717
Disturbed - Spoil		86	22.7	1952.2
Reclaimed	C	81	41.3	3345.3
TOTAL:			130.5	11106.1

Weighted CN = Total CN*Area/ Total Area = 85

DRAINAGE BASIN AREA:

130.5 Acres

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CALCULATED SEDIMENTOLOGY DATA

PROJECT: J19D Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
3DE	0.15	19.9	2.99
			0.00
3BC	0.16	5	0.80
16E,F	0.05	0.3	0.02
			0.00
			0.00
34-spoil	0.12	22.7	2.72
Reclaimed	0.38	41.3	15.69
Mine Pits	0.22	41.3	9.09
TOTAL:		130.5	31.30

Weighted K = Total K*Area/ Total Area = 0.24

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
230	90	39.1%	0.6	21.4	11.23
400	75	18.8%	0.6	10.6	7.23
120	50	41.7%	0.6	22.6	8.06
330	60	18.2%	0.6	10.3	6.21
270	65	24.1%	0.6	13.5	7.55
235	65	27.7%	0.6	15.5	8.05
240	65	27.1%	0.6	15.2	7.97
120	5	4.2%	0.4	2.4	0.59
320	70	21.9%	0.6	12.3	7.52
290	65	22.4%	0.6	12.6	7.29
310	120	38.7%	0.6	21.2	13.30
250	65	26.0%	0.6	14.6	7.83
285	60	21.1%	0.6	11.9	6.73
355	90	25.4%	0.6	14.2	9.40
160	40	25.0%	0.6	14.0	5.74
420	60	14.3%	0.6	8.1	5.38
140	45	32.1%	0.6	17.8	6.88
200	80	40.0%	0.6	21.8	10.54
270	25	9.3%	0.5	5.3	2.02

Average LS = 7.34

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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PROJECT: J19D 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%	25.2	0.22	5.54	1.00	25.20
Sagebrush/Grass					0.00	1.00	0.00
Disturbed	0%	0%	41.3	1.00	41.30	1.00	41.30
Spoil	0%	0%	22.7	1.00	22.70	0.80	18.16
Reclaimed	40%	0%	41.3	0.15	6.20	0.40	16.52
TOTAL:			130.5		75.74		101.18

Weighted C = Total C*Area/ Total Area = 0.580

Weighted P = Total P*Area/ Total Area = 0.775

RAINFALL FACTOR:

R = 40

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CALCULATED SEDIMENT YIELD

PROJECT: J19D Pond

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

PARAMETER DESCRIPTION	VALUE	
Annual Rainfall Factor	40.00	
Soil Erodibility Factor	0.24	
Length Slope Factor	7.34	
Cover Factor	0.58	
Practice Factor	0.78	
Gross Annual Sediment Yield	31.71	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0155	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0139	acre-feet/acre/year
Watershed Area	130.5	acres
Watershed Annual Sediment Yield	1.82	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	1.82	acre-feet

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Pond J19-D Emergency Spillway Outflow

Material: Riprap

Trapezoidal Channel

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

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	79.50 cfs	
Depth:	0.52 ft	1.52 ft
Top Width:	23.10 ft	29.10 ft
Velocity:	7.13 fps	
X-Section Area:	11.15 sq ft	
Hydraulic Radius:	0.479	
Froude Number:	1.81	
Manning's n:	0.0640	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

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Pond J19D Emergency Spillway Outflow

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
20.00	3.0:1	3.0:1	4.2	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	79.50 cfs	
Depth:	0.67 ft	1.67 ft
Top Width:	24.04 ft	30.04 ft
Velocity:	5.36 fps	
X-Section Area:	14.82 sq ft	
Hydraulic Radius:	0.611	
Froude Number:	1.20	
Manning's n:	0.0410	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

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J19-D, Em. Spillway Critical Velocity
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	J19D Critical Velocity
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.015000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	20.00	ft
Discharge	79.50	cfs

Results		
Depth	0.76	ft
Flow Area	16.91	ft^2
Wetted Perimeter	24.80	ft
Top Width	24.56	ft
Critical Depth	0.76	ft
Critical Slope	0.015053	ft/ft
Velocity	4.70	ft/s
Velocity Head	0.34	ft
Specific Energy	1.10	ft
Froude Number	1.00	
Flow is subcritical.		

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APPENDIX B

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

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Peabody Western
Pond J19D

10-year, 24-hour

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djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

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	130.500	130.500	100.20	9.45

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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	130.500	0.203	0.000	0.000	85.000	F	100.20	9.452
	$\sum$	**130.500**						**100.20**	**9.452**

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APPENDIX C

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

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Peabody Western
Pond J19D

25-year, 6-hour

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djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

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)
#1	In	130.500	130.500	118.91	7.86
	Out			79.47	7.40

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Structure Detail:

Structure #1 (Pond)

runoff volume

Pond Inputs:

Initial Pool Elev:	6,744.50
Initial Pool:	19.83 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,744.50	28.75	3.00:1	3.00:1	20.00

Pond Results:

Peak Elevation:	6,745.81
Dewater Time:	2.83 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)
6,725.00	0.460	0.000	0.000	
6,725.50	0.485	0.236	0.000	
6,726.00	0.511	0.485	0.000	
6,726.50	0.537	0.747	0.000	
6,727.00	0.564	1.022	0.000	
6,727.50	0.592	1.311	0.000	
6,728.00	0.620	1.614	0.000	
6,728.50	0.649	1.931	0.000	
6,729.00	0.679	2.263	0.000	
6,729.50	0.709	2.610	0.000	
6,730.00	0.740	2.973	0.000	
6,730.50	0.765	3.349	0.000	
6,731.00	0.791	3.738	0.000	
6,731.50	0.817	4.139	0.000	
6,732.00	0.843	4.554	0.000	
6,732.50	0.870	4.983	0.000	
6,733.00	0.897	5.424	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,733.50	0.925	5.880	0.000		
6,734.00	0.953	6.349	0.000		
6,734.50	0.981	6.832	0.000		
6,735.00	1.010	7.330	0.000		
6,735.50	1.040	7.843	0.000		
6,736.00	1.070	8.370	0.000		
6,736.50	1.101	8.913	0.000		
6,737.00	1.133	9.472	0.000		
6,737.50	1.165	10.046	0.000		
6,738.00	1.197	10.636	0.000		
6,738.50	1.229	11.243	0.000		
6,739.00	1.262	11.866	0.000		
6,739.50	1.296	12.505	0.000		
6,740.00	1.330	13.162	0.000		
6,740.50	1.363	13.835	0.000		
6,741.00	1.396	14.525	0.000		
6,741.50	1.430	15.231	0.000		
6,742.00	1.464	15.955	0.000		
6,742.50	1.498	16.695	0.000		
6,743.00	1.533	17.453	0.000		
6,743.50	1.568	18.228	0.000		
6,744.00	1.604	19.021	0.000		
6,744.50	1.640	19.832	0.000		Spillway #1
6,745.00	1.720	20.672	0.159	63.96*	
6,745.50	1.767	21.544	45.568	3.60	
6,745.81	1.796	22.098	79.470	0.35	Peak Stage
6,746.00	1.814	22.439	100.324		
6,746.50	1.862	23.358	165.457		
6,747.00	1.910	24.300	249.561		
6,747.30	1.950	24.879	309.768		

