DESIGN REPORT

Temporary Sedimentation Structure

J19-E

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

Registered Professional Engineer (Civil)
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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.

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.

Revised 09/12/02

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	2.1 in
	25-year, 6-hour storm	1.9 in
6.	Drainage Area	17.5 ac

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

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

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) (Outflow)	1.6 1.1	ft ft
Channel Width		15	ft
Channel Length	(Spillway) (Outflow)	26 100	ft 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:

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

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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

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
38C	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*

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

PEABODY WESTERN COAL COMPANY
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

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	

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	

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.		

APPENDIX B

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

Peabody Western

Pond J19-E

10-year, 24-hour

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

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

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**

APPENDIX C

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

Peabody Western
Pond J19-E

25-year, 6-hour

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

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

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	

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

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**

APPENDIX D

J19-E TEMPORARY DIVERSION

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.

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

Peabody Western
Pond J19E
Diversion Channel

10-year, 6-hour

djk

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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

General Information

Storm Information:

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

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

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**

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	

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	

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.		

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	

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	

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	

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	