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

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Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,725.00	0.000	0.000
6,725.50	0.000	0.000
6,726.00	0.000	0.000
6,726.50	0.000	0.000
6,727.00	0.000	0.000
6,727.50	0.000	0.000
6,728.00	0.000	0.000
6,728.50	0.000	0.000
6,729.00	0.000	0.000
6,729.50	0.000	0.000
6,730.00	0.000	0.000
6,730.50	0.000	0.000
6,731.00	0.000	0.000
6,731.50	0.000	0.000
6,732.00	0.000	0.000
6,732.50	0.000	0.000
6,733.00	0.000	0.000
6,733.50	0.000	0.000
6,734.00	0.000	0.000
6,734.50	0.000	0.000
6,735.00	0.000	0.000
6,735.50	0.000	0.000
6,736.00	0.000	0.000
6,736.50	0.000	0.000
6,737.00	0.000	0.000
6,737.50	0.000	0.000
6,738.00	0.000	0.000
6,738.50	0.000	0.000
6,739.00	0.000	0.000
6,739.50	0.000	0.000
6,740.00	0.000	0.000
6,740.50	0.000	0.000
6,741.00	0.000	0.000
6,741.50	0.000	0.000
6,742.00	0.000	0.000
6,742.50	0.000	0.000
6,743.00	0.000	0.000
6,743.50	0.000	0.000
6,744.00	0.000	0.000
6,744.50	0.000	0.000

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Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,745.00	0.159	0.159
6,745.50	45.568	45.568
6,746.00	100.324	100.324
6,746.50	165.457	165.457
6,747.00	249.561	249.561
6,747.30	309.768	309.768

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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	130.500	0.203	0.000	0.000	85.000	F	118.91	7.859
	$\sum$	**130.500**						**118.91**	**7.859**

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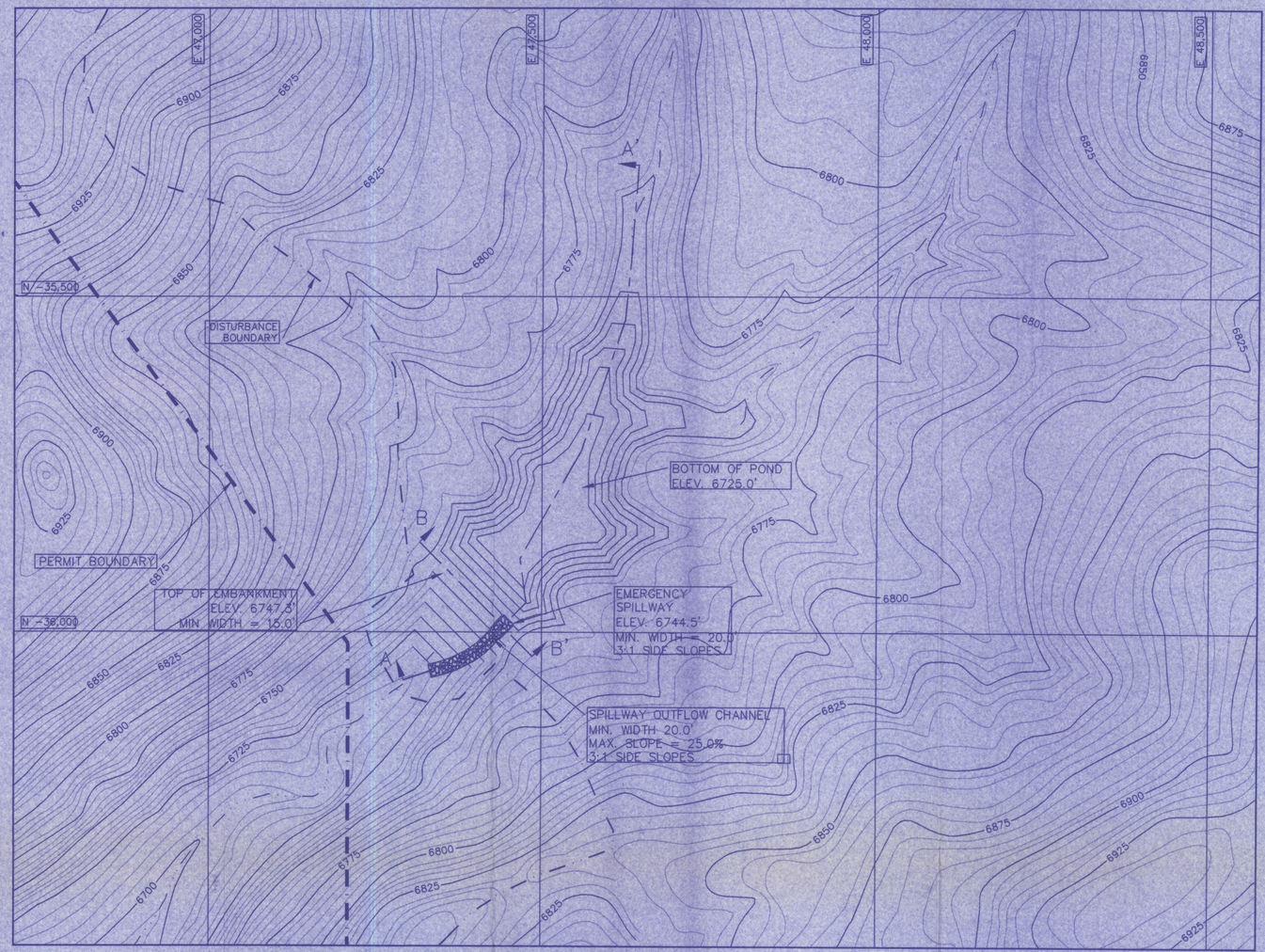
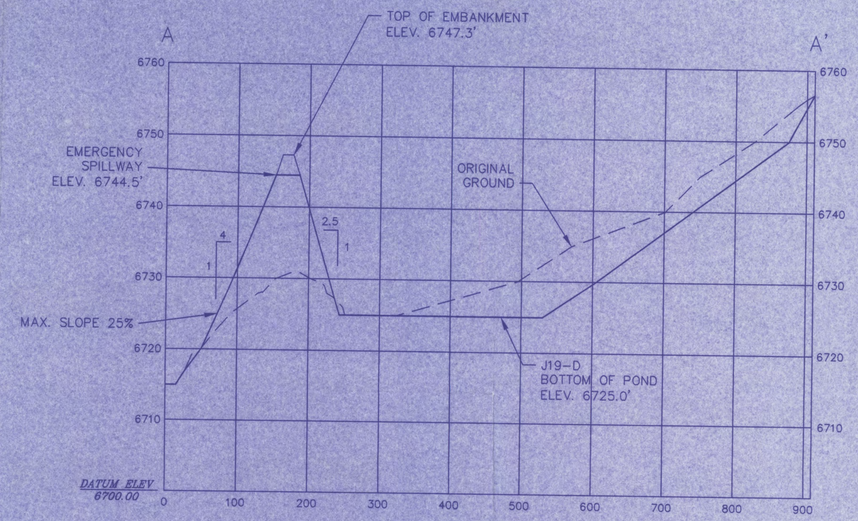


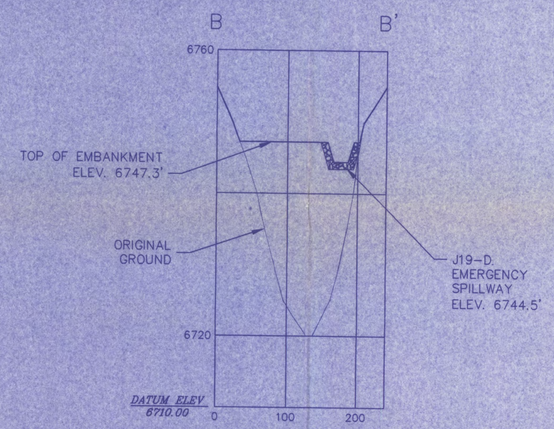
PLAN VIEW

SCALE: 1"=100'
PHOTO DATE 4/21/99
C.I. = 5'



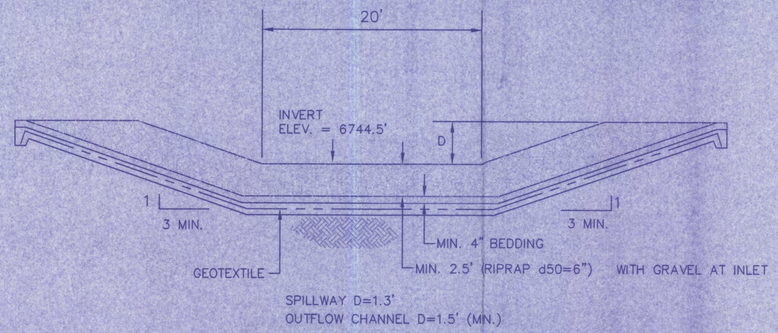
SECTION A–A'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'



SECTION B–B'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'



J19–D POND
TYPICAL CROSS–SECTION OF EMERGENCY SPILLWAY

NOT TO SCALE

J19–D POND STAGE CAPACITY

ELEV. (FT.–MSL)	STAGE (FT.)	AREA (ACRES)	TOT. CAP. (AC.–FT.)	DESCRIPTION
6725	0.0	0.46	0.00	BOTTOM OF POND
6730	5.0	0.74	2.97	
6735	10.0	1.01	8.91	
6740	15.0	1.33	13.16	
6744.5	19.5	1.64	19.83	EMERGENCY SPILLWAY
6745	20.0	1.72	20.67	
6747	22.0	1.91	24.3	
6747.3	27.3	1.95	24.88	TOP OF EMBANKMENT

NOTES:
1) General location, see Drawing No. 85400, Sheets M–10 and Drawing No. 85405.
2) See Chapter 6, Kayenta PAP for Construction Specifications.
3) See Vol. 2, Chapter 1, Attachment D, Sections 1–3 for description of Geotechnical Evaluatin.
4) Salvage topsoil in acordance with approved topsoil salvage plan.
5) Reclamation of the disturbed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slipes, typical 3:1 slope or flatter and blend into natural topography.
7) Stage/Capacity from SEDCAD4 25–year, 24–hour printout.

ENGINEER'S CERTIFICATION

JAMES G. SCHLENVOGT
ENGINEERING & RECLAMATION MANAGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782
DATE: SEP 28 2001

APPROVED OCT 2002

REVISIONS		
DATE	CHK'D	DESCRIPTION

EXHIBIT #1
J19–D
PROPOSED SEDIMENTATION POND

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

DESIGNED BY: MW	SCALE: 1"=100'
DRAWN BY: JMB	DRAWING DATE: 04–24–01
CHECKED BY: JGS	PHOTO DATE: 04–21–99
CONTOUR INT.: 5'	DWG FILE: 081601_J19D–POND.DWG

DESIGN REPORT

Temporary Sedimentation Structure

J19-E

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

APPROVED
OCT 2002

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

SEP 12 2002

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INTRODUCTION

Sedimentation Structure J19-E 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 proposed J-19 West disturbed surface mining area at the Kayenta Mine. The location of Structure J19-E and its watershed boundary are shown on Drawing No. 85400 (Sheets M-10) 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 J19-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 J19-E was inspected in September, 2001 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions existed. 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 J19-E Structure has a watershed of 17.5 acres and is located on a tributary upstream of Red Peak Valley Wash at the Kayenta Mine. The 17.5-acre watershed, which contributes directly to structure J19-E, is classified as 44.5% spoil, 33% reclaimed area, and 22.5% disturbed.

DESIGN ANALYSES

GENERAL

Structure J19-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 1999 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure J19-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 13 feet wide on top. A minimum upstream slope of 2H:1V and minimum downstream slope of 3.0H:1V were assumed. Based on the total embankment height of approximately 10 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 15-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 J19-E 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 was analyzed using the 25-year, 6-hour storm. Structure J19-E was conservatively assumed to be full to the emergency spillway at the time of the design storm event. The storage capacity of structure J19-E was analyzed using the 10-year, 24-hour storm event. The pond was verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging into the Red Peak Valley Wash.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.224 mi.
2.	Elevation Difference, H	164 ft
3.	Time of Concentration, T_c	0.065 hr
4.	NRCS Curve Number	85
5.	Rainfall Depth, 10-year, 24-hour storm 25-year, 6-hour storm	2.1 in 1.9 in
6.	Drainage Area	17.5 ac

Values reported represent the watershed, which drains directly to Pond J19-E.

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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).

J19-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	16.7	21.2
Volume	ac-ft	1.3	1.1
Storage			
Peak Stage	msl	N/A	6798.6
Emergency Spillway Elev.	msl	6798.0	6798.0
Peak Storage	ac-ft	N/A	7.0
Storage Capacity	ac-ft	6.5	6.5
Outflow			
Peak Flow	cfs	N/A	6.3
Spillway Elevation	msl	6798.0	6798.0
Embankment Crest Elev.	msl	6800.0	6800.0
Peak Stage	msl	--	6798.6
Freeboard	ft	--	1.4
Emergency Spillway Channel			
Flow Depth	ft	--	0.6
Critical Velocity	fps	--	2.3
Mannings "n"	--	--	0.03
Width	ft	--	15
Outflow Channel			
Slope	%	14	33
Normal Velocity	fps	--	4.0	3.6
Normal Depth	ft	--	0.1	0.1
Mannings "n"	--	--	0.03	0.054
Riprap D_{50}	in	--	Gravel	1.5

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J19-E will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit #1.

Minimum Channel Depth	(Spillway)	1.6	ft
	(Outflow)	1.1	ft
Channel Width		15	ft
Channel Length	(Spillway)	26	ft
	(Outflow)	100	ft
ide slopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	33	%
Spillway Elevation		6798.0	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 design topography. Structure J19-E is designed to contain approximately 6.5 acre-feet.

The calculations for the sediment load entering structure J19-E 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	0.23
3.	Slope Factor, LS	5.1
4.	Cover Factor, C	0.72
5.	Erosion Control Factor, P	0.71

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume is available for storing sediment. Structure J19-E has sufficient storage to contain the 10-year, 24-hour storm. The total storage capacity was determined for structure J19-E and the results of the analysis are presented below.

Storage for Structure J19-E

Total Storage Capacity	6.5 ac-ft
10-year, 24-hour Storm Inflow	1.3 ac-ft
Available Sediment Storage Capacity	5.2 ac-ft
Sediment Inflow Rate/Year	0.18 ac-ft/yr
Sediment Storage Life	28.8 years

* * *

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- J19-E Proposed Sedimentation Ponds

APPENDIX D -J19-E Temporary Diversion

APPENDIX E -J7-Jr Temporary Diversion

EXHIBIT #1 -J19-E & J7-Jr Temporary Diversion

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J19 AREA

STRUCTURE: J19E Pond

TIME OF CONCENTRATION:

Start Elevation (ft) =	6939
End Elevation (ft) =	6775
Elevation Difference, E (ft) =	164
Watercourse Length (ft) =	1184
Watercourse Length, L (mi) =	0.224
Tc = (11.9L^3/E)^0.385 =	0.065 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	0	0
Sagebrush	D	79	0	0
Disturbed - Mine		90	3.9	351
Disturbed - Spoil		86	7.8	670.8
Reclaimed	C	81	5.8	469.8
TOTAL:			17.5	1491.6

Weighted CN = Total CN*Area/ Total Area = 85

DRAINAGE BASIN AREA:

17.5 Acres

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J19E Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
1B	0.15	0	0.00
1C	0.14	0	0.00
3BC	0.16	0	0.00
5	0.58	0	0.00
12	0.38	0	0.00
13	0.41	0	0.00
15	0.37	0	0.00
34-spoil	0.12	7.8	0.94
Reclaimed	0.38	5.8	2.20
Mine Pits	0.22	3.9	0.86
TOTAL:		17.5	4.00

Weighted K = Total K*Area/ Total Area = 0.23

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
180	55	30.6%	0.6	17.0	7.60
170	35	20.6%	0.6	11.6	4.81
150	35	23.3%	0.6	13.1	5.13
200	15	7.5%	0.5	4.3	1.39
200	50	25.0%	0.6	14.0	6.57
165	15	9.1%	0.5	5.2	1.54
140	55	39.3%	0.6	21.4	8.37
110	25	22.7%	0.6	12.8	4.14
110	35	31.8%	0.6	17.7	5.89

Average LS = 5.05

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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PROJECT: J19E 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%	0	0.22	0.00	1.00	0.00
Sagebrush/Grass	20%	25%	0	0.20	0.00	1.00	0.00
Disturbed	0%	0%	3.9	1.00	3.90	1.00	3.90
Spoil	0%	0%	7.8	1.00	7.80	0.80	6.24
Reclaimed	40%	0%	5.8	0.15	0.87	0.40	2.32
TOTAL:			17.5		12.57		12.46

Weighted C = Total C*Area/ Total Area = 0.718

Weighted P = Total P*Area/ Total Area = 0.712

RAINFALL FACTOR:

R = 40

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CALCULATED SEDIMENT YIELD

PROJECT: J19E Pond

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

PARAMETER DESCRIPTION	VALUE	
Annual Rainfall Factor	40.00	
Soil Erodibility Factor	0.23	
Length Slope Factor	5.05	
Cover Factor	0.72	
Practice Factor	0.71	
Gross Annual Sediment Yield	23.59	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0115	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0104	acre-feet/acre/year
Watershed Area	17.5	acres
Watershed Annual Sediment Yield	0.18	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	0.18	acre-feet

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Pond J19-E Emergency Spillway Outflow

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
15.00	3.0:1	3.0:1	33.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	6.30 cfs	
Depth:	0.11 ft	1.11 ft
Top Width:	15.68 ft	21.68 ft
Velocity:	3.64 fps	
X-Section Area:	1.73 sq ft	
Hydraulic Radius:	0.110	
Froude Number:	1.93	
Manning's n:	0.0540	
Dmin:	1.00 in	
D50:	1.50 in	
Dmax:	3.00 in	

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Pond J19-E Emergency Spillway Outflow

Material: Gravel

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
15.00	3.0:1	3.0:1	14.0	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	6.30 cfs	
Depth:	0.10 ft	1.10 ft
Top Width:	15.62 ft	21.62 ft
Velocity:	4.01 fps	
X-Section Area:	1.57 sq ft	
Hydraulic Radius:	0.100	
Froude Number:	2.23	

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Pond J19E Em. Spillway Critical Velocity
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\2470172 peabody\task 22h\task 22h\flowmaster\j19b.fm2
Worksheet	J19E Critical Velocity
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.024000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	15.00	ft
Discharge	6.30	cfs

Results		
Depth	0.17	ft
Flow Area	2.70	ft²
Wetted Perimeter	16.10	ft
Top Width	16.04	ft
Critical Depth	0.17	ft
Critical Slope	0.023854	ft/ft
Velocity	2.33	ft/s
Velocity Head	0.08	ft
Specific Energy	0.26	ft
Froude Number	1.00	
Flow is supercritical.		

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APPENDIX B

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

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Peabody Western

Pond J19-E

10-year, 24-hour

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djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

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	17.500	17.500	16.67	1.27

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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	17.500	0.065	0.000	0.000	85.000	F	16.67	1.267
	$\sum$	**17.500**						**16.67**	**1.267**

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APPENDIX C

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

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Civil Software Design

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Pond J19-E

25-year, 6-hour

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Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

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)
#1	In	17.500	17.500	21.16	1.05
	Out			6.32	1.05

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Structure Detail:

Structure #1 (Pond)

Storm Volume & Peak Flow

Pond Inputs:

Initial Pool Elev:	6,798.00
Initial Pool:	6.51 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,798.00	26.00	3.00:1	3.00:1	15.00

Pond Results:

Peak Elevation:	6,798.58
Dewater Time:	1.75 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)
6,788.00	0.450	0.000	0.000	
6,788.50	0.469	0.230	0.000	
6,789.00	0.489	0.469	0.000	
6,789.50	0.509	0.719	0.000	
6,790.00	0.530	0.979	0.000	
6,790.50	0.549	1.249	0.000	
6,791.00	0.567	1.528	0.000	
6,791.50	0.587	1.816	0.000	
6,792.00	0.606	2.114	0.000	
6,792.50	0.626	2.422	0.000	
6,793.00	0.646	2.740	0.000	
6,793.50	0.667	3.069	0.000	
6,794.00	0.687	3.407	0.000	
6,794.50	0.709	3.756	0.000	
6,795.00	0.730	4.116	0.000	
6,795.50	0.752	4.486	0.000	
6,796.00	0.775	4.868	0.000	

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,796.50	0.798	5.262	0.000		
6,797.00	0.822	5.667	0.000		
6,797.50	0.846	6.084	0.000		
6,798.00	0.870	6.513	0.000		Spillway #1
6,798.50	0.927	6.962	0.686	38.95	
6,798.58	0.937	7.038	6.322	3.00	Peak Stage
6,799.00	0.986	7.440	36.012		
6,799.50	1.047	7.948	79.016		
6,800.00	1.110	8.488	133.285		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,788.00	0.000	0.000
6,788.50	0.000	0.000
6,789.00	0.000	0.000
6,789.50	0.000	0.000
6,790.00	0.000	0.000
6,790.50	0.000	0.000
6,791.00	0.000	0.000
6,791.50	0.000	0.000
6,792.00	0.000	0.000
6,792.50	0.000	0.000
6,793.00	0.000	0.000
6,793.50	0.000	0.000
6,794.00	0.000	0.000
6,794.50	0.000	0.000
6,795.00	0.000	0.000
6,795.50	0.000	0.000
6,796.00	0.000	0.000
6,796.50	0.000	0.000
6,797.00	0.000	0.000
6,797.50	0.000	0.000
6,798.00	0.000	0.000
6,798.50	0.686	0.686
6,799.00	36.012	36.012
6,799.50	79.016	79.016
6,800.00	133.285	133.285

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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	17.500	0.065	0.000	0.000	85.000	F	21.16	1.054
	$\sum$	**17.500**						**21.16**	**1.054**

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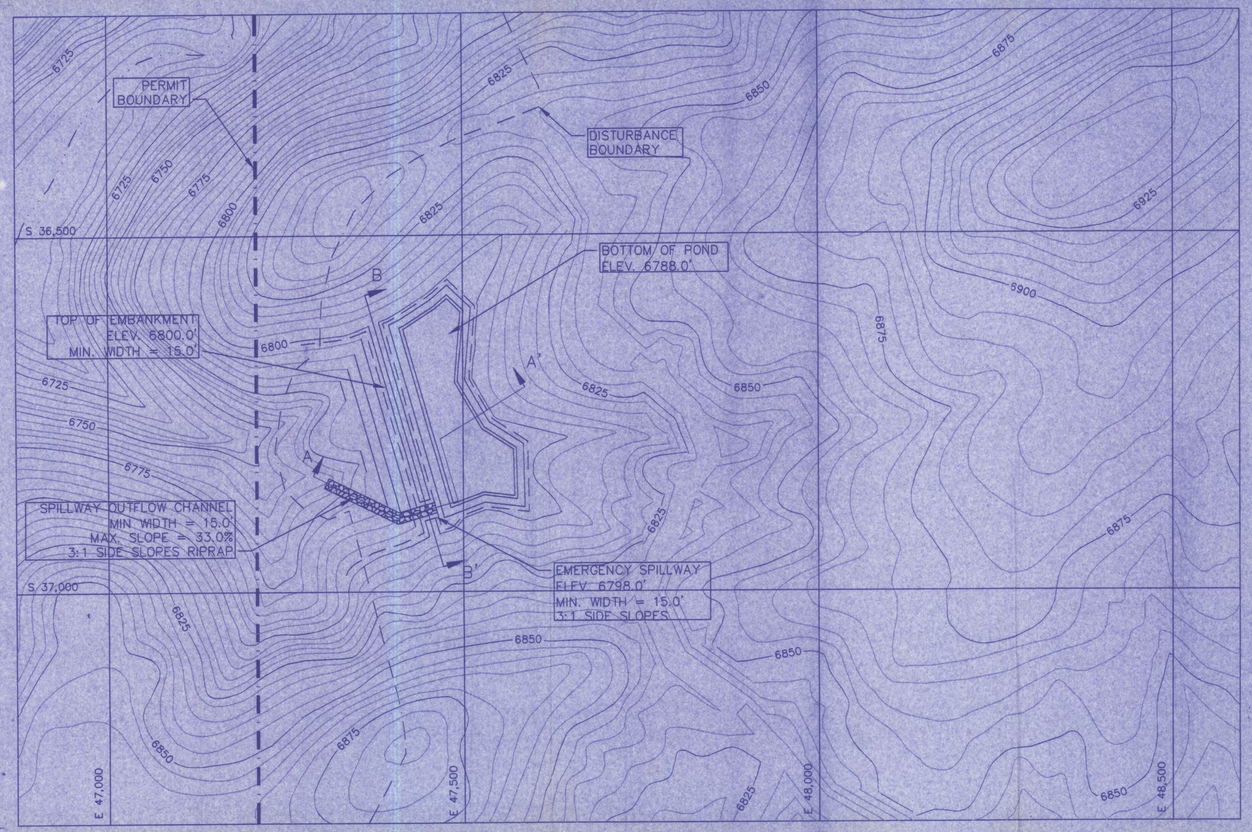
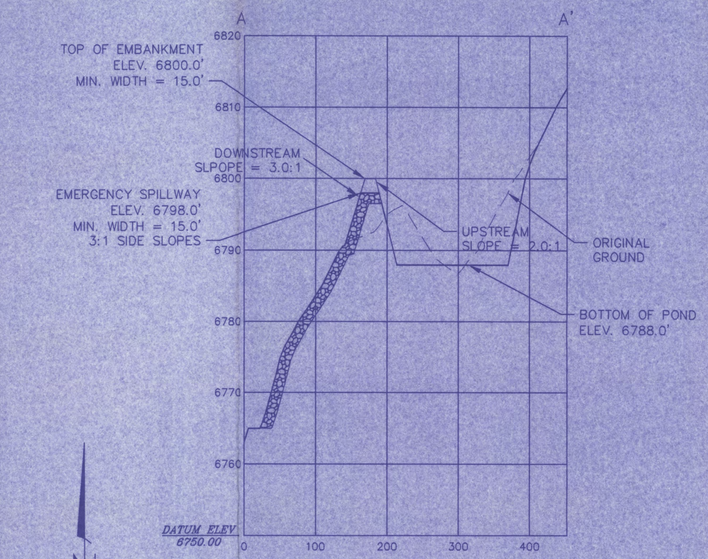
~~APPENDIX D~~

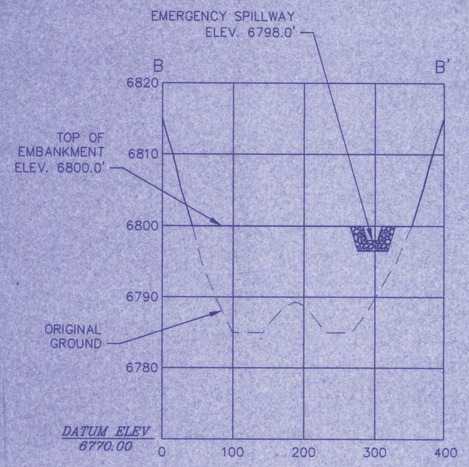
~~J10-E TEMPORARY DIVERSION~~





SECTION A-A'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'



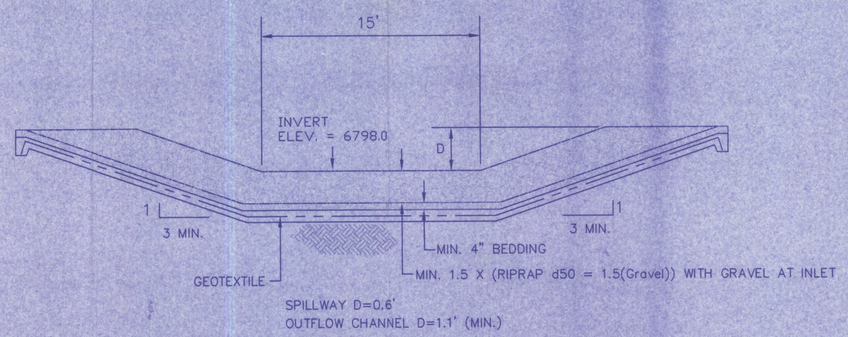
SECTION B-B'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'

N

PLAN VIEW

SCALE: 1" = 100'
PHOTO DATE: 4/21/99
C.I. = 5'



J19-E POND
TYPICAL CROSS-SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE

J19-E POND STAGE CAPACITY

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	TOT. CAP. (AC.-FT.)	DESCRIPTION
6788	0.0	0.45	0.00	BOTTOM OF POND
6790	2.0	0.53	0.98	
6795	7.0	0.73	4.12	
6798	10.0	0.87	6.51	EMERGENCY SPILLWAY
6800	12.0	1.11	8.49	TOP OF EMBANKMENT

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ENGINEER'S CERTIFICATION

JAMES R. SCHLENVOGT
ENGINEERING & RECLAMATION MANAGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782

DATE: SEP 28 2001

NOTES:
1) General location, see Drawing No. 85400, Sheets M-10 and Drawing No. 85405.
2) See Chapter 6, Kayenta PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the distrubed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.

REVISIONS		
DATE	CHK'D	DESCRIPTION

EXHIBIT #1
J19-E
PROPOSED SEDIMENTATION POND

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

DESIGNED BY: MW	SCALE: 1"=100'
DRAWN BY: JMB	DRAWING DATE: 05-04-01
CHECKED BY: JGS	PHOTO DATE: 04-21-99
CONTOUR INT.: 5'	DWG FILE: 081601_J19E_POND.DWG

APPENDIX D

J19-E TEMPORARY DIVERSION

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PEABODY WESTERN – KAYENTA MINE

J-19 WEST AREA

TEMPORARY DIVERSION CHANNELS

PURPOSE: To provide runoff control from potential mine disturbance areas and to provide stable temporary diversion channels in the J-19 West area of the Kayenta Mine. The following channels have been included in this design submittal:

J-19 WEST AREA

- J19-E Diversion Channel, (see Exhibit #1, J19-E & J7-Jr Temporary Diversions)
- J7Jr Diversion Channel, (see Exhibit #1, J19-E & J7-Jr Temporary Diversions)

Design Parameters – Channels

To allow construction to be field-fitted for these temporary diversion channels, three alternative trapezoidal or triangular channels (Design A, Design B, or Design C) are recommended. The channel designs will vary based on channel slope and site conditions

The following design parameters are common to all temporary channel designs.

1. All designs are based on the 10-year, 6-hour precipitation event = 1.6 inches.
2. All areas are disturbed (mine, spoil, topsoil piles) or undisturbed. Curve numbers used include; mine = 90, spoil = 86, topsoil piles = 81(temp. reclaimed) and undisturbed = varies.

Note: The following applies to all channel designs:

1. Design selection will be field-fitted to complement the site conditions.
2. Sedcad4 Hydrology and Channel design outputs are attached.
3. If bedrock is encountered during excavation, Design C will not require the installation of riprap.
4. Minimum 20-ft length of ripraped or graveled channel between Design A and Designs B and C.
5. See Chapter 26 for terrace and downdrain construction specifications.
6. Maximum slope design for graded spoil-lined channel limited by critical slope.
7. Depth of flow (d) based on minimum slope, Velocity (v) based on maximum slope.
8. Side-slopes will be a minimum of 2H: 1V. or flatter.

Design A: Earth/Graded Spoil-lined trapezoidal or triangular channel. This design will apply to slopes up to the calculated Critical slope.

Design B: Gravel-lined trapezoidal or triangular channel. This design will apply until a velocity of 6.0 fps is exceeded.

Design C: Riprap-lined trapezoidal or triangular channel. This design will apply for all subsequent slopes until a limiting velocity of 10.0 fps is exceeded.

Design summaries for the channels are shown on Table J19-1. Hydrology calculations for the channels are attached as Appendix A. Channel designs and critical slope calculations are attached as Appendix B.

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TABLE J19-1
J-19 Diversion Channel Summary

Temporary Channel J19-E

Typical Rip Rap Lined Channel

Channel	Flow (Q) (cfs)	Slope (%)	Bottom Width (ft)	Side Slope H:1V (ft)	Depth Flow (ft)	Velocity (fps)	Free Board (ft)	Total Depth (ft)	Rip Rap (in)	Watershed (acres)	Time of Concentration (hr)	Curve Number	Design
J19-E	1.8	0.5 - 2.2	0	3	0.6	2.71	1	1.6	N/A	1.9	0.054	86	A
	1.8	2.3 - 18	0	3	0.5	5.96	1	1.5	Gravel				B
Q10/6	1.8	19 - 25	3	3	0.2	3.76	1	1.2	1.5				C

Design Flow: 10-year, 6-hour Storm

Temporary Channel J7Jr - Seg. 1

Typical Rip Rap Lined Channel

Channel	Flow (Q) (cfs)	Slope (%)	Bottom Width (ft)	Side Slope H:1V (ft)	Depth Flow (ft)	Velocity (fps)	Free Board (ft)	Total Depth (ft)	Rip Rap (in)	Watershed (acres)	Time of Concentration (hr)	Curve Number	Design
J7-Jr	16.3	0.5 - 1.7	0	3	1.4	4.27	1	2.4	N/A	26.5	0.192	84	A
Seg 1	16.3	1.8 - 4.2	0	3	1.1	5.99	1	2.1	Gravel				B
Q10/6	16.3	4.3 - 8.8	0	3	1.0	6.49	1	2.0	3				C
	16.3	8.9 - 30	0	3	0.9	8.17	1	1.9	6				C

Design Flow: 10-year, 6-hour Storm

Temporary Channel J7Jr - Seg. 2

Typical Rip Rap Lined Channel

Channel	Flow (Q) (cfs)	Slope (%)	Bottom Width (ft)	Side Slope H:1V (ft)	Depth Flow (ft)	Velocity (fps)	Free Board (ft)	Total Depth (ft)	Rip Rap (in)	Watershed (acres)	Time of Concentration (hr)	Curve Number	Design
J7-Jr	20	0.5 - 1.6	0	3	1.5	4.39	1	2.5	N/A	39.9	0.950	91	A
Seg 2	20	1.7 - 3.6	0	3	1.2	5.95	1	2.2	Gravel				B
Q10/6	20	3.7 - 7.3	0	3	1.1	6.50	1	2.1	3				C
	20	7.4 - 30	0	3	1.0	8.73	1	2.0	6				C

Design Flow: 10-year, 6-hour Storm

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Peabody Western
Pond J19E
Diversion Channel

10-year, 6-hour

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djk

Montgomery Watson
165 S. Union Blvd.
Suite 410
Lakewood, Co. 80228

Phone: 303 763-5140

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J19 AREA

STRUCTURE: J19E Pond Diversion Channel

TIME OF CONCENTRATION:

Start Elevation (ft) =	6880
End Elevation (ft) =	6835
Elevation Difference, E (ft) =	45
Watercourse Length (ft) =	653
Watercourse Length, L (mi) =	0.124
Tc = (11.9L^3/E)^0.385 =	0.054 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	0	0
Sagebrush	D	79	0	0
Disturbed - Mine		90	0	0
Disturbed - Spoil		86	1.9	163.4
Diturbed - TS Reclaimed	C	81	0	0
TOTAL:			1.9	163.4

Weighted CN = Total CN*Area/ Total Area = 86

DRAINAGE BASIN AREA:

1.9 Acres

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General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.600 inches

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Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	1.900	1.900	1.81	0.09

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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	1.900	0.054	0.000	0.000	86.000	F	1.81	0.089
	$\sum$	**1.900**						**1.81**	**0.089**

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J19-E Diversion Channel

Material: Graded Spoil

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.5	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.80 cfs	
Depth:	0.62 ft	1.62 ft
Top Width:	3.73 ft	9.73 ft
Velocity:	1.55 fps	
X-Section Area:	1.16 sq ft	
Hydraulic Radius:	0.295	
Froude Number:	0.49	

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J19-E Diversion Channel

Material: Graded Spoil

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	2.2	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.80 cfs	
Depth:	0.47 ft	1.47 ft
Top Width:	2.83 ft	8.83 ft
Velocity:	2.71 fps	
X-Section Area:	0.67 sq ft	
Hydraulic Radius:	0.224	
Froude Number:	0.99	

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J19-E Diversion Critical Slope
Worksheet for Triangular Channel

Project Description	
Project File	untitled.fm2
Worksheet	J19E Critical Slope
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.022800	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Discharge	1.80	cfs

Results		
Depth	0.47	ft
Flow Area	0.66	ft^2
Wetted Perimeter	2.96	ft
Top Width	2.81	ft
Critical Depth	0.47	ft
Critical Slope	0.022833	ft/ft
Velocity	2.74	ft/s
Velocity Head	0.12	ft
Specific Energy	0.58	ft
Froude Number	1.00	
Flow is subcritical.		

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J19-E Diversion Channel

Material: Gravel

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	2.3	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.80 cfs	
Depth:	0.47 ft	1.47 ft
Top Width:	2.80 ft	8.80 ft
Velocity:	2.76 fps	
X-Section Area:	0.65 sq ft	
Hydraulic Radius:	0.221	
Froude Number:	1.01	

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J19-E Diversion Channel

Material: Gravel

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	18.0	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.80 cfs	
Depth:	0.32 ft	1.32 ft
Top Width:	1.90 ft	7.90 ft
Velocity:	5.96 fps	
X-Section Area:	0.30 sq ft	
Hydraulic Radius:	0.150	
Froude Number:	2.64	

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J19-E Diversion 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)
3.00	3.0:1	3.0:1	19.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.80 cfs	
Depth:	0.15 ft	1.15 ft
Top Width:	3.89 ft	9.89 ft
Velocity:	3.54 fps	
X-Section Area:	0.51 sq ft	
Hydraulic Radius:	0.129	
Froude Number:	1.72	
Manning's n:	0.0470	
Dmin:	1.00 in	
D50:	1.50 in	
Dmax:	3.00 in	

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J19-E Diversion 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)
3.00	3.0:1	3.0:1	25.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.80 cfs	
Depth:	0.14 ft	1.14 ft
Top Width:	3.84 ft	9.84 ft
Velocity:	3.76 fps	
X-Section Area:	0.48 sq ft	
Hydraulic Radius:	0.123	
Froude Number:	1.88	
Manning's n:	0.0490	
Dmin:	1.00 in	
D50:	1.50 in	
Dmax:	3.00 in	

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APPENDIX E

J7-Jr TEMPORARY DIVERSION

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PEABODY WESTERN – KAYENTA MINE

J-19 WEST AREA

TEMPORARY DIVERSION CHANNELS

PURPOSE: To provide runoff control from potential mine disturbance areas and to provide stable temporary diversion channels in the J-19 West area of the Kayenta Mine. The following channels have been included in this design submittal:

J-19 WEST AREA

- J19-E Diversion Channel, (see Exhibit #1, J19-E & J7-Jr Temporary Diversions)
- J7Jr Diversion Channel, (see Exhibit #1, J19-E & J7-Jr Temporary Diversions)

Design Parameters – Channels

To allow construction to be field-fitted for these temporary diversion channels, three alternative trapezoidal or triangular channels (Design A, Design B, or Design C) are recommended. The channel designs will vary based on channel slope and site conditions

The following design parameters are common to all temporary channel designs.

1. All designs are based on the 10-year, 6-hour precipitation event = 1.6 inches.
2. All areas are disturbed (mine, spoil, topsoil piles) or undisturbed. Curve numbers used include; mine = 90, spoil = 86, topsoil piles = 81(temp. reclaimed) and undisturbed = varies.

Note: The following applies to all channel designs:

1. Design selection will be field-fitted to complement the site conditions.
2. Sedcad4 Hydrology and Channel design outputs are attached.
3. If bedrock is encountered during excavation, Design C will not require the installation of riprap.
4. Minimum 20-ft length of ripraped or graveled channel between Design A and Designs B and C.
5. See Chapter 26 for terrace and downdrain construction specifications.
6. Maximum slope design for graded spoil-lined channel limited by critical slope.
7. Depth of flow (d) based on minimum slope, Velocity (v) based on maximum slope.
8. Side-slopes will be a minimum of 2H: 1V. or flatter.

Design A: Earth/Graded Spoil-lined trapezoidal or triangular channel. This design will apply to slopes up to the calculated Critical slope.

Design B: Gravel-lined trapezoidal or triangular channel. This design will apply until a velocity of 6.0 fps is exceeded.

Design C: Riprap-lined trapezoidal or triangular channel. This design will apply for all subsequent slopes until a limiting velocity of 10.0 fps is exceeded.

Design summaries for the channels are shown on Table J19-1. Hydrology calculations for the channels are attached as Appendix A. Channel designs and critical slope calculations are attached as Appendix B.

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TABLE J19-1
J-19 Diversion Channel Summary

Temporary Channel J19-E

Typical Rip Rap Lined Channel

Channel	Flow (Q) (cfs)	Slope (%)	Bottom Width (ft)	Side Slope H:1V (ft)	Depth Flow (ft)	Velocity (fps)	Free Board (ft)	Total Depth (ft)	Rip Rap (in)	Watershed (acres)	Time of Concentration (hr)	Curve Number	Design
J19-E	1.8	0.5 - 2.2	0	3	0.6	2.71	1	1.6	N/A	1.9	0.054	86	A
	1.8	2.3 - 18	0	3	0.5	5.96	1	1.5	Gravel				B
Q10/6	1.8	19 - 25	3	3	0.2	3.76	1	1.2	1.5				C

Design Flow: 10-year, 6-hour Storm

Temporary Channel J7Jr - Seg. 1

Typical Rip Rap Lined Channel

Channel	Flow (Q) (cfs)	Slope (%)	Bottom Width (ft)	Side Slope H:1V (ft)	Depth Flow (ft)	Velocity (fps)	Free Board (ft)	Total Depth (ft)	Rip Rap (in)	Watershed (acres)	Time of Concentration (hr)	Curve Number	Design
J7-Jr	16.3	0.5 - 1.7	0	3	1.4	4.27	1	2.4	N/A	26.5	0.192	84	A
Seg 1	16.3	1.8 - 4.2	0	3	1.1	5.99	1	2.1	Gravel				B
Q10/6	16.3	4.3 - 8.8	0	3	1.0	6.49	1	2.0	3				C
	16.3	8.9 - 30	0	3	0.9	8.17	1	1.9	6				C

Design Flow: 10-year, 6-hour Storm

Temporary Channel J7Jr - Seg. 2

Typical Rip Rap Lined Channel

Channel	Flow (Q) (cfs)	Slope (%)	Bottom Width (ft)	Side Slope H:1V (ft)	Depth Flow (ft)	Velocity (fps)	Free Board (ft)	Total Depth (ft)	Rip Rap (in)	Watershed (acres)	Time of Concentration (hr)	Curve Number	Design
J7-Jr	20	0.5 - 1.6	0	3	1.5	4.39	1	2.5	N/A	39.9	0.950	91	A
Seg 2	20	1.7 - 3.6	0	3	1.2	5.95	1	2.2	Gravel				B
Q10/6	20	3.7 - 7.3	0	3	1.1	6.50	1	2.1	3				C
	20	7.4 - 30	0	3	1.0	8.73	1	2.0	6				C

Design Flow: 10-year, 6-hour Storm

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